

# Patterns and Differences of Acetabular Dome Wear of Normal and Operated Hip Joints between the Unipolar and Bipolar Prostheses in the Femoral Neck Fracture Surgery

Surat Songviroon, MD, Manoon Leownorasate, MD

Department of Orthopaedic Surgery, Maharat Nakhonratchasima Hospital,  
Nakhon Ratchasima, Thailand

---

**Purpose:** To describe the patterns and differences of wear at acetabular dome wall of the normal and the operated hip joints between the unipolar and bipolar prostheses in the femoral neck fracture surgery.

**Patients and Methods:** The medical records and radiographic imagings of femoral neck fracture patients who were treated with the unipolar or bipolar prostheses at Maharat Nakhon Ratchasima Hospital since July 2010 to September 2015 were reviewed. The acetabular dome wall thickness (ADWT) was measured on true anteroposterior view of both sides of hip joints at the 1<sup>st</sup> day and every 6 months after surgery. The measurements were designed with various methods for minimizing the deviation and error and detail would be shown in text below. The patterns and differences of wear at acetabular dome wall between operated side and normal side were described. The patient demographic data and the wear at acetabular dome wall were compared between the unipolar and bipolar prostheses groups. A p-value of less than 0.05 was considered statistically significant.

**Results:** All 152 patients were classified into 83 with unipolar and 69 with bipolar prostheses groups. The wear pattern at acetabular dome wall on the normal side was not significantly different in both groups. After sex, ADWT on the operated side at 1 day after surgery and age groups adjusted, the wear differences between two groups were statistically significant at 6, 12, 24, and 30 months after surgery with mean differences of 0.307, 0.609, 0.825, and 2.460, respectively.

**Conclusion:** The wear patterns at acetabular dome wall in femoral neck fracture surgery were different between the unipolar and bipolar prostheses. They were statistically significant only at 6, 12, 24, 30 months after surgery.

**Keywords:** Wear at acetabular dome wall, Unipolar prosthesis, Bipolar prosthesis, Femoral neck fracture

**The Thai Journal of Orthopaedic Surgery: 42 No.1-2: 3-9**

**Full text. e journal:** <http://www.rcost.or.th>, <http://thailand.digitaljournals.org/index.php/JRCOST>

---

## Introduction

Unipolar and bipolar prostheses are instruments which have been widely used in hemiarthroplasty surgical procedure, for treating the femoral neck fractures in older patients. There are many documents demonstrating that bipolar hemiarthroplasty will reduce the forces that transmit to acetabular cartilage surface and decrease wear at acetabulum wall as compared with unipolar hemiarthroplasty<sup>(1,2)</sup>. And some researchers show that the unipolar hemiarthroplasty group has wear rate at acetabulum wall more than the bipolar hemiarthroplasty group<sup>(1-7)</sup>. But both prosthesis designs have equally hip functional outcome, so in the older patients, the unipolar hemiarthroplasty should be preferred due to its lower cost<sup>(1-6)</sup>.

Most researchers stated about acetabular erosion rate of the patients who received surgery as

well as the revision rate from protrusion of acetabulum<sup>(7,11,14,17)</sup>. Nevertheless, no study has shown the information about the pattern and differences of wear at acetabular dome between the unipolar and bipolar prostheses after the femoral neck fracture surgery in any interval of follow up and no study shows how to measure the wear of acetabular dome wall, either.

The purpose of this study is to demonstrate the patterns and differences of acetabular dome wear between the unipolar and the bipolar prostheses in the femoral neck fracture surgery, reference with the contralateral intact acetabular dome wall thickness in different times of follow up after surgery.

