A Ten to Thirteen Years Follow-up and Survivorship Study Cemented Low Contact Stress (LCS) Total Knee Replacement in Thailand

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Objective: *The Low Contact Stress (LCS) rotating platform mobile-bearing knee replacement is a leading, worldwide, knee replacement system, but has not been the subject of long-term clinical and/or radiographic follow-up studies evaluating the device in Thailand. The purpose of the present study was to report the 13-year results of a consecutive series of patients who have had primary total knee replacement performed implanting the LCS devices by a single surgeon, Leelasestaporn C.*
Material and Method: *Between May 1999 and December 2002, the author performed 161 consecutive total knee arthroplasties in 138 patients with LCS rotating-platform device by the Ethic Committee approval. All components were cemented. The average age of the patients at the time of operation was 64.67 years old (range 47-84). One hundred twenty two patients (141 knees) were female, and sixteen patients (20 knees) were male. Data analysis was performed retrospectively on the 161 knees (138 patients) that were followed for more than ten years. Kaplan-Meier survivorship curves were generated using revision as the end point. The Knee Society Score (KSS) and range of motion (ROM) were evaluated for clinical assessment and plane radiographs were used to evaluate implant problems.*
Results: *At the thirteen years follow-up, 101 patients (124 knees) were alive, 13 patients (13 knees) died, and 24 patients (24 knees) were lost to follow-up. Only one patient (1 knee) was revised during this period due to late-infection. The survivorship rate was 99.31% at 13 years for all knees, with an average ROM of 127.08 degrees. The average knee score and function score at end of follow-up were 98.62 and 98.69, respectively.*
Conclusion: *The LCS system, in Thailand, provides predictable results in tri-compartmental arthritis of the knee, after 13 years follow-up with 99.31% survivorship rate or 100% survivorship rate for aseptic loosening condition and excellent-knee society scores.*

Keywords: *Low Contact Stress (LCS), Mobile-bearing knee replacement, Survivorship rate*

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Mobile-bearing total knee prostheses were designed to reduce polyethylene contact stresses, potentially decreasing the fatigue wear associated with polyethylene failure in knee arthroplasty[1,9,19-21,24]. However, in Thailand we have no reports on the intermediate or long-term results associated with these devices. Chief of Arthroplasty Division, Department of Orthopedic, Bhumibol Adulyadej General Hospital, Royal Thai Air Force (RTAF) had significant experience using the Low Contact Stress (LCS) Rotating Platform Knee System (DePuy, Warsaw, Indiana) prior to the start of the present study. The purpose of the present study was to evaluate the 13-year results of a single surgeon's experience with the use of this design.

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Material and Method

Between May 1999 and December 2002, 161 consecutive primary total knee arthroplasties with the LCS rotating platform in 138 patients were performed, by Ethic Committee approval. One hundred twenty two patients (141 knees) were female, and 16 patients (20 knees) were male. The average age of the patients at the time of the surgery was 64.67 years old (range 47-84) as shown in Table 1. The primary diagnoses in 155 knees were osteoarthritis, rheumatoid arthritis in four knees, and arthritis arising from gout in two knees. The surgical procedure consisted of a midline skin incision with a medial parapatellar quadriceps-splitting incision into the joint. The posterior and anterior cruciate ligaments were excised in all patients. The gap balancing technique and tibial bone resection first was performed in every cases. Ligament balancing was also performed and an attempt was made to resect enough tibial bone to achieve a surface that was perpendicular

Table 1. Characteristics of patients

	Patient n (%)	Knee n (%)	Average age years (range)
Male	16 (11.6)	20 (12.4)	68.45 (52-84)
Female	122 (88.4)	141 (87.6)	64.13 (48-82)
Total	138 (100.0)	161 (100.0)	64.67 (48-84)

to the shaft of the tibia in the coronal plane with 7 degrees posterior slope in the sagittal plane. The distal part of the femur was resected with an attempt to achieve a femoral-tibial alignment of 5 to 7 degrees in the coronal plane. Only in rheumatoid arthritis patients was a patellar bone resection performed, with an attempt to remove a volume of bone that was equal to or slightly more than, that of the component to be implanted. In performing the femoral and tibial resection, care was taken to balance the flexion gap and extension gap so as to be equal; all components were cemented. Post-operatively, continuous-passive-motion machines were used during hospital stay.

All patients began walking with a walker and began working on active and passive range-of-motion exercises two days post-opertively. The patients used a walker with full weight-bearing for two to three weeks, and used a cane for four to six weeks. Post-operatively, all patients were followed-up and ratings according to the systems of the Knee Society[17] were obtained for all surviving patients who were examined clinically and evaluated radiographically, 123 knees in total. All patients were examined. Early post-operative and final follow-up standing anteroposterior, lateral, and scannogram[27] radiographs were evaluated, according to the method of The Knee Society[16]. The score greater than 85 was considered as excellent and less than 60 as poor. The range of movement (ROM), alignment, and contractures were assessed with a goniometer. Early post-operative and final follow-up standing anteroposterior and lateral radiographs were evaluated, according to the method of the Knee Society[17] for radiolucency at the bone-implant interfaces, the lateral and medial joint spaces, any change in the position of the components and osteolysis. The range of flexion recorded at the final follow-up evaluation was the active flexion of the knee.

