

A Comparative Study between Minimally Invasive Approach and Conventional Posterior Approach for Bipolar Hemiarthroplasty

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Abstract:

Background: Hip fractures are common and comprise 20% of the operative workload of an orthopedic trauma unit. Intracapsular femoral neck fractures account for 50% of all hip fractures. The use of bipolar hemiarthroplasty has been a very popular alternative to the unipolar hemiarthroplasty. The traditional approaches most commonly utilized for hip arthroplasty are the posterior approach and the direct lateral approach. Minimally invasive hip arthroplasty has now become popular around the world. The minimally invasive approach is described as having a lower degree of trauma for the soft-tissues and, in particular, for the muscles thus facilitating less postoperative pain, early recovery and lesser hospital stay. Our study was conducted to compare the results of minimally invasive and conventional posterior approach for bipolar hemiarthroplasty in terms of immediate postoperative rehabilitation process and long term benefits.

Materials and Methods: In this comparative study, 70 patients of Gardens type II-IV neck of femur fractures belonging to age group of 50-90years undergoing elective hemiarthroplasty surgery were allocated into 2 groups of 35patients each by convenient sampling, Group A (minimally invasive approach) and Group B (conventional posterior approach). Operation duration, duration of hospital stay, immediate postoperative rehabilitation progress (hours postoperatively), Harris hip score (modified), SF-12 general health questionnaire (physical score) were compared between the groups.

Results: Majority of patients who underwent minimally invasive approach had 45% fair outcome in modified Harris hip score at 3 months whereas in conventional approach majority had 50% poor outcome which is statistically significant ($p < 0.005$). Both groups had majority of good Harris hip score at 6 months postoperatively which is statistically insignificant. The mean SF-12 score at 3 months postoperatively in minimally invasive and conventional groups were 39.2 and 38.6 respectively and at 6 months postoperatively were 42.1 and 41.6. Both were statistically insignificant.

Conclusion: our study showed definite advantage of minimally invasive exposure in early postoperative periods allowing early initiation of physical therapy, patient ambulation and early discharge, but it had no added long term benefits.

Key Word: Hemiarthroplasty, Minimally invasive approach, conventional approach, Modified Harris Hip score.

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I. Introduction

Hip fractures are common and comprise 20% of the operative workload of an orthopedic trauma unit.¹ Intracapsular femoral neck fractures account for 50% of all hip fractures.² The most common age group affected is elderly group especially females with most common cause of trivial fall. The usual site of the fracture is in the weakest part of the femoral neck, located just below the articular surface. The recent survey results showed that most surgeons believed reduction and fixation was the treatment of choice for displaced fractures in patients younger than 60 years. Almost all surgeons preferred arthroplasty in patients older than 80 years.³⁻⁵ The use of bipolar hemiarthroplasty has been a very popular alternative to the unipolar hemiarthroplasty. The dual

articulation of bipolar was proposed to reduce the risk of wear and acetabular protrusion. The traditional approaches most commonly utilized for hip arthroplasty are the posterior approach and the direct lateral approach.^{6,7}

Minimally invasive hip arthroplasty has now become popular around the world. It is defined as the use of a 10 cm or even smaller incision that uses inter nervous planes while minimising any tendon or muscle trauma during the exposure to complete the hip joint replacement.⁸⁻¹¹ In general, the minimally invasive approach is described as having a lower degree of trauma for the soft-tissues and, in particular, for the muscles. This opinion is based on the fact that the loss of blood is lower, rate of recovery is faster, the post-operative level of pain is lower and patients are released sooner from hospital.¹²⁻¹⁷ It also has its own setbacks like neurovascular injury and component malpositioning and thus inturn leading to increased prosthetic wear¹⁸. This technique may be a risk factor for early revision surgery and the long-term survival therefore may be lower than that for non-minimal invasive surgery.⁶ one of the modification of traditional posterior moores approach represents the minimal-invasive posterior approach.

II. Material And Methods

This prospective comparative study was carried out on patients of Department of orthopaedics at Regional Institute of Medical Sciences, Imphal, Manipur from September 2017 to August 2019. A total 70 adult patients of aged between 50-90 years (both male and females) with Gardens classification type II-IV neck of femur fractures were for in this study. We excluded pathological fractures, fractures neck of femur with extension in to metaphysis, open fractures, previous hip surgery patients.

