Invention Technique and Clinical Results of Lampang Cement Injection Gun Used in Hip Hemiarthroplasty

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Background: *Cemented hemiarthroplasty is the common treatment of femoral neck fracture in elderly patients. The authors had invented Lampang cement gun (LCG) from a caulking gun to improve cementing technique. There was no previous study about LCG in clinical use.*
Objective: *To describe invention technique and evaluate clinical result of using LCG for cemented hemiarthroplasty in elderly patients with femoral neck fracture.*
Material and Method: *A retrospective study was conducted on 96 elderly patients who underwent cemented hemiarthroplasty (58 Austin Moore, 14 Thompson, 24 bipolar) in Lampang Hospital between October 2003 and April 2008. The femoral canal was filled with cement by using LCG. Clinical outcome was assessed by Harris hip score (HHS). Radiographic quality of cementing technique was evaluated by Barrack's grading system.*
Results: *The mean age of the patients was 76 years (range, 62-96) and follow-up period was 39 months (range, 12-66). Twenty-four patients died and five were lost to follow-up. The mean HHS in bipolar group was higher than Thompson and Austin Moore groups (83.2, 78.3 and 76.9 respectively). Excellent and good scores were found in 90.9% of bipolar hips compared with 46.7% in unipolar hips. Less than 10% of the patients had poor clinical result. Cement mantles was grade A 37.3%, B 32.8%, C 20.9% and D 9%. Probably loose was found in one grade-D hip. Two grade-D hips were removed due to infection and dislocation. One grade-C hip was revised due to periprosthetic fracture. The mortality rate at 36 months was 20.8% in unipolar and 8.3% in bipolar group.*
Conclusion: *The use of LCG for cemented hemiarthroplasties in elderly patients with femoral neck fracture provided satisfactory clinical outcome. LCG could be used to improve cementing technique and save the operative cost.*

Keywords: *Hemiarthroplasty, Austin Moore, Thompson, Bipolar, Caulking gun, Cement gun, Invented, Femoral neck fracture*

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Cemented hip hemiarthroplasty (HMA) is an important treatment for femoral neck fracture in elderly patients. The standard cementing technique requires an injection gun to deliver bone cement into the femoral canal[1]. Commercialized cement gun is expensive (2,000 Baht) for routine use in Thailand, difficult for retrieval and must be imported. The authors has invented Lampang cement gun (LCG) that is easy to assemble and cost only 100 Baht[2]. It is made of a household caulking gun, a polyethylene (PE) disposable syringe, a polyvinylchloride (PVC) cap and garden hose. All materials were safely sterilized for use with the patient. For the past five years, LCG has been used by most of orthopaedic surgeons in Lampang hospital. The purpose of this study was to describe invention technique and present the short-term clinical result of this injection gun.

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Material and Method

Between October 2003 and April 2008, the authors used LCG for 96 cemented HMA in Lampang hospital. The patients aged 60 years or more, sustained femoral neck fracture less than 2 weeks. The exclusion criteria was pathological fracture or previous internal fixation. Spinal anesthesia was used unless contraindicated. Intravenous cefazolin was administrated for 24-48 hours postoperatively.

Invention and surgical technique

LCG is composed of 3 parts: nozzle, cartridge and gun. The nozzle is invented from a 1" PVC internal threaded cap and 3/8" PVC garden hose (Thai Pipe, Bangkok). The PVC hose is translucent, flexible and 20-cm long. It is inserted into a drilled hole at the center of PVC cap and secured with cyanoacrylate glue (Fig. 1). The cartridge is made from a 50-ml disposable syringe (Terumo, Tokyo) with its end having been cut and opened. A household silicone caulking gun (SL Home Products, Bangkok) is used for the injection gun. The entire kit is sterilized by ethylene oxide gas.

During the surgery, the femoral canal was prepared and snuggly occluded with a canal plug. The authors used a local bone plug obtained from the femoral head for unipolar prosthesis and used commercially available PE plug for bipolar prosthesis. The femoral canal was thoroughly irrigated with normal saline solution and dried with a long ribbon gauze. One 40-gm package of polymethylmethacrylate (PMMA) cement was mixed in an open bowl and poured into a syringe. Thereafter, it was capped with a PVC cap and nozzle (Fig. 2). The open end of Terumo syringe was well fitted with internal thread of the PVC cap. The cement cartridge was engaged into the caulking gun and the trigger was repeatedly pressed to squeeze the cement (Fig. 3). The nozzle was inserted into femoral canal and cement was retrogradely injected in early dough stage (Fig. 4). As soon as cement overflowed out of femoral canal, the nozzle was cut from the cartridge. A stainless steel or plastic obturator, 8-mm in diameter, was introduced into the nozzle to push out residual cement. After manual pressurization for 10 seconds, femoral prosthesis was inserted and held motionless until the cement fully hardened.

