Comparison of Prosthesis Position in Total Hip Arthroplasty by Lateral and Posterior Approach in Pathum Thani Hospital

Kaewkun C, MD

Department of Orthopaedic Surgery, Pathum Thani Hospital, Pathum Thani, Thailand

Purpose: To compare differences in prosthetic position in total hip arthroplasty between the lateral and posterior approaches.
Methods: Retrospective analytical study reviewed the X-ray films and medical records of every patient treated with total hip arthroplasty from 2002 to 2010. There were 107 hips in 93 patients.
Results: There was no statistically significant difference in sex, age, or diagnosis between the two approaches. Acetabular inclination, vertical height, horizontal distance, and anteversion were also not significantly different between the two groups, yet the femoral stem alignment significantly tended to be varus in the posterior approach and valgus in the lateral approach. This also made the posterior approach group have longer offset with statistically significance. This might be the influence of the position of the femur when inserting the femoral stem. Limb length discrepancy was similar in both groups.
Conclusion: The femoral stem alignment significantly tended to be varus in the posterior approach and valgus in the lateral approach. This data can be used to prevent prosthetic malalignment following the selected approach in total hip arthroplasty.

Keywords: Hip arthroplasty, comparison of prosthesis, stem, malalignment, misalignment

The Thai Journal of Orthopaedic Surgery: 34 No.3-4: P43-48
Full text. e journal : *http://www.rcost.or.th/journal, http://thailand.digitaljournals.org/index.php/JRCOST*

Total hip arthroplasty has been documented to be remarkably successful in patients with degenerative arthritis, avascular necrosis of the femoral head, and nonunion of the femoral neck who cannot be relieved by nonsurgical treatment[1]. In Pathum Thani Hospital, there has been a significantly increase in the number of total hip arthroplasty surgery in the past eight years, particularly in therapy for patients who were diagnosed with avascular necrosis of the femoral head (AVN). Nevertheless, total hip arthroplasty can cause complications such as loosening, dislocation, and femoral stem failure that arise from the position of the prosthesis[2].

In order to determine the appropriate position for the placement of hip prosthesis during surgery, many approaches have been devised using obvious anatomical landmarks. Most of these techniques use minimal skin incision to prevent cellular tissue injury. Consequently, they lead to inadequate exposure of the whole important anatomical location of the hip joint. It is generally believed that different surgical approaches result in different locations for hip prosthesis insertion[2]. In Pathum Thani Hospital, orthopedic surgeons have been using both lateral and posterior approaches for total hip arthroplasty. Even though there are many studies of the two approaches and their risks and benefits have been established, it seems that there is no comparison between these two approaches. The objective of this retrospective study was to compare the differences of prosthetic positions in total hip arthroplasty between the two approaches in patients of the Department of Orthopedic Surgery, Pathum Thani Hospital.

Correspondence to : Kaewkun C, Department of Orthopaedic Surgery, Pathum Thani Hospital, Pathum Thani, Thailand
E-mail: chatmk6609@hotmail.com

Material and method

The retrospective data was reviewed by using the X-ray films and medical records of every patient treated with total hip arthroplasty form January 2002 to June 2010 in Pathum Thani Hospital. All patients' data were categorized based on the surgical approaches used, i.e. lateral and posterior approaches. Exclusion criteria were diagnosis of revision total hip arthroplasty, hemiarthroplasty, and congenital hip deformity. The parameters used included (1) sex, (2) age, (3) diagnosis, (4) acetabular inclination, (5) acetabular anteversion, (6) acetabular cup vertical height, (7) acetabular cup horizontal distance, (8) femoral stem alignment, (9) femoral offset, and (10) limb length discrepancy.

In order to obtain accurate information, the anteroposterior view of both hips' X-ray films and anteroposterior views of operation side X-ray films

within 1 year after operation were reviewed. To eliminate subjective bias, double-blind trials for all measurements were conducted by three individuals who did not know which surgical procedures had been used.