Study Design: Quasi experimental study

Study Location: Hospital based study in the department of Orthopaedics, RIMS, Imphal, Manipur.

Study Duration: September 2017 to August 2019.

Sample size: 46 in each group

Sample size calculation: From a study conducted by Schleicher I et al¹⁹ using Short Form 12 Physical component of Standard group and minimal invasive group respectively,

Sample size was calculated using formula

$$N = \frac{(U+V)^2 \{ (S_1)^2 + (S_2)^2 \}}{(M_1 - M_2)^2}$$

Where, S₁ (standard deviation of standard group) = 13.02, S₂ (standard deviation of minimal invasive group) = 12.01, M₁ (mean of standard group) = 39.69, M₂ (mean of minimal invasive group) = 44.56, Power (U) = 80%, Alpha error (V) = 90%, Calculated sample size is 46 in each group.

Subjects & selection method:

Convenience sampling was done to divide them into two groups after informing the patient about the type of the incision ahead of surgery during the consent taking.

Group A: Minimal invasive group

Group B: Conventional incision group

First case was done with a minimally invasive incision and subsequently alternate cases done with conventional incision. 35 patients underwent hemiarthroplasty by minimally invasive exposure, out of which 3 patients had to be converted into conventional exposure intraoperatively and were excluded from the study. 35 patients underwent hemiarthroplasty by conventional exposure. Group A patients underwent hemiarthroplasty by mini-incision posterior approach to hip. Group B patients underwent hemiarthroplasty by the standard posterior moores hip approach.

Working definitions:

Minimally invasive exposure: Standard posterior approach to hip where the length of the skin incision is less than 10cm. Conventional exposure: Standard posterior approach to hip where the length of the skin incision is more than or equal to 15cm.

- Harris hip score (Modified)

Score	Rating
90-100	Excellent
80-89	Good
70-79	Fair
<70	Poor

Procedure methodology

All the patients were operated under spinal Anaesthesia. Skin preparation was done with 10% povidine iodine solution followed by rectified spirit. The operative field was isolated with sterile drapes. For the study purpose posterior approach was used as it the most popular approach for hip arthroplasty. Bipolar prosthesis implant was used for the study.

Positioning

Patient was kept in the lateral position with the affected limb uppermost which was internally rotated and flexed.

Minimally invasive technique

A 6-10cm oblique incision was placed in line with the femur along the posterior edge of the greater trochanter with approximately one third of the incision proximal to the tip of the greater trochanter and two thirds distal. The gluteus maximus was then split for only a short distance, the incision of the fascia lata is limited, and the quadrates femoris was left mostly intact but retracted to expose the lesser trochanter. The capsule was incised along the inferior border of piriformis from the edge of the acetabulum to the posterior border of the femur, continuing distally in an 'L' shape, detaching the capsule, gemelli and obturatorinternus as one. The hip was then dislocated and osteotomy of the neck performed in the normal manner. After insertion of the component a combined capsulotendinous repair was performed through two drill holes in the bone. Drill holes were placed from lateral to medial at the posterior aspect of the greater trochanter, resulting in an anatomical repair to their correct point of attachment.