Clinical and radiological assessment

Harris hip score (HHS)[3] was evaluated at 3 months and yearly follow-up by medical students and interns. Radiological outcome was determined from anteroposterior and lateral view of the affected hip

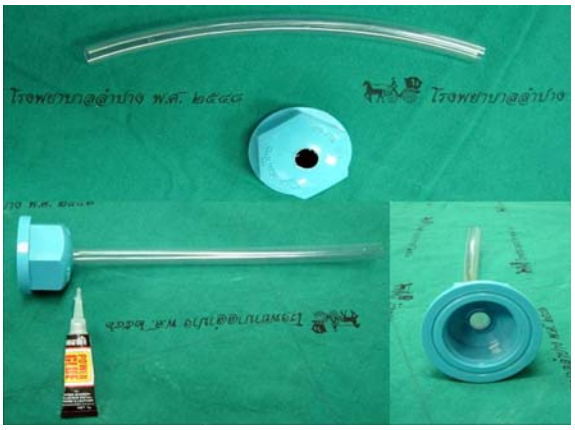

Fig. 1 The nozzle (It is made from a 1" PVC internal threaded cap and 3/8" PVC garden hose, secured with cyanoacrylate glue)

Fig. 2 The cartridge (It is made from a 50-ml disposable syringe and capped with a PVC cap and nozzle)

Fig. 3 A household silicone caulking gun before and after assembly with cement cartridge and nozzle

Fig. 4 The insertion of nozzle into femoral canal and the retrograde injection of cement

Fig. 5 Radiographs of cemented hemiarthroplasties using 3 types of prostheses: Austin Moore (top), Thompson (middle) and bipolar prosthesis (bottom)

(Fig. 5). Radiographs were taken immediately after the surgery, at 3 months and yearly thereafter. The quality of femoral cementation was evaluated by Barrack grading system[4]. The current radiographs were evaluated for prosthesis loosening. Radiological assessment was performed by two independent raters. The data was analyzed by descriptive statistics.

Results

Unipolar prostheses were implanted in 72 patients (58 Austin Moore, 14 Thompson) and bipolar prostheses (CPT, Zimmer, USA) were used in 24 patients. Three-forth were female and most cases were in the American Society of Anesthesiologist's (ASA) classification class 3. The mean age of unipolar group was 78 years (range, 65-96) and bipolar group was 71 (range, 62-83). Twenty-four patients died at 2-46 months (mean 20) postoperatively because of unrelated medical conditions. Five cases were lost to follow-up and the remaining 67 cases enrolled the study. Among these, 50 were female and 17 were male (Table 1).

The average duration of follow-up was 39 months (range, 12-66). The mean postoperative HHS in bipolar group was higher than Thompson and Austin Moore groups (83.2, 78.3 and 76.9 respectively). Excellent and good scores were found in 90.9% of bipolar hips compared with 46.7% in unipolar hips. Less than 10% of the patients had poor clinical result (Table 2).

The average duration of radiological follow-up was 35 months (range, 4-66). In 25 of 67 hips (37.3%) there was complete cement filling of the medullary canal (Barrack grade A). Twenty-two hips (32.8%) had localized radiolucent line (grade B). In 14 hips the cement mantle was grade C, with full thickness defect. There were 6 hips showing no cement covering the

Table 1. Demographic data of the patients (n = 96)

Variable	Number			(%)
	Male	Female	Total	
Age				
60-65 yrs	2	5	7	(7.3)
66-70 yrs	4	11	15	(15.6)
71-75 yrs	5	17	22	(22.9)
76-80 yrs	3	26	29	(30.3)
81-85 yrs	7	6	13	(13.5)
> 85 yrs	3	7	10	(10.4)
Total	24	72	96	(100)
ASA class 1	3	6	9	(9.4)
2	7	21	28	(29.2)
3	10	34	44	(45.8)
4	4	11	15	(15.6)
Dead	6	18	24	(25.0)
Lost to follow-up	1	4	5	(5.2)
Enrolled the study	17	50	67	(69.8)
Type of prosthesis				
Unipolar				
: Austin Moore	14	44	58	(60.4)
: Thompson	4	10	14	(14.6)
Bipolar	6	18	24	(25.0)

