



## Comparison Between Minimally Invasive Anterolateral and Conventional Posterior Hip Approaches for Hemiarthroplasty in Hip Fractures

Pranpawee Rojcharoenngam, MD

*Department of Orthopedics, Maharaj Nakhon Si Thammarat Hospital, Nakhon Si Thammarat, Thailand*

**Purpose:** To compare the results between minimally invasive anterolateral and conventional posterior hip approaches for hemiarthroplasty in hip fractures.

**Methods:** The elderly patients who had undergone hip hemiarthroplasty for hip fractures in Maharaj Nakhon Si Thammarat Hospital, were randomly divided into two groups: minimally invasive anterolateral and posterior approach groups. Data were collected from March 2020 to November 2021, which included the duration of the surgery, length of the surgical wound, intraoperative bleeding volume, postoperative days of walking with a walker, morphine dosage for pain relief, and postoperative complications.

**Results:** No significant difference ( $P$ -value  $> 0.05$ ) was found between the baseline data of patients in both the groups, which included sex, age, body mass index, underlying musculoskeletal disease, and drug usage. The minimally invasive anterolateral approach group used an average surgical time of  $53.48 \pm 8.22$  min, while the conventional posterior approach group required  $65 \pm 20.41$  min; the length of the surgical wound was  $7.78 \pm 0.87$  and  $13.78 \pm 1.37$  cm, respectively; the volume of intraoperative bleeding was  $82.17 \pm 48.94$  and  $195.65 \pm 163.24$  ml, respectively; the postoperative days of walking with a walker were  $3.09 \pm 0.92$  and  $6.59 \pm 2.52$  days, respectively; and the postoperative analgesic doses of morphine were  $6.59 \pm 2.80$  and  $11.09 \pm 3.89$  mg, respectively. The blood transfusion was required in 4 patients in the minimally invasive anterolateral approach group, while it was required in 14 patients in the conventional posterior approach group. Statistically significant ( $P$ -value  $< 0.05$ ). Postoperative complications included, prosthetic hip joint dislocation in a patient in each group and sciatic nerve neurapraxia in a patient in the conventional posterior approach group.

**Conclusions:** Hip hemiarthroplasty with the minimally invasive anterolateral approach in elderly patients with hip fractures was found to be superior to the conventional posterior approach.

**Keywords:** Hip hemiarthroplasty, Hip fractures in the elderly, Minimally invasive hip surgery, Surgical hip approach

### Article history:

Received: December 21, 2021 Revised: April 1, 2022

Accepted: May 17, 2022

Correspondence to: Pranpawee Rojcharoenngam, MD  
Department of Orthopedics, Maharaj Nakhon Si  
Thammarat Hospital, Nakhon Si Thammarat, Thailand  
E-mail: [dr.pranpawee@gmail.com](mailto:dr.pranpawee@gmail.com)

The current world population has entered into “aging society”. Osteoporosis is one of the major problems that can lead to health hazards and/or death in the elderly. One-third of the female and one-fifth of the male population above 50 years of age, suffer from fractures due to osteoporosis<sup>(1)</sup>. When an elderly person falls, the most common

sites where the fracture occurs, are at the neck of the femur and at the intertrochanteric femur (hip fractures)<sup>(2)</sup>. In Thailand, the average life expectancy of the population has increased. It is estimated that by 2050, about 45% of population will be above 50 years of age<sup>(3)</sup>. An elderly population comprising about 11%, is found to be present in Nakhon Si Thammarat, which is ranked 4th in the country. 32.1% of falls were observed in this population, among which 90% resulted in hip fractures, leading to long hospital stays and sometimes disability<sup>(4)</sup>.