Fig 1. Painting and draping of the part

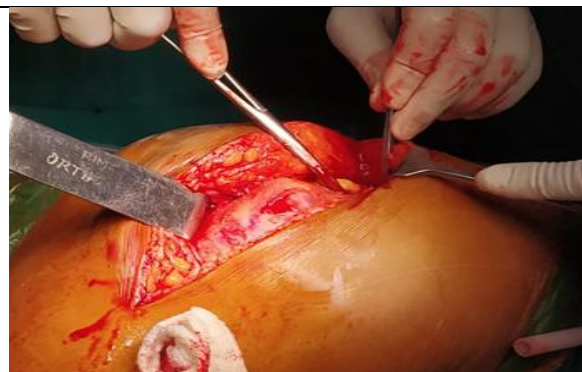


Fig 2. Skin incision for minimally invasive exposure of hip



Fig 3. Final wound closure



Fig 4. Post operative AP radiograph showing bipolar prosthesis of Right hip

Conventional approach

A 15cm or longer curved incision centred on the posterior aspect of the greater trochanter was made and the incision was extended across the buttock cutting over the posterior aspect of greater trochanter continuing down along the shaft of femur. The fascia lata was incised to uncover the vastuslateralis distally and the fascial incision was lengthened in line with skin incision to split the fibres of gluteus maximus by blunt dissection. Any bleeding vessels were cauterized to prevent any excessive blood loss. The hip was then internally rotated to place the short external rotators of hip on stretch. A stay suture was placed in piriformis and obturator internus tendon just before they insert into the greater trochanter and the muscles was detached close

to their femoral insertion to reflect them backward and laying them over the sciatic nerve to protect it during the rest of the procedure. The posterior aspect of the hip joint capsule was then fully exposed and a T-shaped or longitudinal incision was made over the posterior capsule and the hip was dislocated by internal rotation after performing capsulotomy. The femoral neck was delivered into the wound and the femoral neck cut and removed from the acetabulum. The femoral canal was reamed and the chosen bipolar prosthesis inserted. The hip joint capsule, abductors of the hip, fascia lata, and subcutaneous tissue was repaired with absorbable suture and finally the skin was closed with a stapler.

All the Patient was given i.v. antibiotics till 5th postoperative day followed by oral antibiotics till 10th postoperative day. X-ray taken on 2nd postoperative day. Stitch removal done on 10th postoperative day. Weight bearing allowed with crutches and walking support and advanced as tolerated till 1 month after surgery. Patient was followed up on 3rd and 6th month postoperatively. Outcome variables were taken as immediate post operative rehabilitation progress(hours postoperatively), Harris hip score, SF -12 general health questionnaire (physical score).

Statistical analysis

Data was checked for completeness and consistency. Data was entered and analysed using SPSS V.21 for Windows. Descriptive data was presented in terms of percentage, mean and standard deviation. The data were compared between the two groups under study by using the independent sample t-test. A p-value of less than 0.05 was considered significant.

III. Result

In our study, Majority of the participants were between the age of 61-70 in both the groups, comprising 48% in the minimally invasive group and 59% in the conventional group. Females were common in both the groups, 58% in the minimally invasive and 62% in the conventional group. Right side was more commonly involved in both the groups, 55% in the minimally invasive group and 62% in the conventional group. As per the Garden's classification Garden's type IV constituted the most common fracture type in both the group, 61% in the minimally invasive and 65% in the conventional group. Most common mode of injury in both the group was trivial fall, comprising 45% in the minimally invasive and 53% in the conventional group.

The mean interval between injury and surgery in minimally invasive group was 7.6 days whereas in the conventional group the mean interval was 8 days. The difference was statistically insignificant ($p > 0.05$). The mean operative time in minimally invasive group was 63.7 minutes whereas in the conventional group the mean operative time was 44.8 minutes. The difference was statistically significant ($p < 0.05$). The mean preoperative Hb in the minimally invasive group was 11.1mg/dl while in the conventional group it was 11mg/dl. The difference was statistically insignificant. Similarly, the mean postoperative Hb in the minimally invasive group was 10.1mg/dl while in the conventional group it was also 10.1mg/dl. The difference was statistically insignificant ($p > 0.05$). The mean duration of hospital stay in minimally invasive group was 11.5 days whereas in conventional group was 14.1 days. The difference was statistically significant ($p < 0.05$).