Table 2. Clinical evaluation by HHS comparing between type of prosthesis (n = 67)

HHS		Type of prosthesis					
		Thompson (n = 8)		Austin Moore (n = 37)		Bipolar (n = 22)	
		n	(%)	n	(%)	n	(%)
90-100	excellent	1	(12.5)	3	(8.2)	9	(40.9)
80-89	good	3	(37.5)	14	(37.8)	11	(50.0)
70-79	fair	3	(37.5)	16	(43.2)	2	(9.1)
< 70	poor	1	(12.5)	4	(10.8)	0	(0)
Average score		78.3		76.9		83.2	
Follow-up period (months)							
	Mean (min-max)	37 (12-65)		42 (12-66)		32 (12-62)	

Table 3. Radiographic evaluation by Barrack cement grading system comparing between type of prosthesis (n = 67)

Radiographic evaluation		Type of prosthesis					
		Thompson (n = 8)		Austin Moore (n = 37)		Bipolar (n = 22)	
		n	(%)	n	(%)	n	(%)
Grade	A	4	(50.0)	9	(24.3)	12	(54.6)
	B	3	(37.5)	10	(27.1)	9	(40.9)
	C	1	(12.5)	12	(32.4)	1	(4.5)
	D	0	(0)	6	(16.2)	0	(0)
Loosening							
	Possible	0	(0)	0	(0)	0	(0)
	Probable	0	(0)	1	(2.7)	0	(0)
	Definite	0	(0)	0	(0)	0	(0)
Follow-up period (months)							
	Mean (min-max)	34 (12-63)		36 (4-66)		31 (12-60)	

distal tip of stem (grade D). Percentage of grade-A-bipolar hips was more than unipolar hips, whereas grade-D was found only in the unipolar group. One grade-D-Austin Moore patient with dementia had recurrent dislocation and the prosthesis was removed. One grade-C-hip was revised from Thompson to long stem bipolar prosthesis after the periprosthetic fractured at 15 months. In the current radiographs only one grade-D-Austin Moore hip was judged to be probably loose: continuous radiolucent line at cement-bone interface without evidence of migration. This patient had periprosthetic fracture at 8 months and treated non-operatively by skin traction till union. No hip was classified as definite or possibly loose (Table 3).

There is no patient died during the peri-operative period. The mortality rate at 36 months was 20.8% in unipolar and 8.3% in bipolar group. Most of these patients were having one or more co-morbidities and their age was above 70. Four hips had dislocation. Three of them could be reduced and treated conservatively. Surgical site infection was found in only 1 Austin Moore hip (1.5%) at 4 months postoperatively and the prosthesis was removed.

Discussion

Primary prosthetic replacement is the standard treatment for displaced femoral neck fractures in the elderly with limited activity and poor quality bone stock. A controversy remains as to the implant of choice: unipolar versus bipolar prostheses. The recommended indications for the bipolar design were in younger, physically active patients, whereas unipolar design

was recommended for older, less active patients[5]. There are two types of stem designs for common unipolar prostheses; Austin Moore and Thompson. Both of them were originally used without cement but commonly cemented nowadays because of more favorable results without significantly different complications[5-8]. In case the fracture was close to the lesser trochanter, Thompson prosthesis was implemented. When sufficient residual bone-length of the neck existed, the Austin Moore was preferred[9].

At the average of 39 months, the mean HHS in unipolar cases was slightly below 80. Eighty percent of the patients had good and fair results. Less than 10% had a poor clinical score. Our final HHS was higher than other series of cementless Austin Moore HMA to report the mean HHS 55-77 at 32-120 months[10-13]. Interestingly, there were no previous publication about HHS evaluation in cemented Austin Moore HMA. The Thompson group had a slightly higher score than the Austin Moore group. The functional outcome of bipolar hips was better than unipolar hips (HHS 83.2 vs. 76.9-78.3). Most of the bipolar HMA outcomes in the femoral neck fracture reported the mean HHS 70-86 at 24 months[14-16].