Treatment of elderly patients with hip fractures can be done using both conservative or surgical approaches. The goal of surgery is to achieve maximum stability in the hip joint and to allow the patient to ambulate quickly, resulting in better results than in conservative approach. The mortality rate within one year was very high in the conservative group<sup>(5)</sup>. Elderly patients with hip fractures accompanied with osteoporosis, prefer hip hemiarthroplasty to reduce the chances of reoperation and to restore the function more efficiently<sup>(6-7)</sup>. Most orthopedic surgeons in Nakhon Si Thammarat perform hip hemiarthroplasty with Moore's posterior approach. In this approach, the skin incision is 10 cm distal to the posterior superior iliac spine, which extends laterally and distally to the greater trochanter. It is then carried distally up to 15 cm, along the femoral shaft. The fascia lata and gluteal fascia are divided, while the fibers of the gluteus maximus are separated bluntly in line with the skin incision. This ensures that branches of the superior gluteal vessels and nerve in the proximal half of the muscle and those of the inferior gluteal vessels and nerve in the distal half of the muscle, are preserved. The sciatic nerve is then identified and protected. The short external rotator muscles are bluntly dissected and detached near their femoral insertion. The muscles are retracted medially to protect the sciatic nerve, and then the capsule is exposed. The disadvantages of this approach are hip dislocation and sciatic nerve injury<sup>(8)</sup>. In the anterolateral approach, the curved skin incision starts slightly anteriorly, about 7-10 cm proximal to the lateral part of the greater trochanter (directed towards the tubercle of the iliac crest – the posterior landmark of the tensor fasciae

lata origin). Distally, the incision extends along the femur, about 5 cm below the greater trochanter. The fascia lata is exposed sharply, incised over the femur, and the incision is extended proximally, along the posterior border of the tensor fascia lata. After exposing the greater trochanter and the gluteus medius muscle, the gluteus medius and minimus muscles are divided from the greater trochanter, and then the capsule is exposed. In this approach, though the posterior capsule is not damaged and the chances of injury to the sciatic nerve is eliminated, chances of damage to the abductor muscle are present. In addition, people in Nakhon Si Thammarat province consider that joint replacement surgery is a daunting major surgery for broken hip. They were reluctant to undergo surgery and were worried that they would not be able to walk after the surgery. The minimally invasive anterolateral approach does not damage the abductor muscles, external rotator muscles, and posterior capsule. This reduces the chances of hip dislocations and sciatic nerve injuries. It also reduces intraoperative blood loss, postoperative pain, and helps the patient to ambulate faster using a walker<sup>(9-11)</sup>. Therefore, this study aims to compare the results between the minimally invasive anterolateral and the conventional posterior hip hemiarthroplasty in hip fractures, to develop surgical techniques with less morbidity and blood loss, and for faster recovery in patients.

## METHODS

Patients were randomly divided into 2 groups, with 46 patients each in the minimally invasive anterolateral approach, and in the conventional posterior approach groups. Exclusion criteria included those patients who were status unable to walk before falling. The team of orthopedic surgeons consisted of two surgeons; one performed the surgery using the minimally invasive anterolateral approach, while the other performed using the conventional posterior approach.

Steps in the minimally invasive anterolateral approach were as follows: The patient was placed in a side-lying position. An incision was centered towards the front edge of the trochanter, extended 2 cm superior and 4-6 cm inferior to the

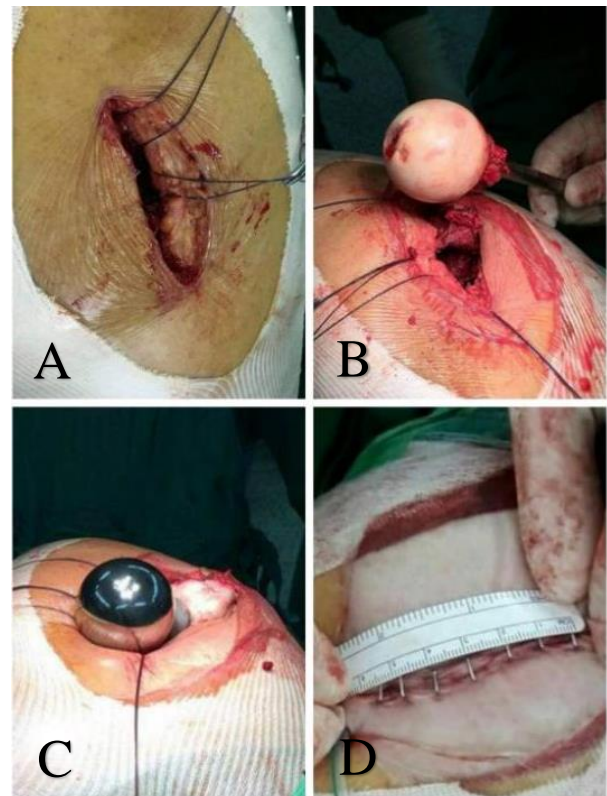
trochanter, along the femoral axis. The length of a surgical wound was 6-8 cm. During the surgery, the hips were slightly flexed. The incision was made to open the fascia twice the length of the surgical wound. The periosteum was used to push the gluteus medius, gluteus minimus, and the vastus lateralis muscles, to expose the anterior capsule. The capsule was dissected into an inverted T shape to reach the hip joint.