The means of each of the following calculated parameters were recorded and used for evaluation in this study.

Acetabular inclination was measured as the angle of two intersecting vector lines from the lowest part of both-sided ischial tuberosity to the anterior surface of the acetabular cup. In cases where the ischial tuberosity was distorted from normal anatomy or ischial tuberosity could not be clearly seen on the X-ray film, perpendicular vector lines of the midpoint of the sacrum or the vector line from the lowest part of the tear drop were used instead to measure the acetabular inclination.

Acetabular anteversion was measured by mathematic calculation using the long axis and the transverse axis of the hip joint from the anteroposterior view of operation side X-ray films[3].

Acetabular cup vertical height was determined by measuring the distance from the perpendicular vector line of rotation center of the acetabular cup to the lowest part of the tear drop in each X-ray film.

Acetabular cup horizontal distance was measured as the distance from the horizontal vector line of rotation center of the acetabular cup to the lowest part of the tear drop in each X-ray film.

Measurement of femoral stem alignment was done by determining the femoral stem alignment compared with the proximal femoral medullary canal[4].

Measurement of femoral offset was determined by the perpendicular distance between the long axis of the proximal femoral medullary canal and the central of the femoral head.

Measurement of limb length discrepancy was taken by calculating the different limb lengths of each patient from the X-ray film. If the lesser trochanter could not be clearly seen from the X-ray films, the location of the tip of the greater trochanter was used instead for this measurement.

Operation techniques

According to the medical records and X-ray films, all patients enrolled in this study were anesthetized by spinal nerve block. Patients lay down on one side and the operation was performed on the other side. The skin incision was done at the greater trochanter area and the fascia lata was cut at the same level as the skin incision.

For the lateral approach technique, the superficial part of the gluteus medius and the vastus lateralis were separated from the greater trochanter, but the tendons of both muscles were intact. The thigh was externally rotated to cause anterior dislocation of the hip joint.

For posterior approach techniques, the tendons of the external rotator muscle group and the posterior part of hip joint capsule were dissected. The thigh was internally rotated to cause posterior dislocation of the hip joint.

The femoral neck was further cut to prepare for prosthesis insertion. The estimation of external alignment was evaluated by the following criteria: acetabular inclination 45-55 *degrees*, acetabular anteversion 10-15 *degrees*, anatomic hip center, neutral stem, no limb length discrepancy.

Statistical Analysis

Chi-square test was used to evaluate the age group, sex, and diagnosis of all selected patients used in this work, whereas two-tailed student *t- test* was performed to compare the age and prosthesis positions. The significant difference was determined by using p-value ≤ 0.05. Sample size calculation was performed by using online software.
(http://hedwig.mgh.harvard.edu/sample_size/size.html, accessed May, 2010)

Results

The number of patients receiving total hip arthroplasty at Pathum Thani Hospital during January 2002 to June 2010 equaled 102 patients and 116 hips. Due to the incompleteness of X-ray films and medical records, together with the exclusion criteria, this study examined the records of 93 patients with 107 hips.

Table 1. Basic demographic data

Characteristics	Lateral	Posterior (N=49)	p-value (N=58)
Sex male:female	23:20	27:23	0.85
Average age (SD)	50.33 (12.54)	55.67(15)	0.24
AVN	47	55	0.70
Other	2	3	-

Note: Number was counted according to the number of operated hips

As shown in Table 1, the numbers of males and female patients were similar, and there were no statistically significant differences in average age or diagnosis (Table 1).

The prosthetic position was, on average, near the desired target, with no statistical difference except that the femoral stem alignment in the lateral approach had a small valgus trend, whereas the posterior approach had a small varus trend, resulting in slightly more femoral offset to a statistically significant degree (Table 2).