Statistical analysis

A Kaplan-Meier analysis method[48] was used in order to calculate survivorship with the end-point being revision of a component for any reason.

Results

Thirteen years after the procedure 101 patients (123 knees) were alive, 13 patients (13 knees) died, cause of deaths was not related to knee surgery. The most common cause of death was cancer, at a mean of 8.5 years after surgery; 24 patients (24 knees) had been lost to follow-up, only one patient had undergone a revision because of late infection seven years after surgery. The follow-up data were shown in Table 2. The diagnoses were osteoarthritis in 155 knees (96.27%), rheumatoid arthritis in four knees (2.48%), and arthritis arising from gout in two knees (1.24%). The survivorship rate was 99.31% at 13 years for all knees, the survivorship curve as shown in Fig. 1. The average ROM was presented by age of patient in Table 3. These data show that the average ROM in the older patient was greater than that of the younger patient.

At the final follow-up evaluation, 110 knees were not painful, 12 were mildly painful (anterior = 6, posterior = 4, medial = 2), and one was moderately painful (in the posterior like radiated pain) when walking for more than one hour, but no further surgery for treatment for these groups. All four rheumatoid patients had patellar resurfacing, which had no complications such as patellar fractures loosening, wear, subluxation, or dislocation of the patellar component. Six patients who had no patellar resurfacing had mild anterior knee pain (5.04% of all none patellar resurfacing cases). During the thirteen years follow-up

Table 2. Follow-ups the performance of knee replacement at 10 and 13 years respectively

Performance of replacement	10-years follow-up n (%)	13-years follow-up n (%)
Good	124 (77.0)	123 (76.4)
Revision	1 (0.6)	1 (0.6)
Dead	12 (7.5)	13 (8.1)
Loss follow-up	24 (14.9)	24 (14.9)
Total	161 (100.0)	161 (100.0)

Table 3. Average range of motion by the age of patients

Age group	Average range of motion degree (range)
40-49	125.8 (120-130)
50-59	129.0 (125-135)
60-69	132.0 (125-140)
70-79	135.0 (130-140)
80-89	138.0 (130-140)

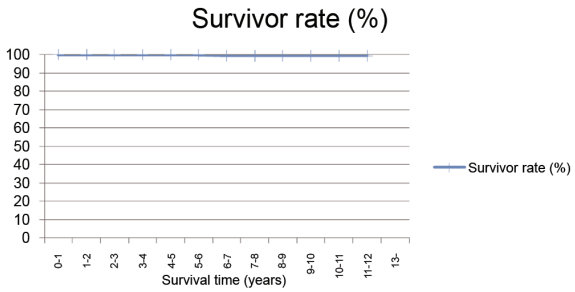

Fig. 1 Survivor rate curve 13 years follow-up (n = 161 knees).

period, only one knee was revised due to late infection, and there were no dislocations of the mobile bearing polyethylene. When the patients were specifically questioned about anterior knee pain, the responses indicated that 117 knees were not painful, three were occasionally painful, and three were mild to moderately painful with activities. The symptom of anterior knee pain was associated with getting up from a chair in all six knees; 101 patients (123 knees) were satisfied with the result of the operation. The average knee score and function score after the thirteen years follow-up were 99.4 and 99.4, respectively. The average knee score and function score classified by the age group of the patient were shown in the Table 4.