Steps in the posterior approach (Moore's) were as follows: The patient was placed in a side-lying position, slightly prone. The incision was placed in the posterior part of the hip, from the posterior superior iliac spine to the greater trochanter, down to the femur. The length of a surgical wound was 12-15 cm. The incision was placed through the fascia and gluteus maximus muscle, while the sciatic nerve was protected using a retractor. The external rotator muscles and the posterior capsule were dissected to reach the hip joint. After the prosthesis was inserted and reduced back into the hip joint, the soft tissue including the piriformis muscle, external rotator muscles, and the posterior capsule were repaired.

Both groups received the same bipolar hip hemiarthroplasty models (cemented BLHAU). The duration of the surgery and the intraoperative bleeding volume data were collected. Furthermore, the length of the wound was measured after it was closed. The postoperative care program was same for both the groups. If required, intravenous morphine 3 mg 4 hourly was used to relieve the pain. Mobilization was initiated on postoperative day 2 using a walker, with partial weight-bearing as tolerated, based on the individual's level of cooperation and on the pain intensity. The patients in both the groups were not allowed to bend their hips more than 90 degrees. Adduction-internal rotation posture in the conventional posterior approach and abduction-external rotation in the anterolateral minimal invasive approach, were performed cautiously. All patients who were able to walk with a walker, were discharged. Follow-up appointments were scheduled at 2 weeks, 6 weeks, and 3 months.

Demographic data, such as sex, age, body mass index, underlying musculoskeletal disease

and drug usage, the duration of the surgery, the length of the surgical wound, intraoperative bleeding volume, postoperative days of walking with a walker, morphine dosage for pain relief, and postoperative complications, were collected. All data were presented as frequencies and percentages, or means and standard deviations, as appropriate. Independent T-test and Chi-Square tests were used for comparing data between both the groups. Statistical analyses were conducted using SPSS software for Windows version 23.0. A P-value of less than 0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Review Board, Maharaj Nakhon Si Thammarat Hospital Ethics Committee: 11/2562.



**Fig. 1.** Minimally invasive bipolar hemiarthroplasty

- A. Anterolateral minimal invasive approach
- B. The broken bone of the femoral head is removed.
- C. A bipolar prosthesis is replaced.
- D. The length of the wound is measured after the stitches were closed.



**Fig. 2.** Radiographic image after minimally invasive bipolar hemiarthroplasty (anterolateral approach).

## RESULTS

The minimally invasive anterolateral and the posterior approach groups included 46 patients each. Demographic data of the patients are shown in [Table 1](#). There were no statistically significant differences in sex, age, body mass index, occupation, underlying disease, or any medication that can be a risk factor for falls.

The average duration of surgery in the minimally invasive anterolateral approach group was  $53.48 \pm 8.22$  min, while it was  $65 \pm 20.41$  min in the conventional posterior approach group; the length of the surgical wound was  $7.78 \pm 0.87$  and  $13.78 \pm 1.37$  cm, respectively; the volume of intraoperative bleeding was  $82.17 \pm 48.94$  and  $195.65 \pm 163.24$  ml, respectively; the postoperative days of walking with a walker were  $3.09 \pm 0.92$  and  $6.59 \pm 2.52$  days, respectively; and the postoperative analgesic doses of morphine were  $6.59 \pm 2.80$  and  $11.09 \pm 3.89$  mg, respectively. The blood transfusion was required in 4 cases in the minimally invasive anterolateral approach group, while it was obtained in 14 cases in the conventional posterior approach group. Statistically significant difference was noted in all of the values mentioned above ( $P$ -value  $< 0.05$ ), as shown in [Table 2](#). Postoperative complications during hospitalization included, prosthesis hip joint dislocation in a patient in each group and sciatic nerve neurapraxia in a patient in the posterior approach group.