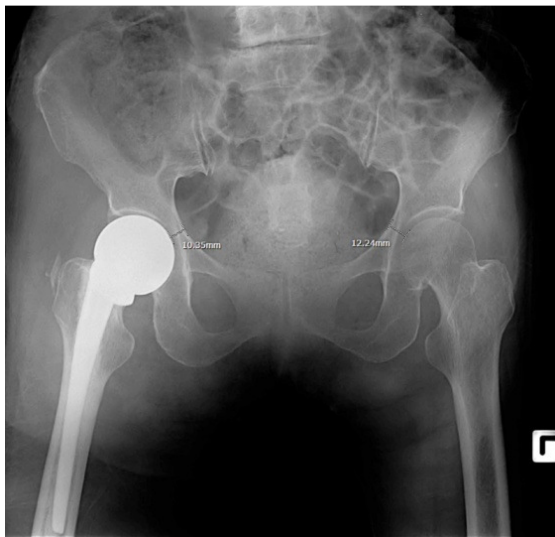
## Patients and Methods

The medical records of patients who were admitted at Maharat Nakhon Ratchasima Hospital with femoral neck fractures and surgically treated with the unipolar or the bipolar prostheses between July 2010 and September 2015 were collected from the hospital's database. The radiographic imagings of both hips in anteroposterior view (AP) were

---

Correspondence to: Songviroon S, Department of Orthopaedic Surgery, Maharat Nakhonratchasima Hospital, Nakhonratchasima, Thailand  
E-mail: [surathortho@yahoo.com](mailto:surathortho@yahoo.com)

concurrently reviewed. The radiographic images which were not clearly sharp, blurred, not in true AP view of which coccyges were not in the mid to pubic symphysis or lacked of follow up images at 6 months after surgery were excluded. The measurements were done preoperatively on both sides of hip joints. Postoperative measurements were done on day 1 and every 6 months after surgery on both normal and operated sides. All images were magnified at full screen before measurement to decrease the errors. Acetabular dome wall thickness was measured from tip of femoral head prosthesis directly to the center of the acetabular dome in millimeters with two decimal points (Figure 1). The films were measured in the first round and left for 1 week before starting to measure them again in the second round with blindness in results of the first round and were done in the same manner in the third round with blindness in results of the first and second rounds also. All patients' profile and measurement data were collected for statistical analysis.



**Fig.1** Acetabular dome wall thickness measurement on radiography

## Results

One hundred and fifty-two patients were included, 83 were allocated into the unipolar prosthesis group and the rest (69) were in the bipolar group. The mean age was 82.35 years in the unipolar group which was higher than 73.14 years of the bipolar group with statistical significance ( $P < 0.001$ ). But when they were grouped according to age group: less than 75, 75-84 and  $\geq 85$  years, there were no differences between two groups. All measurements were performed by the first author only for the avoidance of the inter-observer variation of the measurement. The follow up periods were 6 and 36 months after surgery in both groups.

Table 1 showed demographic data that the unipolar and bipolar groups had no statistically significant differences in sex, underlying diseases: hypertension, diabetes mellitus, chronic kidney disease, ASA Classification and radiographic imaging for acetabular dome wall thickness at the normal and operated sides at 1 day after surgery.

## Data analysis

The frequency distributions of demographic characteristics and medical histories of the unipolar and bipolar prostheses groups were expressed as means and standard deviation for continuous variables and counts and percentages for categorical variables. The Fisher's exact test and Student T test were used to analyze the bivariate differences for categorical and continuous variables, respectively. To estimate differences of acetabular dome wear between the unipolar and bipolar prostheses in femoral neck fracture surgery, linear regression procedures were performed to estimate the mean differences and confidence intervals (95 % CI) after adjusted for potential confounding factors. All reported p-values were two tailed, and confidence intervals were calculated at the 95 % level.

On the normal side of the unipolar group, there was loss of acetabular dome wall thickness firstly at 24 months after surgery with little wear at 30 months. At 36 months after surgery, the pattern showed that they looked like no further wear but some data were lost during follow up. This may disturb the conclusion of the direction of wear at acetabular dome wall. For the bipolar group, the pattern of wear at acetabular dome wall appeared in every follow-up until 36 months after surgery with a slower rate compared with the unipolar group.

