Initial Clinical and Radiographic Results with the Short Stem THA

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Background: *The patient who suitable for short stem THA must has good neck quality for initial stable fixation. In Thailand, the majority of patients are end stage osteonecrosis and have relatively narrow neck diameter so it's may be increased risk of intraoperative femoral fractures and leading to stem failure.*
Objective: *Evaluate the initial clinical and radiographic results of short stem THA over a maximum follow-up period of about 24 months, paying special attention to early problem.*
Material and Method: *The case series of 50 patients receiving short stem THA during March 2010 to September 2011. There were 15 cases of Mayo stem and 35 cases of Metha stem. The appearance of bone trabeculae development and radiolucent line at 1 year postoperative was reviewed using Gruen's classification. The Harris hip score was recorded at 6 months, 12 months and 24 months postoperative for evaluated the clinical results.*
Results: *In Mayo stem group, the mean age of patient was 44.2 years (range, 19-58) with the mean BMI of 20.9 (range, 16.9-28.1). There were 2 cases of intraoperative fractures and were treated with cerclage wires, 1 case had 3 mm subsidence with radiolucent line in zone 1, 2. Bone trabeculae was developed at zone 2 (60%), 6 (86.7%), 7 (53.3%) and radiolucent line was observed at zone 1 (6.7%) and zone 2 (6.7%). In Metha stem group, the mean age of patient was 43.9 years (range, 24-59) with the mean BMI of 22.2 (range, 16.5-32.3). There was 1 case of intraoperative fracture and was treated with cerclage wire, no further subsidence was observed. Bone trabeculae was developed at zone 1 (15.4%), 3 (79.9%), 6 (100%), 7 (92.3%) and no radiolucent line was observed. The mean Harris hip score was significantly improved from 44.9 (range, 22.7-59.7) preoperatively to 95.9 (range, 87-100) at 6 months ($p < 0.01$) in both stem design.*
Conclusion: *The clinical results of short stem THA are generally satisfactory. The short term results are promising and the learning curve acceptable. Its design enable preservation of the bone stock and the bone trabeculae appears to confirm the assumption of proximal force transmission. It is a promising option for young and active patients.*

Keywords: *Arthroplasty, Hip, Short stem*

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The short stem THA is gaining in importance, reflect by an increasing number of surgical procedures as well as an increasing number of implant models available on the market. The short stem THA seems to have major advantages over conventional THA, including the absent of significant postoperative thigh pain and ease of conversion to revision THA owning to the minimal bone resection during the primary operation[1,2]. The other advantage of the smaller sized implant is also well suited for less invasive procedure.

There are some drawbacks in this implants due to little data is available on early risks and complications during learning curve. Long-term results are lacking therefore. The patient who suitable for this implant must has good neck quality for initial stable fixation. In Thailand, the majority of patients are end stage osteonecrosis and have relatively narrow neck diameter so it's may be increased risk of intraoperative femoral fractures and leading to stem failure.

The propose of the present study was to evaluate the initial clinical and radiographic results of short stem THA over a maximum follow-up period of about 24 months, paying special attention to early problem. The authors hypothesized that the short stem THA is suitable for Thai patients with relatively narrow neck diameter.

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Material and Method

The present study was approved by the ethic committee of Maharat Nakhon Ratchasima Hospital.

This study included all patients receiving Mayo stem (Zimmer international, Warsaw, IN) (Fig. 1) and Metha stem (BBraun, Aesculap, Tuttlingen, Germany) (Fig. 2) in the present department between March 2010 to September 2011. The inclusion criterias were patients age between 15 and 60 with severe hip destruction and good bone quality. The exclusion criterias were patients age over 60 and below 15, poor bone quality or anatomical variants which complicate implantation of a short stem (severe coxa vara or valga, severe antetorsion), post infection and post tumor.

All of the patients in this study were performed short stem THA by two of our authors (YS, RN). The authors used modified Hardinge approach in lateral decubitus position. The rasps were inserted under an image intensifier in the first 9 hips in each stem design. A cementless acetabular cup was used in all hips. Any intraoperative femoral fractures were treated with cerclage wires.

Patients without intraoperative fractures were allowed to walk using crutches full weight-bearing on the third postoperative day. Patients with intraoperative fractures were allowed to walk under partial weight-bearing using crutches within 6 weeks then full weight-bearing.

Patients were routinely contacted every 3 months in the first postoperative year and then every year, an anteroposterior of both hips with the affected leg in 20° internal rotation and lateral radiographs were taken. The appearance of bone trabeculae development and radiolucent line at 1 year postoperative was reviewed in all hips using Gruen's classification[3] by JS who was not involved with the surgery or the patient care. Stem subsidence more than 2 mms was defined as positive subsidence by comparison with the radiographs taken after surgery. The Harris hip score was recorded at 6 months, 12 months and 24 months postoperative for evaluated the clinical results.