The radiographic cement mantles in 38.8% of the hips were complete (grade A) and 61.2% had a defect. Most of grade C and D cementation was found in Austin Moore hips and yielded lower HHS. Unipolar hips had more cement defects around the stem tip because the prostheses were inserted without centralizing devices. The centralizer, as inserted in bipolar HMA, facilitated an adequate cement mantle by placing the stem in the center of femoral cavity[17]. Moreover, the shape of Austin Moore or Thompson broach was not truly identical to the prosthesis, so the femoral canal was not adequately over-broached for the desired cavity. When starting cement injection, the tip of LCG nozzle might not be at the optimal position. Nevertheless, the nozzle diameter and cement flow rate of LCG was equal to the commercialized gun[2]. After its use for bipolar HMA, the cement grading was comaparable to other series[4,5,13].

The dislocation rate in the present study was 4.2% whereas other series reported 1-5.3%[9,18-23]. Surgical site infection was found only in 1.5% and lower than that reported in the literature (2-6%)[6,9,20,22-24]. Probably loose was found in one grade-D-Austin Moore hip (2.7%). The loosening rate of Austin Moore implantation in the present study was lower than those of other cementless Austin Moore series to report 21% (range, 3-37) loosening rate at 45 months (range, 24-60)[10,25-29].

LCG is simple to assemble in any hospital in Thailand. Neither caulking gun nor cyanoacrylate glue contacted directly with PMMA during cement injection. The PVC tube and PE syringe do not change any property of PMMA since their melting point were much higher than the peak exothermic temperature during cement polymerization[30,31]. The authors recommended single use for all plastic components. The metal caulking gun could be re-sterilized at least 10 times unless a mechanical error occurred. It could not inject the high viscosity cement in late dough stage, otherwise the plunger of Terumo syringe might be broken before complete cement delivery. At present, LCG is used instead of manual impaction for cementing unipolar prostheses in Lampang hospital. It also replaces those brand-name cement guns in most bipolar cases.

The present study is limited by being a retrospective review with small sample size and no randomization of treatment allocation. The comparative study with previous cementing technique should be further investigated. Nevertheless, this is the first report in Thailand presenting clinical result of cemented unipolar HMA in elderly patients with femoral neck fracture. All of the previous literatures about clinical result of unipolar HMA in Thai elderly were cementless implantation[23,24,32-35]. Moreover, to the authors' knowledge, this study is also the first publication about clinical result of using of caulking gun in orthopaedic surgery.

In summary, using LCG for cemented hemiarthroplasties in elderly patients with femoral neck fracture provided satisfactory clinical outcome at average of 39 months follow-up. LCG could be used to improve cementing technique and save operative cost.

References

1. Harkess JW. Arthroplasty of hip. In: Canale ST, editor. Campbell's operative orthopaedics. 10th ed. St Louis: Mosby; 2003: 315-482.
2. Pongkunakorn A, Pengkong N, Maneeratroj W. Comparison of caulking gun and standard cement gun using for femoral cementation. J Med Assoc Thai 2008; 91: 62-7.
3. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. J Bone Joint Surg Am 1969; 51: 737-55.