**Table 1** Patient demographic data of the minimally invasive anterolateral and the posterior approach groups. (N = 92)

Parameters	Minimally invasive anterolateral approach group	Parameters	Minimally invasive anterolateral approach group
Sex			0.174
- Male	11 (23.91)	17 (36.96)	
- Female	35 (76.09)	29 (63.04)	
Age	79.69	81.15	0.348
BMI	22.12	22.07	0.954
Occupation			0.054
- Agriculture	11 (23.91)	15 (32.61)	
- Employee	3 (6.52)	0 (0)	
- Merchant	1 (2.18)	4 (8.70)	
- Government	0 (0)	3 (6.52)	
- Not working	31 (67.39)	24 (52.17)	
Underlying disease			0.197
- None	14 (30.43)	8 (17.39)	
- Only 1	18 (39.14)	26 (56.52)	
- More than 1 or use of > 4 drugs	14 (30.43)	12 (26.09)	

\*Statistical significance was set at  $P$ -value  $< 0.05$ .



**Table 2** Intraoperative and Postoperative variables.

Variables	Minimally invasive anterolateral approach group (N = 46)	Conventional posterior approach group (N = 46)	P-value
Surgical time (min)	53.48 ± 8.22	65 ± 20.41	0.001*
Length of the surgical wound (cm)	7.78 ± 0.87	13.78 ± 1.37	0.000*
Estimate blood loss (ml)	82.17 ± 48.94	195.65 ± 163.24	0.001*
Transfusion rate (number of patients)	4/46	14/46	0.043*
Postoperatively walked self-confidently using a walker (days)	3.09 ± 0.92	6.59 ± 2.52	0.001*
Complications			0.603
- Hip dislocation	1	1	
- Sciatic nerve injury	-	1	

\*Statistically significant difference was set at P-value < 0.05.

At 2 weeks, 6 weeks, and 3 months follow-up evaluation, no complications were noted in both the groups.

## DISCUSSION

Minimally invasive hip surgery gained attention in the orthopedic surgeon society in the USA. The incision for hip replacement surgery is usually 10-15 cm long; therefore, a minimally invasive hip replacement technique has been developed with an objective of reducing the size of the surgical wound to less than 10 cm, without the need for special tools, which can reduce postoperative pain, intraoperative blood loss, and can result in fast recovery. There are many approaches for minimally invasive hip surgeries, such as the posterior minimally invasive approach, anterior minimally invasive approach, and an anterolateral minimally invasive approach.

Robin Martin, Patrick E. Clayson et al.<sup>(13)</sup> carried out a comparative study between patients undergoing hip replacement surgery using an anterolateral minimally invasive approach (Rottinger ALMIS) and Hardinge transgluteal technique. They divided the patients into groups of 42 and 41 members, respectively. The results of the study found that the Rottinger ALMIS technique demonstrated less blood loss, but longer surgery time, which was statistically significant; however, statistically significant differences were not noted

in relation to the length of stay in the hospital, morphine usage, postoperative complications, and radiographic analysis. After a year of continuous follow-up, both groups demonstrated similar values in relation to the functional outcome Harris hip and Short Form-36v1 scores. This study shows favorable results for the anterolateral minimally invasive hip surgery. The patient was in less pain and returned home quickly. In future, a long-term study should be carried out to determine the functional outcome, as stated in this study.

Patrick F. Bergin, Jason D. Doppelt et al.<sup>(14)</sup> carried out a comparative study between patients undergoing hip replacement surgery using an anterior minimally invasive approach versus a posterior approach. They divided patients into groups of 29 equal members. The findings indicate that the radiographs after surgery were not statistically different; however, the blood test results in relation to the levels of serum creatine kinase, C-reactive protein, interleukin-6, interleukin-1 beta, and tumor necrosis factor-alpha, indicated up to 5.5 times higher and statistically significant tissue destruction in the posterior approach group. The study focused only on surgical tissue injuries. This study shows that anterior minimally invasive hip surgery involves less tissue destruction and fewer inflammatory reactions, which would be beneficial for patients after surgery.

Moritz M. Innmann, Marcus R. Streit et al.<sup>(15)</sup> carried out a comparative study between patients undergoing hip replacement surgery using an anterolateral minimally invasive approach versus a lateral approach. Both approaches used the same implant type and the hip offset equally. The results showed that the hip offset did not affect the acetabular, femoral offset, the vertical position of the rotation center, stem, and the leg lengths. However, in the anterolateral minimally invasive approach group, it was found that the misalignment of the cup was 38.5%, and the error was more statistically significant. The placement of the cup is a disadvantage in the anterolateral minimally invasive approach. In this study, only the bipolar hemiarthroplasty technique was applied; moreover, a problem with acetabulum positioning in total hip replacement surgery was found in the anterolateral minimally invasive approach. Therefore, the anterolateral minimally invasive approach was chosen for the bipolar hemiarthroplasty.