Statistic analysis

Wilcoxon's signed-rank test was used to compare the preoperative and postoperative Harris hip scores.

Results

Fifty-five cases of short stem THA were performed in our department in this period. Five cases with inadequate data and loss to follow-up were excluded. After these exclusions, 50 cases of short stem THA were included in the present study. The authors used the Mayo stem in the first 15 cases and used the Metha stem in the following 35 cases. The average follow-up period was 14.6 months (range, 6-24).

In Mayo stem group, the mean age of patient was 44.2 years (range, 19-58). There were 4 women and 11 men, with the mean BMI of 20.9 (range, 16.9-28.1). The surgical indication was osteonecrosis in 86.7% and posttraumatic OA in 13.3%. Post-operatively, full follow-up data were available for 15 patients at 6 months, 15 patients at 12 months and 3 patients at 24 months. The mean Harris hip score were significantly improved from 43.6 (range, 28-51) preoperatively to 94.5 (range, 87.8-99.8) at 6 months ($p < 0.01$), 95.4 (range, 87.8-99.8) at 12 months ($p < 0.01$) and 97.9 (range, 94-99.8) at 24 months post-operatively ($p < 0.01$). There were 2 cases of intraoperative fractures and were treated with cerclage wires, 1 case had 3 mm subsidence with radiolucent line in zone 1, 2 (Fig. 2) (Table 1).

In Metha stem group, the mean age of patient was 43.9 years (range, 24-59). There were 7 women and 28 men, with the mean BMI of 22.2 (range, 16.5-32.3). The surgical indication was osteonecrosis in 85.7%, DDH in 5.75%, primary OA in 2.8%, posttraumatic OA in 2.8% and SLE in 2.8%). Post-operatively, full follow-up data were available for 35 patients at 6 months and 13 patients at 12 months. The mean Harris hip score were significantly improved from 45.4 (range, 22.7-59.7) preoperatively to 96.5 (range, 87-100) at 6 months ($p < 0.01$) and 98.5 (range, 90-100) at 12 months post-operatively ($p < 0.01$). The mean Harris hip score significantly improved from 45.4 (range, 22.7-59.7) preoperatively to 96.5 (range, 87-100) 6 months post-operatively ($p < 0.01$). There was 1 case of intra-operative fracture and was treated with cerclage wire, no further subsidence was observed (Table 2).

The radiographic change around the stems

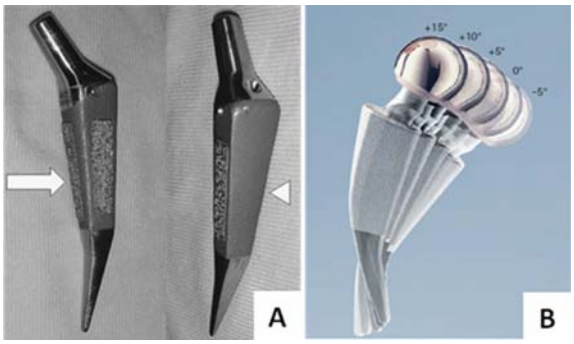

Fig. 1 Photographs of short stem designs A. Mayo stem (Zimmer international, Warsaw, IN) B. Metha stem (BBraun, Aesculap, Tuttlingen, Germany)

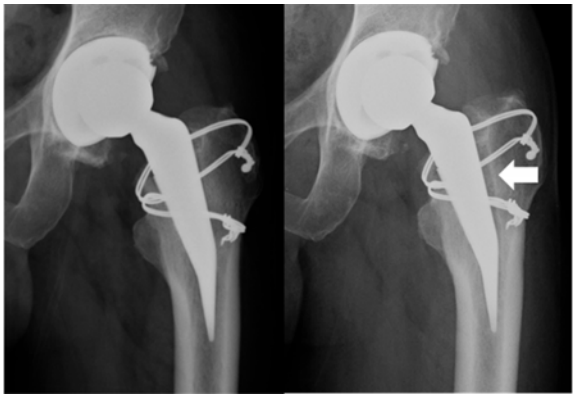

Fig. 2 Anteroposterior radiographs of subsiding and varus malposition of Mayo stem at 12 months postoperatively with radiolucent line at zone 1, 2 compare to initial postoperative