Knee flexion of $>30^\circ$ was achieved at a mean time of 48 hours postoperatively in minimally invasive group. The same was achieved at a mean time of 50.3 hours postoperatively in the conventional groups. The difference was statistically insignificant ($p > 0.05$). Lifting straight leg $>30^\circ$ was achieved at a mean time of 79.7 hours postoperatively in minimally invasive group. The same was achieved at a mean time of 114.8 hours postoperatively in the conventional groups. The difference was statistically significant ($p < 0.05$). Active hip abduction of $>30^\circ$ was achieved at a mean time of 70.2 hours postoperatively in minimally invasive group. The same was achieved at a mean time of 106.5 hours postoperatively in the conventional groups. The difference was statistically significant ($p < 0.05$). Ability to stand with support was possible at a mean time of 80.2 hours postoperatively in minimally invasive group. The same was possible at a mean time of 85.9 hours postoperatively in the conventional groups. The difference was statistically insignificant ($p > 0.05$). Independently getting out of the bed was possible at a mean duration of 110.9 hours postoperatively in minimally invasive group. The same was possible at a mean duration of 119.1 hours postoperatively in the conventional groups. The difference was statistically significant ($p < 0.05$). Independently getting into the bed was possible at a mean duration of 113.2 hours postoperatively in minimally invasive group. The same was possible at a mean duration of 121.6 hours postoperatively in the conventional groups. The difference was statistically significant ($p < 0.05$). Walking distance of >10 meters was possible at a mean time of 114.6 hours postoperatively in minimally invasive group. The same was possible at a mean time of 121.6 hours postoperatively in the conventional groups. The difference was statistically insignificant ($p > 0.05$).

Majority of the patients in minimally invasive group 45% had a fair Harris hip score at 3 months postoperatively. Whereas majority of the patients in the conventional group 50% had a poor Harris hip score at 3 months postoperatively. The difference was statistically significant ($p < 0.05$). Majority had good Harris hip score

of 58% and 67% in minimally invasive and conventional group respectively at 6 months postoperatively which was statistically insignificant ($p>0.05$).

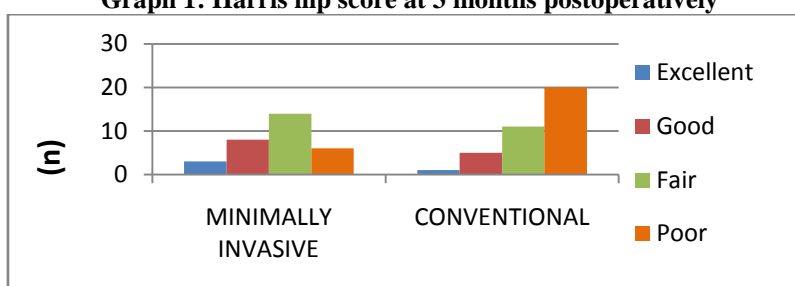
Table 1: HHS at 3 months postoperatively

HHS	MINIMALLY INVASIVE n (%)	CONVENTIONAL n (%)	P VALUE
Excellent	3 (10)	1 (3)	0.012
Good	8 (26)	5 (15)	
Fair	14 (45)	11 (32)	
Poor	6 (19)	17 (50)	

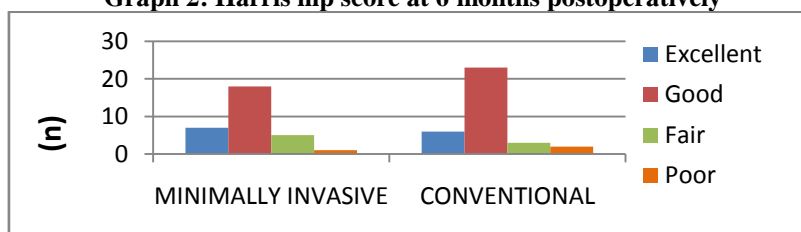
Table 2: HHS at 6 months postoperatively

HHS	MINIMALLY INVASIVE n (%)	CONVENTIONAL n (%)	P VALUE
Excellent	7 (23)	6 (18)	0.802
Good	18 (58)	23 (67)	
Fair	5 (16)	3 (9)	
Poor	1 (3)	2 (6)	

Graph 1: Harris hip score at 3 months postoperatively



Graph 2: Harris hip score at 6 months postoperatively



The mean SF-12 score at 3 months postoperatively in minimally invasive and conventional groups were 39.2 and 38.6 respectively. The difference was statistically insignificant ($p>0.05$), whereas 6 month postoperatively SF- 12 were 42.1 and 41.6 respectively. This difference was also statistically insignificant ($p>0.05$).