Bernd Fink, Alexander Mittelstaedt et al.<sup>(16)</sup> carried out a comparative study between patients undergoing hip replacement surgery using a posterior minimally invasive approach versus a posterior approach. They divided patients into 2 groups of 50 equal members. The results of the study stated that the patients operated using the posterior minimally invasive approach exhibited a significantly lower loss of blood, pain at rest, and a faster rate of recovery. The results of this study are supportive to the results obtained in the present study.

## CONCLUSION

Hip hemiarthroplasty with a minimally invasive anterolateral approach in elderly patients with hip fractures is found to be superior to the conventional posterior approach in terms of reducing the duration of the surgery, the size of the wound, intraoperative bleeding, postoperative analgesic doses of morphine, the patient ambulated faster using a walker, and minimal postoperative complications

## REFERENCES

1. Facts and Statistic. International Osteoporosis Foundation. Available from: <http://www.iofbonehealth.org/facts-statistics>.
2. Kanis JA, Oden A, McCloskey EV, et al. A systematic review of hip fracture incidence and probability of fracture worldwide. *Osteoporosis int* 2012;23:2239-56.
3. United State Census Bureau 2013, Census. Gou, September 2013, Available from: <http://www.census.gov/population/international/data/idb/informationGateway.php>.
4. Rojcharoenngam P. Risk factors for falls and hip fractures of the elderly in Nakhon Si Thammarat. *12th RMJ* 2017;28:58-64.
5. Wongworaphithak C. Mortality at one year in elderly hip fracture patients treated with nonoperative procedures. *11th RMJ* 2016;30:345-55.
6. Palanisamy AM, dorshi HK, Selvaraj D, et al. Fixation versus replacement in geriatric hip fractures: does functional outcome and independence in self-care differ?. *Geriatr Orthop Surg Rehabil* 2015;6:258-62.
7. Viberga B, Froslevc T, Overgaard S, et al. Mortality and revision risk after femoral neck fracture: comparison of internal fixation for undisplaced fracture with arthroplasty for displaced fracture: a population-based study from Danish National Registries. *Acta Orthop* 2021;92:163-9.
8. Onyemaechi N, Anyanwu E, Obikili E, et al. Anatomical basis for surgical approaches to the hip. *Ann Med Health Sci Res* 2014;4:487-94.
9. Jerosch J, Theising C, Fadel ME. Antero-lateral minimal invasive (ALMI) approach for total hip arthroplasty technique and early results. *Arch Orthop Trauma Surg* 2006;126:164-73.
10. Pfeil J, Siebert WE. *Minimally Invasive Surgery in Total Hip Arthroplasty*. Berlin, Heidelberg: Springer Verlag; 2000.

11. Gulan G, Jurdana H, Mikačević M, et al. Anterolateral minimally invasive approach in hip arthroplasty– a surgical technique. *Medicina Fluminensis* 2015;51:41-51.
12. Mahmoud Awad AK, Tammam H, Said E, et al. Evaluation of minimally invasive versus conventional total hip replacement. *SVU-IJMS* 2021;4:231-9.
13. Martin R, Clayson PE, Troussel S, et al. Anterolateral minimally invasive total hip arthroplasty: a prospective randomized controlled study with a follow-up of 1 year. *J Arthroplasty* 2011;26:1362-72.
14. Bergin PF, Doppelt JD, Kephart CJ, et al. Comparison of minimally invasive direct anterior versus posterior total hip arthroplasty based on inflammation and muscle damage markers. *J Bone Joint Surg Am* 2011;93:1392-8.
15. Innmann MM, Streit MR, Kolb J, et al. Influence of surgical approach on component positioning in primary total hip arthroplasty. *BMC Musculoskelet Disord* 2015;16:180.
16. Fink B, Mittelstaedt A, Schulz MS, et al. Comparison of a minimally invasive posterior approach and the standard posterior approach for total hip arthroplasty A prospective and comparative study. *J Orthop Surg Res* 2010;5:46.