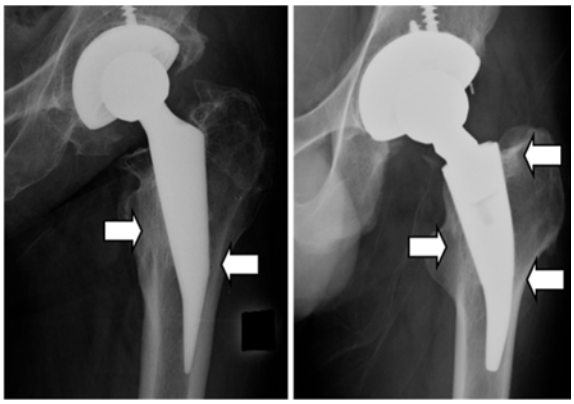

Fig. 3 Anteroposterior radiographs of Mayo stem and Metha stem show bone trabeculae development at 1 year postoperatively

Table 1. Details of patients with Mayo stem

Parameters	Values
No. of hips	15
Sex (M/F)	11/4
Mean age (years) (range, SD)	44.2 (19-58, 10.1)
Mean BMI (range, SD)	20.9(16.9-28.1, 3.2)
Diagnosis	
Osteonecrosis	13(86.7%)
Posttraumatic OA	2(13.3%)
Stem size(cases)	
Extra small	10
Small	5
Mean Harris Hip Score (points) (range, SD)	
Preoperative	43.6(28-51, 6.9)
Postoperative 6 months	94.5(87.8-99.8, 4.3)
Postoperative 12 months	95.4(87.8-99.8, 4.1)
Postoperative 24 months	97.9(94-99.8, 3.4)
Complications	
Intraoperative femoral fracture(cases)	2
Subsidence(cases)(mm)	1(3mm)

based on Gruen's classification at 1 year postoperative were available for all 15 cases of Mayo stem and 13 cases of Metha stem and were summarized in Table 3 (Fig. 3).

Discussion

Our initial results with Mayo and Metha short stem prosthesis were satisfactory and were comparable with other previous studies[4,5], with low complication rate and the learning curve is acceptable. The mean Harris hip score significantly improved at 6 months postoperative ($p < 0.01$). Of the first 50 implantations, there were 3 cases (6%) (2 Mayo, 1 Metha) with intraoperative femoral fractures and 2 cases could be safety treated by cerclage and remained stable without the need for further intervention. One case of Mayo stem (2%) was subsidence 3 mm with radiolucent line at zone 1, 2 but patient refused to reoperation with conventional stem. Morrey et al[1] reported that subsidence of the short stems exceeding 2 mm occurred in 7% of hips while intraoperative femoral fractures occurred in 6.2% of hips. They also described that stem subsidence did not occur in hips with intraoperative femoral fractures treated by cerclage wires. The lower

Table 2. Details of patients with Metha stem

Parameters	Values
No. of hips	35
Sex(M/F)	28/7
Mean age (years) (range, SD)	43.9(24-59, 9.6)
Mean BMI (range, SD)	22.2(16.5-32.3, 3.9)
Diagnosis	
Osteonecrosis	30(85.7%)
DDH	2(5.7%)
Primary OA	1(2.8%)
Posttraumatic OA	1(2.8%)
SLE	1(2.8%)
Stem size(cases)	
0	20
1	11
2	4
Mean Harris Hip Score (points) (range, SD)	
Preoperative	45.4(22.7-59.7, 10.7)
Postoperative 6 months	96.5(87-100, 2.7)
Postoperative 12 months	98.5(90-100, 2.9)
Complications	
Intraoperative femoral fracture(case)	1
Subsidence	-

Table 3. Radiographic changes around the stems

Zone(Gruen)	Development of bone trabeculae		Radiolucent lines	
	Mayo stem (15)	Metha stem (13)	Mayo stem (15)	Metha stem (13)
	n(%)	n(%)	n(%)	n(%)
1	-	2(15.4%)	1(6.7%)	-
2	-	-	1(6.7%)	-
3	9(60%)	10(76.9%)	-	-
4	-	-	-	-
5	-	-	-	-
6	13(86.7%)	13(100%)	-	-
7	8(53.3%)	12(92.3%)	-	-

rate of stem subsidence in our study may be related to the lower weight and BMI of Thai patients. There were 3 cases of fractures and one case of subsidence, the authors believe that intraoperative femoral fractures were more common than subsidence in the present study because of the relatively narrow diameter of femoral neck, reflected by the most common sized of stems were the smallest sizes in both stem design.