4. Barrack RL, Mulroy RD Jr, Harris WH. Improved cementing techniques and femoral component loosening in young patients with hip arthroplasty. A 12-year radiographic review. J Bone Joint Surg Br 1992; 74: 385-9.
5. Levine BR, Meere PA, DiCesare PE, Zuckerman JD. Hip fractures treated by arthroplasty. In: Callaghan JJ, Rosenberg AG, Rubash HE, editors. The adult hip. 2nd ed. Philadelphia: Lippincott-Raven; 2007: 1187-210.
6. Sonne-Holm S, Walter S, Jensen JS. Moore hemi-arthroplasty with and without bone cement in femoral neck fractures. A clinical controlled trial. Acta Orthop Scand 1982; 53: 953-6.
7. Dorr LD, Glousman R, Hoy AL, Vanis R, Chandler R. Treatment of femoral neck fractures with total hip replacement versus cemented and noncemented hemiarthroplasty. J Arthroplasty 1986; 1: 21-8.
8. Parker MJ, Gurusamy KS. Arthroplasties (with and without bone cement) for proximal femoral fractures in adults. Cochrane Database Syst Rev 2009; (4): CD001706
9. Stavrakis T, Lyras D, Kremidas N, HardouVelis C, Dermon A. Hemiarthroplasty for fractures of the neck of the femur: a comparative study. EEXOT 2008; 59: 63-6.
10. Meyer S. Prosthetic replacement in hip fractures: a comparison between the Moore and Christiansen endoprostheses. Clin Orthop Relat Res 1981; 57-62.
11. Biscevic M, Smrke D, Gavrankapetanovic I. Possibilities of unipolar hip hemiarthroplasty after femoral neck fracture. Med Arch 2005; 59: 179-82.
12. Clayer M, Bruckner J. The outcome of Austin-Moore hemiarthroplasty for fracture of the femoral neck. Am J Orthop 1997; 26: 681-4.
13. Nottage WM, McMaster WC. Comparison of bipolar implants with fixed-neck prostheses in femoral-neck fractures. Clin Orthop Relat Res 1990; 38-43.
14. Lo WH, Chen WM, Huang CK, Chen TH, Chiu FY, Chen CM. Bateman bipolar hemiarthroplasty for displaced intracapsular femoral neck fractures. Uncemented versus cemented. Clin Orthop Relat Res 1994; 75-82.
15. Frihagen F, Nordsletten L, Madsen JE. Hemi-arthroplasty or internal fixation for intracapsular displaced femoral neck fractures: randomised controlled trial. BMJ 2007; 335: 1251-4.
16. Blomfeldt R, Tornkvist H, Eriksson K, Soderqvist A, Ponzer S, Tidermark J. A randomised controlled trial comparing bipolar hemiarthroplasty with total hip replacement for displaced intracapsular fractures of the femoral neck in elderly patients. J Bone Joint Surg Br 2007; 89: 160-5.
17. Learmouth ID. The evolution of contemporary cementation techniques. Orthopedics 2005; 28 (8 Suppl): s831-2.
18. Tellisi N, Wahab KH. Re-operations following Austin Moore hemiarthroplasty: a district hospital experience. Injury 2001; 32: 465-7.
19. Faraj AA, Branfoot T. Cemented versus uncemented Thompson's prostheses: a functional outcome study. Injury 1999; 30: 671-5.
20. Ahmad I. Mortality and morbidity in elderly patients with fracture neck of femur treated by hemiarthroplasty. J Coll Physicians Surg Pak 2006; 16: 655-8.
21. Holt EM, Evans RA, Hindley CJ, Metcalfe JW. 1000 femoral neck fractures: the effect of pre-injury mobility and surgical experience on outcome. Injury 1994; 25: 91-5.
22. Nather A, Seow CS, Iau P, Chan A. Morbidity and mortality for elderly patients with fractured neck of femur treated by hemiarthroplasty. Injury 1995; 26: 187-90.
23. Limpiwan W. Unipolar hemiarthroplasty for displaced fracture of femoral neck in the elderly at Prachuabkirikhan hospital. Region 6-7 Medical Journal 2007; 26: 245-51.
24. Tang-yingyong P. Unipolar hemiarthroplasty for displaced fracture of femoral neck in the elderly at Rayong hospital. Region 4 Medical Journal 1999; 18: 1-8.
25. Andersson G, Nielsen JM. Results after arthroplasty of the hip with Moore's prosthesis. Acta Orthop Scand 1972; 43: 397-410.
26. Jensen JS, Holstein P. A long term follow-up of Moore arthroplasty in femoral neck fractures. Acta Orthop Scand 1975; 46: 764-74.
27. Kofoed H, Kofod J. Moore prosthesis in the treatment of fresh femoral neck fractures. A critical review with special attention to secondary acetabular degeneration. Injury 1983; 14: 531-40.
28. Lindholm RV, Puranen J, Kinnunen P. The Moore vitallium femoral-head prosthesis in fractures of the femoral neck. Acta Orthop Scand 1976; 47: 70-8.
29. Whittaker RP, Abeshaus MM, Scholl HW, Chung SM. Fifteen years' experience with metallic endoprosthetic replacement of the femoral head for femoral neck fractures. J Trauma 1972; 12: 799-806.

30. Wright TM, Li S. Biomaterials. In: Buckwalter JA, Einhorn TA, Simon SR, editors. Orthopaedics basic science: biology and biomechanics of the musculoskeletal system. 2nd ed. Rosemont, IL: AAOS; 2000: 181-215.
31. Wilkes CE, Summers JW, Danels CA, editors. PVC handbook. Cincinnati, OH: Hanser Gardner Publisher; 2005.
32. Nipatasaj P, Bhovati V, Patanakumjorn D, Chokepatanapong S, Jirarachvaro S. Austin Moore hip prosthesis replacement in Ratchaburi Hospital. J Med Assoc Thai 1995; 78: 469-73.
33. Mulpruek P, Chusung P, Keorochana S. Retrospective study of Austin Moore prosthesis. J Thai Orthop Assoc 1984; 9: 11-4.
34. Naovaratanaophas P, Ukrisana B, Hanpanitkitkan S. Austin Moore hip replacement in Vajira hospital. Vajira Med J 1982; 26: 1-9.
35. Prasartritha T, Popartanachai N, Intuwongse C. Treatment of fracture of the femoral neck by primary hemiarthroplasty. J Thai Orthop Assoc 1980; 5: 9-15.