Table 13: Complications

COMPLICATIONS	MINIMALLY INVASIVE n (%)	CONVENTIONAL n (%)
Superficial infection	0 (0)	0 (0)
Sciatic nerve injury	0 (0)	0 (0)
Limb length discrepancy	1 (3)	3 (9)
Dislocation	0 (0)	0 (0)



Fig 5. Active knee flexion



Fig 6. Straight leg raising



Fig 7. Active hip abduction



Fig 8. Walking with support

IV. Discussion

This study was conducted in the Department of Orthopaedics, RIMS Imphal between September 2017 to August 2019. Aim of our study was to compare the minimally invasive exposure and conventional exposure of hip joint in hemiarthroplasty of hip for the management of displaced fracture neck of femur using clinical and functional assessment scores. The results were studied by comparing the two groups. The following variables of each patients were analyzed: age, sex, religion, side involved, fracture type, mode of injury, interval between injury and surgery, preoperative and postoperative haemoglobin, operation duration, duration of hospital stay, immediate postoperative rehabilitation progress (hours postoperatively), Harris hip score (modified), SF-12 general health questionnaire (physical score). In our study, significant difference was observed in terms of mean operation duration between the two groups, 63 minutes in minimally invasive group and 44 minutes in conventional group ($p=0.000$). Similar observation was made by study conducted by Fink B et al²⁰ we encountered significant difficulty in the delivery of the femoral head and subsequent reduction of the head back into the acetabulum which was due to limited exposure and difficulty in identifying the structures.

In this study, significant difference was noted in terms of mean duration of hospital stay with a mean duration of 11.5 days in minimally invasive group and 14.1 days in conventional group ($p=0.000$). Similar observation was made in the study conducted by Fink B et al²⁰.

In our study, significant difference was noted in the early rehabilitation milestones such as: lifting straight leg, active hip abduction, getting in and out of the bed. Schleicher I et al¹⁹ also made similar observation in his study. The overall mean Harris Hip Score (HHS) in the minimally invasive group was 76.9 ± 8.09 and in the conventional group the mean score was 71.4 ± 8.94 ($p=0.012$). The overall mean Harris Hip score at 6 months postoperative in the minimally invasive group was 83.3 ± 6.07 and in the conventional group the mean score was 82.9 ± 6.48 ($p=0.802$). Both were in correlation with the study conducted by Schleicher I et al¹⁹.

Mean SF-12 score at 3 month postoperatively in minimally invasive and conventional groups were 39.2 and 38.6 respectively ($p=0.199$). The mean SF-12 score at 6 months postoperatively in minimally invasive and conventional groups were 42.1 and 41.6 respectively ($p=0.081$). In his study Schleicher I et al¹⁹ also made similar observation. In our study, no significant difference was observed in terms of complications rates between the two groups. Limb length discrepancies were observed in 1 case in minimally invasive group and 3 cases in conventional group ($p=0.356$). Despite limited exposure and difficulty in identifying the structures no major complications was observed in the minimally invasive exposure except that 3 patients had to be converted into conventional exposure intraoperatively which was due to difficulty in the delivery of the femoral head and subsequent reduction of the head back into the acetabulum.

V. Conclusion

In this comparative study, the statistical analysis showed significant difference between the minimally invasive exposure and the conventional exposure in terms of immediate postoperative rehabilitation progress, duration of hospital stay and Harris hip score at 3 months which showed definite advantage of minimally invasive exposure in early postoperative periods allowing early initiation of physical therapy, patient ambulation and early discharge. However small skin incision and limited exposure posed significant difficulty in identifying the structures, delivery of the femoral head and subsequent reduction of the bipolar prosthesis back into the acetabulum.

Overall functional outcomes in terms of SF-12 general health questionnaire and Harris hip score at 6 months were comparable in both the groups. Thus we conclude that minimally invasive exposure of hip joint for hemiarthroplasty is a technically challenging procedure which has no added long term benefits.