Kamada et al[6] reported the radiographic change around the Mayo stems, bone trabeculae was developed at zone 3 (69.8%), 5 (82.1%), 6 (11.3%) and radiolucent line was observed at zone 1 (23.6%) and 2 (11.3%). In our study, the results were similar to Kamada et al[6] but bone trabeculae was not observed at zone 5. In Mayo stems, bone trabeculae was developed at zone 3 (60%), 6 (86.7%), 7 (53.3%) and radiolucent line was observed at zone 1 (6.7%) and zone 2 (6.7%). The authors believed that radiolucent line mainly appeared at the proximal-lateral side of Mayo stems because of it does not have a fiber metal pad at this portion. In Metha stems, bone trabeculae was developed at zone 1 (15.4%), 3 (79.9%), 6 (100%), 7 (92.3%) and no radiolucent line was observed. The bone trabeculae was developed mainly at medial portion in both stem

designs revealed a concentrated load distribution on the medial of the femur, which is an important region to guarantee long-term implant survival.

Chen et al[7] studied bone remodeling of femur after THA with Mayo stem and reported that increase of BMD was shown in zone 2 and 3, both of which were on the lateral side. In the present study, the authors could observe bone trabeculae on lateral side of Mayo stem only in zone 3, this mean distal stress transfer to the lateral femoral cortex.

Lerch M et al[8] studied bone remodeling around the Metha stem and reported that increase of BMD was shown in zone 6 and 7, both of which on the medial side. In the present study, the authors could observe bone trabeculae on medial side of Metha stem in both zone 6 and 7 which revealed a concentrated load distribution on the calcar area.

In the present study, Mayo and Metha stems seem to offer the same good results, but Metha stem could offer some advantage of neck modularity. This option may extent the indication to mild proximal femoral changes and could adjust for the good off-set. Metha stem presents an overall reduction in dimensions (length, cross-section area) compared to Mayo stem, it may be easier to implant in patients with narrow neck diameter than Mayo stem.

There are several limitations of the present study. (1) There are limit number of patients. (2) The present study was not based on dual-energy radiograph absorptiometry so the authors were unable to objectively evaluate the changes in bone density and (3) the present study is only short term results, paying special attention to early problem. However, the authors await the results of longer-term follow-up.

Conclusion

The clinical results of short stem THA are generally satisfactory. The short term results are promising and the learning curve acceptable. Its design enable preservation of the bone stock and the bone trabeculae appears to confirm the assumption of proximal force transmission. It is a promising option for young and active patients.

Potential conflicts of interest

None.

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การศึกษาผลทางคลินิกของการผ่าตัดเปลี่ยนข้อสะโพกเทียมชนิดก้านสั้น

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***ภูมิหลัง**: ผู้ป่วยไทยส่วนใหญ่มีขนาดคอสะโพกแคบ อาจจะเกิดกระดูกแตกขณะผ่าตัดเปลี่ยนข้อสะโพกเทียมชนิดก้านสั้น*

***วัตถุประสงค์**: ศึกษาผลทางคลินิกของการผ่าตัดเปลี่ยนข้อสะโพกเทียมชนิดก้านสั้น*

***วัสดุและวิธีการ**: ศึกษาในผู้ป่วยผ่าตัดเปลี่ยนข้อสะโพกเทียมชนิดก้านสั้น 50 ราย แบ่งเป็นแบบ Mayo 15 ราย และแบบ Metha 35 ราย ประเมินภาพถ่ายรังสีหลังผ่าตัด 1 ปี เก็บข้อมูล Harris hip score ที่ 6, 12 และ 24 เดือน*

***ผลการศึกษา**: ข้อเทียมชนิดก้านสั้นแบบ Mayo ผู้ป่วยมีอายุเฉลี่ย 44.2 ปี (19-58 ปี) ค่าเฉลี่ย BMI 20.9 (16.9-28.1) พบกระดูกแตกระหว่างผ่าตัด 2 ราย มี 1 รายที่ข้อเทียมจมลง 3 ม.ม. พบ bone trabeculae เกิดที่โซน 3 (60%) โซน 6 (86.7%) และโซน 7 (53.3%) และพบ radiolucent line ที่โซน 1 (6.7%) และ 2 (6.7%) ในแบบ Metha อายุเฉลี่ย 43.9 ปี (24-59 ปี) ค่าเฉลี่ย BMI 22.2 (16.5-32.3) พบกระดูกแตกระหว่างผ่าตัด 1 ราย พบ bone trabeculae เกิดที่โซน 2 (15.4%) โซน 3 (79.9%) โซน 6 (100%) และโซน 7 (92.3%) ไม่พบ radiolucent line ค่าเฉลี่ย Harris hip score ที่ 6 เดือนเพิ่มขึ้นอย่างมีนัยสำคัญทั้งแบบ Mayo และ Metha*

***สรุป**: ผลการผ่าตัดเปลี่ยนข้อสะโพกเทียมชนิดก้านสั้นได้ผลดี พบภาวะแทรกซ้อนน้อย เหมาะสมสำหรับผู้ป่วยอายุน้อย*