วิธีการประดิษฐ์ชุดปีนฉีดซีเมนต์ลำปางและผลทางคลินิกในการผ่าตัดเปลี่ยนข้อสะโพกเทียม

อนุวัตร พงษ์คุณากร, พรพินิตย์ ทิศายุกตะ, พัฒนพงศ์ ปาละวงศ์

ภูมิหลัง: *การผ่าตัดเปลี่ยนข้อสะโพกเทียมโดยใช้ซีเมนต์ เป็นวิธีที่นิยมใช้เพื่อรักษาการหักบริเวณส่วนคอของกระดูกต้นขาในผู้สูงอายุ ผู้นิพนธ์ได้ประดิษฐ์ชุดปีนฉีดซีเมนต์ลำปาง (LCG) จากปืนฉีดซิลิโคนเพื่อใช้ในการผ่าตัดดังกล่าว*

วัตถุประสงค์: *เพื่อนำเสนอวิธีการประดิษฐ์และศึกษาผลการผ่าตัดเปลี่ยนข้อสะโพกเทียมโดยใช้ซีเมนต์ในผู้สูงอายุที่มีการหักบริเวณส่วนคอของกระดูกต้นขา โดยบรรจุซีเมนต์ด้วย LCG*

วัสดุและวิธีการ: *เป็นการศึกษาแบบพรรณนาในผู้ป่วยสูงอายุ 96 ราย ที่ได้รับการผ่าตัดเปลี่ยนข้อสะโพกเทียมชนิดออสตินมัวร์ 58 ราย, ทอมป์สัน 14 ราย และไบโพลาร์ 24 ราย ในโรงพยาบาลลำปาง ตั้งแต่ ตุลาคม พ.ศ. 2546 ถึง เมษายน พ.ศ. 2551 และบรรจุซีเมนต์ด้วย LCG ประเมินผลทางคลินิกโดยใช้ Harris hip score (HHS) ประเมินการกระจายและแทรกตัวของซีเมนต์จากภาพรังสีตามเกณฑ์ของ Barrack*

ผลการศึกษา: *ผู้ป่วยมีอายุเฉลี่ย 76 ปี (พิสัย 62-96 ปี) เสียชีวิต 24 ราย ติดต่อไม่ได้ 5 ราย ระยะเวลาติดตามเฉลี่ย 39 เดือน (พิสัย 12-66 เดือน) คะแนน HHS ในกลุ่มไบโพลาร์มีค่าสูงกว่ากลุ่มทอมป์สันและออสตินมัวร์ (83.2, 78.3 และ 76.9 ตามลำดับ) ผู้ป่วยในกลุ่มไบโพลาร์มีคะแนนอยู่ในระดับดีและดีมาก 90.9 % ในขณะที่กลุ่มยูนิโพลาร์มี 46.7% ผู้ป่วยที่มีคะแนนอยู่ในระดับเลวพบไม่ถึง 10% คุณภาพการบรรจุซีเมนต์พบว่าได้เกรด A 37.3%, B 32.8 %, C 20.9% และ D 9% ผู้ป่วยเกรด D เริ่มมีการหลวมของข้อสะโพก 1 ราย และต้องผ่าตัดเอาข้อสะโพกเทียมออก 2 รายเนื่องจากการติดเชื้อและข้อเคลื่อนหลุด ผู้ป่วยเกรด C มีกระดูกหักบริเวณก้านข้อสะโพกเทียม 1 รายและต้องผ่าตัดเปลี่ยนข้อใหม่ พบอัตราตายหลังการผ่าตัด 20.8% ที่ 36 เดือนในกลุ่มยูนิโพลาร์และ 8.3% ในกลุ่มไบโพลาร์*

สรุป: *การผ่าตัดเปลี่ยนข้อสะโพกเทียมโดยใช้ซีเมนต์ในผู้สูงอายุที่มีการหักบริเวณส่วนคอของกระดูกต้นขา โดยบรรจุซีเมนต์ด้วย LCG ได้ผลทางคลินิกเป็นที่น่าพึงพอใจ สามารถเพิ่มประสิทธิภาพการผ่าตัด และประหยัดค่าใช้จ่าย*