On the operated side, patterns of wear at acetabular dome wall both in the unipolar and bipolar groups looked similar. The loss firstly started at the 30 months after surgery with a slightly slower rate of loss at 18 months. The pattern at 36 months showed that they looked like no further loss but the amount of data were less than those in the earlier follow-up which might disturb the results for concluding the direction of wear at acetabular dome wall. The severity of wear in the bipolar group was less than in the unipolar group.

After sex, ADWT on the operated side at 1 day after surgery and age groups were adjusted, comparison between the unipolar and bipolar groups as described in table 2, there were statistically significant differences at 6, 12, 24, 30 months after surgery with 95 % CI but no statistically significant differences at 18 and 36 months.

**Table 1** Demographic data

Factors	Unipolar Prosthesis (n=83)		Bipolar Prosthesis (n=69)		P-value
	Mean (SD)	No (%)	Mean (SD)	No (%)	
Female		69 (83.13)		58 (84.06)	1.000
Age, year					< 0.001
< 75		6 (7.2)		31 (44.9)	
75-84		45 (54.2)		32 (46.4)	
≥85		32 (38.6)		6 (8.7)	
Hypertension		33 (39.8)		30 (43.5)	0.74
Diabetes mellitus		10 (12.0)		14 (20.3)	0.19
Chronic kidney disease		5 (6.0)		4 (5.8)	1.000
ASA Classification					0.08
Class 1		5 (6.0)		8 (11.6)	
Class 2		32 (38.6)		35 (50.7)	
Class 3		43 (51.8)		26 (37.7)	
Class 4		3 (3.6)		0 (0.0)	
ADWT on normal side*	12.76 (2.55)		12.71 (1.75)		0.90
ADWT on operated side *	10.57 (2.54)		10.40 (2.14)		0.67