References

- [1]. Singer BR, McLauchlan GJ, Robinson CM, Christie J. Epidemiology of fractures in 15,000 adults: the influence of age and gender. *J Bone Joint Surg Br* 1998;80(2):243–8.
- [2]. Dennison E, Mohamed MA, Cooper C. Epidemiology of osteoporosis. *Rheum Dis Clin North Am* 2006;32(4):617–29.
- [3]. Bhandari M, Devereaux PJ, Tornetta P 3rd, Swiontkowski MF, Berry DJ, Haidukewych G, et al. Operative management of displaced femoral neck fractures in elderly patients. An international survey. *J Bone Joint Surg Am* 2005;87(9):2122–30.
- [4]. Crossman PT, Khan RJ, MacDowell A, Gardner AC, Reddy NS, Keene GS. A survey of the treatment of displaced intracapsular femoral neck fractures in the UK. *Injury* 2002;33(5):383–6.
- [5]. Iorio R, Schwartz B, Macaulay W, Teeney SM, Healy WL, York S. Surgical treatment of displaced femoral neck fractures in the elderly: a survey of the American Association of Hip and Knee Surgeons. *J Arthroplasty* 2006;21(8):1124–33.
- [6]. Graw BP, Woolson ST, Huddleston HG, Goodman SB, Huddleston JI. Minimal incision surgery as a risk factor for early failure of total hip arthroplasty. *ClinOrthopRelat Res* 2010;468(9):2372–6.
- [7]. Hardinge K. The direct lateral approach to the hip. *J Bone Joint Surg Br* 1982;64(1):17–9.
- [8]. Sculco TP, Jordan LC, Walter WL. Minimally invasive total hip arthroplasty: the hospital for Special Surgery experience. *OrthopClin North Am* 2004;35(2):137–42.
- [9]. Szendrői M, Sztrinkai G, Vass R, Kiss J. The impact of minimally invasive total hip arthroplasty on the standard procedure. *IntOrthop* 2006;30(3):167–71.
- [10]. Wall SJ, Mears SC. Analysis of published evidence on minimally invasive total hip arthroplasty. *J Arthroplasty* 2008;23(7 suppl):55–58.
- [11]. de Beer J, Petruccioli D, Zalzal P, Winemaker MJ. Single-incision, minimally invasive total hip arthroplasty: length doesn't matter. *J Arthroplasty* 2004 Dec;19(8):945–50.
- [12]. Berger RA. Mini-incisions: two for the price of one! *Orthopedics* 2002;25(5):472–98.
- [13]. Mayr E, Nogler M, Benedetti MG, Kessler O, Reinthaler A, Krismer M, et al. A prospective randomized assessment of earlier functional recovery in THA patients treated by minimally invasive direct anterior approach: a gait analysis study. *ClinBiomech* 2009;24(10):812–8.
- [14]. Cameron HU. Mini-incisions: visualization is key. *Orthopedics* 2002;25(5):473.
- [15]. DiGioia AM 3rd, Plakseychuk AY, Levison TJ, Jaramaz B. Mini-incision technique for total hip arthroplasty with navigation. *J Arthroplasty* 2003;18(2):123–8.
- [16]. Dorr LD, Maheshwari AV, Long WT, Wan Z, Sirianni LE. Early pain relief and function after posterior minimally invasive and conventional total hip arthroplasty. A Prospective, randomized, blinded study. *J Bone Joint Surg Am* 2007;89(6):1153–60.
- [17]. Huo MH, Brown BS. What's new in hip arthroplasty. *J Bone Joint Surg Am* 2003;85(9):1852–64.
- [18]. Woolson ST, Mow CS, Syquia JF, Lannin JV, Schurman DJ. Comparison of primary total hip replacements performed with a standard incision or a mini-incision. *J Bone Joint Surg Am* 2004;86(7):1353–8.
- [19]. Schleicher I, Haas H, Adams TS, Szalay G, Klein H, Kordelle J. Minimal-invasive posterior approach for total hip arthroplasty versus standard lateral approach. *ActaOrthopBelg* 2011;77(4):480–7.
- [20]. Fink B, Mittelstaedt A, Schulz MS, Sebena P, Singer J. Comparison of a minimally invasive posterior approach and the standard posterior approach for total hip arthroplasty A prospective and comparative study. *J OrthopSurg Res* 2010;5:46

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