Table 2. Prosthetic position (N=107)

Characteristics	Lateral Mean (SD)	Posterior Mean (SD)	p-value
Acetabular cup			
Inclination (degree)	44.78(7.53)	42.38(6.53)	0.29
Vertical height (cm)	2.06(0.38)	2.24(0.53)	0.22
Horizontal distance (cm)	3.65(0.53)	3.55(0.46)	0.52
Anteversion (degree)	14.17(1.92)	15.67(3.68)	0.13
Femoral stem			
Alignment (degree)	2.17(2.20)	-0.65(1.59)	0.01
Offset (cm)	3.48(0.79)	3.98(0.56)	0.03
Discrepancy (cm)	0.22(0.78)	-0.02(0.39)	0.24

Note: Positive alignment means valgus stem and negative alignment means varus stem. Positive discrepancy means the operated leg is longer than the normal leg and negative discrepancy means the operated leg is shorter than the normal leg.

Discussion

Complications in total hip arthroplasty, especially for instability and erosion of prosthesis, are accepted to be related to malalignment of the prosthesis. The most common cause of dislocation is incorrect placement of the acetabular cup. This misplacement can also limit hip movement[5]. In general, the aim of operation is successful placement of the prosthesis in a position that is highly similar to the normal anatomical position. However, getting that result requires selecting an approach which allows clear sight of the anatomy, including all brims of the acetabulum, the greater trochanter, and the lesser trochanter. It is believed that greater trochanteric osteotomy can cause more dislocation of the hip but allows a better view of the acetabulum. Nevertheless, preparation of the femoral canal has a lower chance of perforation, and placement of the prosthesis is easier and more precise[6]. However, selecting the approach which allows clear sight of the anatomy must be weighed against the risk of more tissue injuries and more complications. Since greater trochanteric osteotomy still has many disadvantages including increased blood loss and the problem of fixation of the trochanter, it is specifically used in cases where a better view of the hip joint is needed such as revision total hip arthroplasty[1].

Many new approaches have been introduced. Sometimes, textbooks and journals distinguish two significantly different classifications between them as anterior and posterior hip dislocations. The author has chosen the lateral approach, which is classified as anterolateral approach in some textbooks, as representative of anterior hip dislocation, and the posterior approach, which is also classified in some textbooks as either the posterior or the posterolateral approach[7], as the representative of posterior hip dislocation. It is believed that the approach in the first group provides better observation of the anterior brim of the acetabulum and allows for better acetabular cup alignment in the anteversion position whereas the posterior approach provides better observation of the posterior brim of the acetabulum.

Generally, it is believed that anterolateral approach provides a better view of the operating field and that the increased post-operative dislocation in the posterior approach is due to the poor view of the operation field, resulting in incorrect placement of the acetabular cup[8].Woo studied the anteversion of the acetabular cup in dislocated hips and found averages of 7.7, 3.0, and 2.3 in anterior, lateral transtrochanteric, and posterior incision, respectively. However, the measured values are the values from the dislocated hip, so it cannot be concluded that the posterior approach results in less anteversion than the anterior and lateral transtrochanteric approaches[9]. Maruyama observed that the surgeon tends to place the acetabular cup within 5-7 degrees decreased anteversion in the posterior approach[10]. However, Ritter performed a comparative study among anterolateral, transtrochanteric, and posterior approaches and found different results[11]. The author compared lateral and posterior incisions and also found discordant results as well. This might be

because the mentioned error is usually corrected by the surgeon intraoperatively.

Placing the acetabular cup in the superior and lateral position will increase the lever arm and thus increase the force in the hip joint. This might result in increased loosening. However, it cannot be concluded that the acetabular cup should only be placed in the superior position. There are some discordant reports. Delp found that the placement of the acetabular cup in the superior and lateral alignment cannot be compensated for by increasing the femoral neck whereas the placement of the acetabular cup in the superior position can compensate[12]. However, some studies have reported that the placement of the acetabular cup in the superior position still increase the chance of loosening[13]. In comparing between placement in the superior and inferior alignments by vertical height measurement as representative, and comparing between placement in the medial and lateral alignments by horizontal height measurement as representative, the author found no significant different between the two alignments.