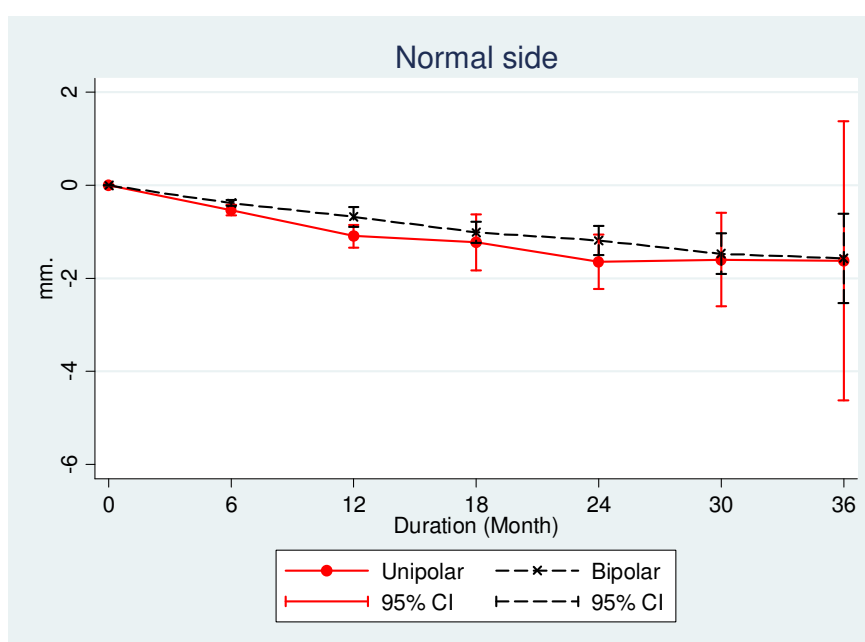
ADWT = acetabular dome wall thickness

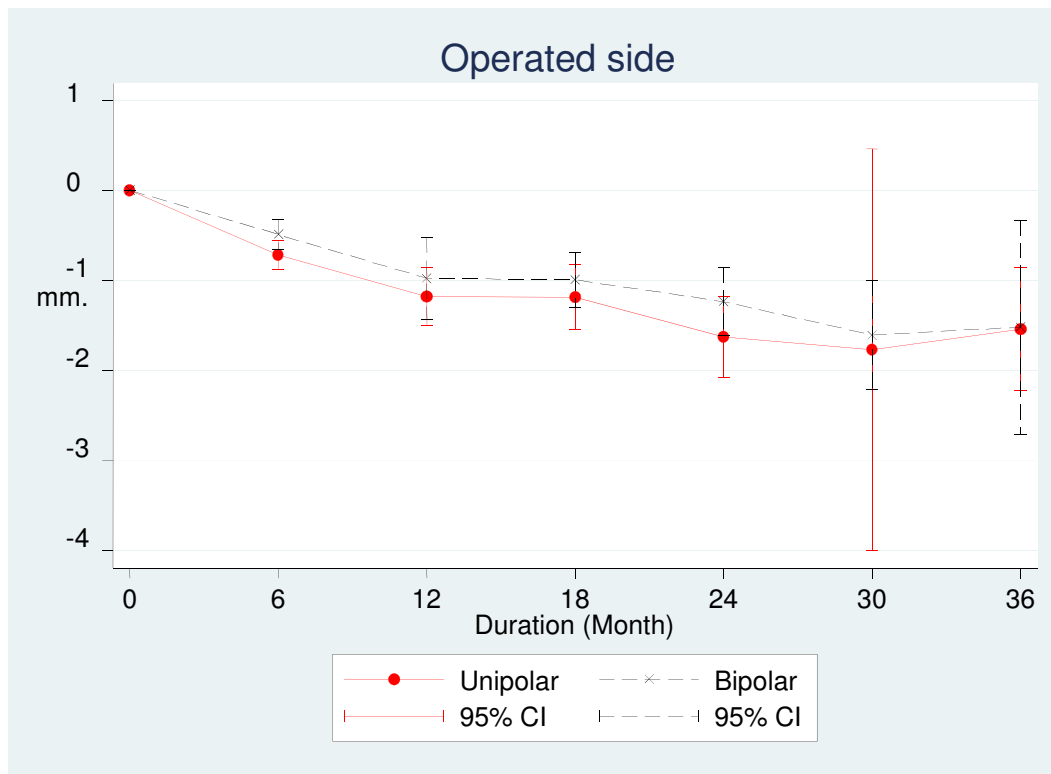
\*on day 1 after surgery

**Table 2** Wear differences between the unipolar and the bipolar groups at acetabular dome wall in each follow up time after surgery

Duration after surgery (Months)	Mean wear difference* (mm.)	95% CI
6	0.307	0.043, 0.570
12	0.609	0.308, 1.187
18	0.542	- 0.110, 1.194
24	0.825	0.091, 1.558
30	2.460	0.420, 4.505
36	0.219	-1.519, 2.010

Note:\* – adjust for sex, ADWT on operated side at 1 day after surgery and age groups

**Fig.2** Patterns of wear at acetabular dome wall on normal side



**Fig.3** Pattern of wear at acetabular dome wall on the operated side

## Discussion

The mean age in the unipolar group was higher than that in the bipolar group with statistical significance ( $P$ -value $<0.001$ ) but when the patients were classified into subgroups for age:  $<75$ ,  $75$ - $84$  and  $\geq 85$  years, there were no statistically significant differences between the unipolar and bipolar groups. This may explain why many researchers show good or better results in the patients who undergo the surgery using the bipolar prosthesis compared with the unipolar groups especially in the aspect of the acetabular erosion rate and the revision rate which are higher in the latter group<sup>(1-7)</sup>. Most of orthopedic surgeons prefer using the bipolar prosthesis in the younger patients who may live longer with no complications while the unipolar prosthesis that has lower cost is preferably chosen for the older patients who may not live longer.

Dalldorf et al<sup>(8)</sup> showed no statistically significant difference in the cartilage wear between the unipolar and the bipolar components. According to them, the severity of the degeneration correlated directly with the duration of articulation of the implant with the acetabulum and the loss of radiographic joint space closely correlated with the deterioration of the histological grade of the acetabular cartilage.

Kanto<sup>(9)</sup> analyzed radiographs in 147 patients; 72 in the bipolar and 75 in the unipolar

groups, at the initial post-operation and one year after operation. The rate of acetabular erosion was measured and found that early protrusion was equal in both groups. Khan et al<sup>(10)</sup> found two patients who were symptomatic with acetabular protrusion occurring at a mean of 5.6 years after the procedure.

In the unipolar group, the wear pattern at acetabular dome wall on normal side was firstly recognized at 24 months after surgery but less wear at 30 months. Comparing with the bipolar group, there were no statistically significant differences at any follow up duration after surgery. These results showed that no statistical significant differences in the patterns and the severity of the wear at acetabular dome wall on normal sides after surgery at least about 30 months. Data after 30 months should be further collected to evaluate the pattern and the severity of the wear at acetabular dome wall in the long run.

On the operated side, the wear pattern at acetabular dome wall both in the unipolar and bipolar groups looked similar, viz., the loss firstly started at the 30 months after surgery with a slightly slower rate of loss at 18 months. The wear pattern at 36 months showed that they looked like no further loss. However because of the inadequate amount of data in longer follow up period, it might disturb the conclusion of the direction of the wear at acetabular dome wall. In the bipolar group, the

pattern of wear looked nearly similar to those of the unipolar group but had less degree of the wear.

It was found that the longer time after the operation, the wear at the acetabular dome wall was more severe. However the mean differences of the wear had slightly slower rate at 18 and 36 months without statistical significance. At 30 months after surgery, mean difference of the wear was 2.46 millimeters which was very striking. If the data after 30 months could be collected with adequate amount, there would be more information to be analyzed and the trend of the wear's pattern and mean differences of the wear could be summarized.

When our data were interpreted, there were several points being considered. First, there were some patients who lost to follow up due to many reasons such as the unaffordable fee for transportation to the hospital, the difficulty in travel from remote rural area to the hospital, the unavailable time of care givers to transfer the patients on the follow up day, etc. The tracking data at each visit of follow- up, 6-36 months in the unipolar prosthesis group were 64, 27, 20, 16, 10 and 5 whereas in the bipolar prosthesis group were 61, 39, 13, 12, 4 and 4.

All patients who received surgery should avoid the weight bearing on ambulation after surgery for some time interval, depending on the situation of the patients and the opinion of the surgeons. If the duration of time for avoidance of the weight bearing of the patients can be extended to at least 6-12 months after surgery, there may be some benefit to lessen the severity of the wear in acetabular dome wall on the operated side. This should be verified in the further study. And it is true, it will be helpful to change the clinical practice in the future.

So far there has never been study showing the information about the patterns and differences of the wear at acetabular dome wall thickness comparing between the unipolar and bipolar prostheses after the femoral neck fracture surgery in each period of time like this study before. The more proper design to allocate patients, the longer time of follow up, a large number of radiographic imagings from the patients may be helpful to clarify this topic.

## Conclusion

The wear pattern at acetabular dome wall in the femoral neck fracture after surgery was different between the unipolar and the bipolar prostheses. The wear differences were statistically significant only at 6, 12, 24, 30 months after surgery.

## Acknowledgements

The authors greatly appreciate Mrs. Kanyalak Na Rangsi for her statistical analysis of the data.

## Potential conflicts of interest

None.