According to the results, the lateral approach results in the femoral stem having significant more valgus alignment than with the posterior approach. This might be due to the fact that the proximal femur in external rotation results in placement of the femoral stem with a tendency to lean toward the medial cortex. On the other hand, the posterior approach with the proximal femur in the internal rotation position might result in placement of femoral stem with a tendency to lean to the lateral cortex if the assistant does not completely raise the leg in the appropriate flexion position.

The femoral offset might lengthen in many cases, such as placement of the femoral stem in the varus position, increased femoral neck length, and use of the femoral stem with increased offset. The author found that the femoral stem in posterior approach has statistically more varus alignment implying that it might be an important cause of increased offset. Generally, the advantage of greater femoral offset is increased range of motion and reduction of active force in the joint due to increased momentum of abductor muscles; however, greater femoral offset due to varus femoral stem might induce increased stem loosening[8]. However, Ritter reported that the alignment of the femoral stem did not relate to the failure of prosthesis[14].

The limitation of comparative study is that approaches are selected based on the surgeon's specific skills rather than randomly. In other words, surgical techniques are selected depending on the orthopedic surgeon's preference. However, the author did not find a statistical difference between basic demographic data between the two studied groups. This can imply that the two studied groups have similar characteristics and that the study was designed as a retrospective analytic study without selectively assigning the surgical technique.

In conclusion, the femoral stem alignment significantly tended to be varus in the posterior approach and valgus in the lateral approach. The author hopes that the data from this work is useful for preventing prosthetic malalignment following the selected approach in total hip arthroplasty, which will result in a good survival rate of prosthesis and good functional outcome.

Acknowledgements

The author would like to thank Amornpun Sereemaspun, M.D., Ph.D., Department of Anatomy, Faculty of Medicine, Chulalongkorn University, for kindly proofreading this manuscript.

References

1. Harkess JW. Arthroplasty of the hip. In: CrenShaw AH, ed. Campbell's operative orthopaedics. 9th ed. St Louis: CV Mosby. 1998: 296-471.
2. Bozic KJ, Freiberg AA, Harris WH. The high hip center. Clin Orthop Relat Res. 2004(420): 101-5.
3. Ackland MK, Bourne WB, Uhthoff HK. Anteversion of the acetabular cup. Measurement of angle after total hip replacement. J Bone Joint Surg Br. 1986; 68(3): 409-13.
4. Yoder SA, Brand RA, Pedersen DR, O'Gorman TW. Total hip acetabular component position affects component loosening rates. Clin Orthop Relat Res. 1988 (228): 79-87.
5. D'Lima DD, Urquhart AG, Buehler KO, Walker RH, Colwell CW Jr. The effect of the orientation of the acetabular and femoral components on the range of motion of the hip at different head-neck ratios. J Bone Joint Surg Am. 2000; 82(3): 315-21.
6. Masonis JL, Bourne RB. Surgical approach, abductor function, and total hip arthroplasty dislocation. Clin Orthop Relat Res. 2002(405): 46-53.
7. Demos HA, Rorabeck CH, Bourne RB, MacDonald SJ, McCalden RW. Instability in primary total hip arthroplasty with the direct lateral approach. Clin Orthop Relat Res. 2001(393): 168-80.
8. McGrory BJ, Morrey BF, Cahalan TD, An KN, Cabanela ME. Effect of femoral offset on range of motion and abductor muscle strength after total hip arthroplasty. J Bone Joint Surg Br. 1995; 77(6): 865-9.
9. Woo RY, Morrey BF. Dislocations after total hip arthroplasty. J Bone Joint Surg Am. 1982; 64(9): 1295-306.
10. Maruyama M, Feinberg JR, Capello WN, D'Antonio JA. The Frank Stinchfield Award:

Morphologic features of the acetabulum and femur: anteversion angle and implant positioning. Clin Orthop Relat Res. 2001(393): 52-65.
11. Ritter MA, Harty LD, Keating ME, Faris PM, Meding JB. A clinical comparison of the anterolateral and posterolateral approaches to the hip. Clin Orthop Relat Res. 2001(385): 95-9.
12. Delp SL, Wixson RL, Komattu AV, Kocmond JH. How superior placement of the joint center in hip arthroplasty affects the abductor muscles. Clin Orthop Relat Res. 1996(328): 137-46.
13. Pagnano W, Hanssen AD, Lewallen DG, Shaughnessy WJ. The effect of superior placement of the acetabular component on the rate of loosening after total hip arthroplasty. J Bone Joint Surg Am. 1996; 78(7): 1004-14.
14. Ritter MA, Zhou H, Keating CM, Keating EM, Faris PM, Meding JB, et al. Radiological factors influencing femoral and acetabular failure in cemented Charnley total hip arthroplasties. J Bone Joint Surg Br. 1999; 81(6): 982-6.

การศึกษาเปรียบเทียบตำแหน่งของข้อเทียมในการทำ ผ่าตัดเปลี่ยนข้อสะโพกเทียม ระหว่างวิธี lateral และ posterior approach ในโรงพยาบาลปทุมธานี

ชัชวาลย์ แก้วคุณ, พบ.

วัตถุประสงค์: เพื่อศึกษาความแตกต่างของตำแหน่งข้อเทียมที่ได้จากการทำ total hip arthroplasty ด้วยวิธี lateral approach และ posterior approach

วัสดุและวิธีการ: เป็นการศึกษาเชิงวิเคราะห์เปรียบเทียบแบบย้อนหลังโดยรวบรวมข้อมูลจากภาพถ่ายรังสีและเวชระเบียนของผู้ป่วยที่รับการรักษาโดยการผ่าตัดเปลี่ยนข้อสะโพกเทียม ทุกรายในโรงพยาบาลปทุมธานีตั้งแต่ปี พ.ศ.2545-2553

ผลการศึกษา: จากผู้ป่วย 93 คน 107 สะโพก พบอัตราส่วนเพศชายต่อเพศหญิง อายุ และ การวินิจฉัยโรคทั้งสองกลุ่ม ไม่แตกต่างกันอย่างมีนัยสำคัญทางสถิติ ตำแหน่งของข้อเทียมที่วัดได้ ได้แก่ acetabular cup inclination, vertical height, horizontal distance และ anteversion ไม่แตกต่างกันอย่างมีนัยสำคัญทางสถิติ แต่ femoral stem ในกลุ่ม posterior approach มีแนวโน้มที่จะเป็น varus alignment ซึ่งแตกต่างกับ lateral approach ซึ่งมีแนวโน้มเป็น valgus alignment อย่างมีนัยสำคัญทางสถิติ ซึ่งส่งผลให้กลุ่ม posterior approach มี offset มากกว่ากลุ่ม lateral approach อย่างมีนัยสำคัญทางสถิติ ซึ่งเชื่อว่าเกิดจากตำแหน่งของ proximal femur ที่แตกต่างกันขณะใส่ femoral stem ประเด็น limb length discrepancy ของทั้งสองกลุ่มไม่มีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ

สรุป: femoral stem ในกลุ่ม posterior approach มีแนวโน้มที่จะเป็น varus alignment ซึ่งแตกต่างกับ lateral approach ซึ่งมีแนวโน้มเป็น valgus alignment อย่างมีนัยสำคัญทางสถิติ ข้อมูลดังกล่าวสามารถนำไปใช้เป็นแนวทางในการป้องกันการวางตำแหน่งข้อเทียมที่ผิดพลาดตาม approach ที่เลือกใช้ในการทำผ่าตัดเปลี่ยนข้อสะโพกเทียม