## References

1. Yang B, Lin X, Yin XM, Wen XZ. Bipolar versus unipolar hemiarthroplasty for displaced femoral neck fractures in the elder patient: a systematic review and meta-analysis of randomized trials. *Eur J Orthop Surg Traumatol* 2015; 25: 425-33.
2. Liu Y, Tao X, Wang P, Zhang Z, Zhang W, Qi Q. Meta-analysis of randomized controlled trials comparing unipolar with bipolar hemiarthroplasty for femoral-neck fractures. *International Orthopaedics* 2014; 38: 1691-6.
3. Frihagen F, Nordsletten L, Madsen JE. Hemiarthroplasty or internal fixation for intracapsular displaced femoral neck fractures: randomized controlled trial. *BMJ* 2007; 335: 1251-4.
4. Gjertsen JE, Vinje T, Engesaeter LB, Lie SA, Havelin LI, Furnes O, et al. Internal screw fixation compared with bipolar hemiarthroplasty for treatment of displaced femoral neck fracture in elderly patients. *J Bone Joint Surg Am* 2010; 92: 619-28.
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: 1124-33.
6. Keating JF, Grant A, Masson M, Scott NW, Forbes JF. Randomized comparison of reduction and fixation, bipolar hemiarthroplasty and total hip arthroplasty. Treatment of displaced intracapsular hip fractures in healthy older patients. *J Bone Joint Surg Am* 2006; 88: 249-60.
7. Hedbeck CJ, Blomfeldt R, Lapidus G, Törnkvist H, Ponzer S, Tidermark J. Unipolar hemiarthroplasty versus bipolar hemiarthroplasty in the most elderly patients with displaced femoral neck fractures: a randomized, controlled trial. *Int Orthop* 2011; 35: 1703-11.
8. Dalldorf PG, BanasMp, Hicks DG, Pellegrini VD Jr. Rate of degeneration of human acetabular cartilage after hemiarthroplasty. *J Bone Joint Surg Am* 1995; 77: 877-82.
9. Kento K, Sihvonen R, Eskelinen A, Laitinen MK. Uni- and bipolar hemiarthroplasty with a modern cemented femoral component provides elderly patients with displaced femoral neck fractures with equal functional outcome and survivorship at medium-term follow-up. *Arch Orthop Trauma Surg* 2014; 134: 1251-9.
10. Khan SK, Jameson SS, Sims A, A'Court J, Reed MR, Rangan A, et al. Cemented Thompson's hemiarthroplasty in patients with

- intracapsular neck of femur fractures: survival analysis of 1,670 procedures. *Eur J Orthop Surg Traumatol* 2015; 25: 655-60.
11. Davison JN, Calder SJ, Anderson GH, Ward G, Jagger C, Harper WM, et al. Treatment for displaced intracapsular fracture of the proximal femur. A prospective, randomized trial in patients aged 65 to 79 years. *J Bone Joint Surg Br* 2011; 83: 206-12.
  12. Inngul C, Hedbeck C-J, Blomfeldt R, Lapidus G, Ponzer S, Enocson A. Unipolar hemiarthroplasty versus bipolar hemiarthroplasty in patients with displaced femoral-neck fractures. A four-year follow-up of a randomized controlled trial. *Int Orthop* 2013; 37: 2457-64.
  13. Kannan A, Kancherla R, McMahon S, Hawdon G, Soral A, Malhotra R. Arthroplasty options in femoral-neck fracture: answers from the national registries. *Int Orthop* 2012; 36: 1-8.
  14. Diwanji SR, Kim SK, Seon JK, Park SJ, Yoon TR. Clinical results of conversion total hip arthroplasty after failed bipolar hemiarthroplasty. *J Arthroplasty* 2008; 23: 1009-15.
  15. Dudani B, Shyam AK, Arora P, Arjun Veigus A. Bipolar hip arthroplasty for avascular necrosis of femoral head in young adults. *Indian J Orthop* 2015; 49: 329-35.
  16. Jia Z, Ding F, Wu Y, Li W, Li H, Wang D, et al. Unipolar versus bipolar hemiarthroplasty for displaced femoral neck fractures: a systematic review and meta-analysis of randomized controlled trials. *J Orthop Surg Res* 2015; 10: 8. doi: 10.1186/s13018-015-0165-0.
  17. Somashekar, Krishna SV, Sridhara Murthy J. Treatment of femoral neck fractures: unipolar versus bipolar hemiarthroplasty. *Malays Orthop J* 2013; 7: 6-11.

---

**รูปแบบและความแตกต่างของการสีกที่ผนังส่วนบนสุดของ *Acetabulum* ข้างปกติและข้างผ่าตัดเปรียบเทียบระหว่างการผ่าตัดด้วยการใส่ข้อสะโพกเทียมแบบเบ้าหนึ่งชั้นและสองชั้นในผู้ป่วยที่กระดูกแตกหักบริเวณสะโพก**

**สุรัตน์ ส่งวิรุพท์, พบ, มนูญ เลียวนรเศรษฐ์, พบ**

**วัตถุประสงค์:** ศึกษารูปแบบและความแตกต่างของการสีกที่ผนังส่วนบนสุดของ *Acetabulum* ข้างปกติและข้างผ่าตัดเปรียบเทียบระหว่างการผ่าตัดด้วยการใส่ข้อสะโพกเทียมแบบเบ้าหนึ่งชั้นและสองชั้น ในผู้ป่วยที่กระดูกแตกหักบริเวณสะโพก

**ผู้ป่วยและวิธีการ:** เวชระเบียนของผู้ป่วยที่มีการแตกหักบริเวณคอกระดูกต้นขา ซึ่งได้รับการผ่าตัดด้วยการใส่ข้อสะโพกเทียมแบบเบ้าหนึ่งชั้นและสองชั้น และฐานข้อมูลภาพเอกซเรย์ที่โรงพยาบาลมหาสารคามระหว่างเดือนกรกฎาคม ค.ศ. 2010 ถึง เดือนกันยายน ค.ศ. 2015 จำนวน 152 ราย ได้รับการทบทวน การวัดความหนาที่ส่วนบนสุดของ *Acetabulum* ถูกออกแบบด้วยวิธีการหลายอย่างในการควบคุมความเบี่ยงเบนและความผิดพลาดซึ่งแสดงรายละเอียดไว้ในรายงานการศึกษา โดยวัดทั้งข้างปกติและข้างผ่าตัดที่ 1 วันหลังผ่าตัดและทุกๆ ช่วง 6 เดือนหลังผ่าตัด

**ผลการศึกษา:** มีผู้ที่ผ่าตัดใส่ข้อสะโพกเทียมแบบเบ้าหนึ่งชั้น 83 ราย และแบบสองชั้น 69 ราย รูปแบบการสีกของผนังส่วนบนสุดของ *Acetabulum* ข้างปกติ ไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติทั้งกลุ่มที่ผ่าตัดด้วยข้อสะโพกเทียมแบบเบ้าหนึ่งชั้นและสองชั้น เมื่อทำการปรับด้วยเพศ, ข้างผ่าตัด 1 วันหลังผ่าตัด และอายุ พบว่ามีความแตกต่างอย่างมีนัยสำคัญทางสถิติที่ 6, 12, 24, 30 เดือนหลังผ่าตัดที่ 0.307, 0.609, 0.825 และ 2.460 ตามลำดับ ในขณะที่ไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติที่ 18 และ 36 เดือนหลังผ่าตัดที่ 0.542 และ 0.219 ตามลำดับ

**สรุป:** รูปแบบของการสีกที่ผนังส่วนบนสุดของ *Acetabulum* เปรียบเทียบระหว่างการผ่าตัดด้วยการใส่ข้อสะโพกเทียมแบบเบ้าหนึ่งชั้นและสองชั้น ในผู้ป่วยที่มีกระดูกแตกหักบริเวณสะโพกมีความแตกต่างอย่างมีนัยสำคัญทางสถิติในข้างที่ผ่าตัด ค่าเฉลี่ยความแตกต่างของการสีกมีความแตกต่างอย่างมีนัยสำคัญทางสถิติที่ระยะเวลา 6, 12, 24, 30 เดือนภายหลังการผ่าตัด

---