Discussion

Total knee arthroplasties with well-designed fixed-bearing prostheses have provided the durable long-term fixation, with prosthetic survival rates of 95 to 97% reported at ten to fifteen years[10,12,14,18,25,30-41,43]. However, some fixed-bearing designs have had problems with polyethylene wear and fixation failure[12,15,26,36,44-47]. In the middle to late 1970s, mobile-bearing knee prostheses were designed to reduce contact stresses in the polyethylene and to potentially decrease wear[1,3,5,7,9,13,20,21,28]. In addition, it was postulated that the mobile bearing would minimize bone-prosthesis stresses at the tibial surface[5,20]. In the designing surgeon's report of his first twelve years of experience with this rotating-platform prosthesis, survivorship analyses with component revision as the end point revealed that 97% of forty-three cemented components and 98% of sixty-five cementless components had survived at ten years; no confidence intervals were reported[8]. Sorrells demonstrated a ten-year survival rate (and 95% confidence interval) of 94±4% in a series of 665 knees followed for one to thirteen years[40]. Callaghan et al was presented radiographic follow-up study, in which detailed clinical and radiographic evaluation was performed at nine to twelve years, demonstrated the safety and efficacy of this rotating-platform mobile-bearing device, which has been used extensively in clinical practice[11]. The authors performed the present study to evaluate the long-term durability of the LCS rotating-platform design with cement fixation and to determine whether any detrimental effects (such as dislocation of bearings, backside wear of the mobile bearing contributing to particulate debris, and periprosthetic osteolysis) occurred over time in Thailand. The results from the present study confirmed that a well-designed rotating-platform type of mobile-bearing total knee replacement could perform well over the long-term. No components were revised because of failure of fixation or polyethylene wear, and there were no patellar problems, such as patellar fracture, subluxation, or dislocation, that required a reoperation. The rotating-platform mobile-bearing tibial component may help the patellar component to center itself in knees with 5 to 10 degrees of rotational mismatch between the tibial and femoral components[42]. This may partially account for the absence of patellar fractures as well as loosening, wear, subluxation, or dislocation of the patellar component. Another unique feature of this prosthesis was the anterior-proximal to posterior-distal (15-degree) resection of the distal part of the femur, which allowed the designers to make the patellofemoral groove deeper and longer than that in many of the femoral component designs of the late 1970s and early 1980s. This feature may also account for the low prevalence of patellar problems and anterior knee pain in the present study, in which only six of 119 knees were mild to moderate painful anteriorly but they did not treated by re-surgery. Potential problems associated with this design that may not be encountered with fixed-bearing designs included dislocation of the polyethylene platform and debris from backside polyethylene wear[4,8]. However, no dislocations were

Table 4. Average knee and function score classified by age group of the patient

Age group	Average knee score point (range)	Average function score point (range)
40-49	98.5 (98-100)	98.0 (97-100)
50-59	98.5 (98-100)	99.5 (99-100)
60-69	100.0 (100-100)	99.5 (99-100)
70-79	100.0 (100-100)	100.0 (100-100)
80-89	100.0 (100-100)	100.0 (100-100)

noted in the present study; care was taken to balance the flexion and extension gap precisely. There was little radiolucency at the bone-cement interfaces around the components and no radiographic evidence of periprosthetic osteolysis or asymmetrical accelerated polyethylene wear, although early detection of either osteolysis or wear in the total knee arthroplasty can be difficult on plain radiographs. Authors of studies of fixed-bearing posterior-cruciate-substituting designs have reported occasional revisions because the substituting post of the tibial component has dislocated from the femoral component box[22,31]. In addition, some authors have reported concern about backside wear in the modular fixed-bearing tibial components because of motion between the metal modular tibial tray and the polyethylene insert[16,29,44]. Inherent in a rotating platform or any other mobile-bearing design is an attempt to minimize backside wear with use of a hard, polished, chromium-cobalt tibial tray, which better accommodates motion. In conclusion, the present study showed the durability of the LCS rotating-platform mobile-bearing total knee replacement after 13 years of follow-up in Thailand. Although platform dislocation and periprosthetic osteolysis from backside wear of the bearing surface are potential problems, they were not noted in this series. Avoidance of a loose flexion gap may account for the absence of platform dislocation but also for the average active range of flexion 127.8 degrees. Patellar resurfacing was used only in rheumatoid patients in the present study without complications and with no occurrence of patellofemoral pain. Patellar resurfacing was not used in all others cases without any long-term problem. This rotating-platform design appeared to be safe as well as efficacious in an older population without necessity of patella resurfacing.

Conclusion

The LCS system in Thailand provided predictable results in tri-compartmental arthritis of the knee after 13 years follow-up with 99.31% survivorship rate and excellent-knee society scores. From the present study, it showed 100% survivorship rate for aseptic loosening condition after 13 years follow-up.

What is already known on this topic?

From the research in Thailand, LCS mobile bearing total knee artroplasty system has excellence results both survival-ship rate (99.31%) and average knee score and function score at end of follow-up (98.62 and 98.69, respectively) for Thai patients.

What this study adds?

Total knee arthroplasty in Thailand has been done for many years, and the most common procedure is fixed bearing. There was no report for survivalship rate and long-term follow-up for mobile bearing total knee arthroplasty (LCS system) in Thailand before. Thus, this research has shown that the LCS system in Thailand, provides predictable results in tri-compartmental arthritis of the knee, after 13 years follow-up with 99.31% survivorship rate and excellent to average knee score and function score at end of follow-up (98.62 and 98.69, respectively).

Potential conflicts of interest

None.

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การติดตามผลการผ่าตัดเปลี่ยนผิวข้อเข่าเทียม LCS ชนิดใช้ cement ที่ระยะเวลา 10-13 ปี และศึกษาอัตราการสัมฤทธิ์ผลของการผ่าตัดในประเทศไทย

จำรูญเกียรติ ลีลเศรษฐพร, เปรมเสถียร ศิริธนาพิพัฒน์, ธนา นรินทร์ศรศักดิ์, กฤษกมล สิทธิทูล

วัตถุประสงค์: *เพื่อศึกษาและนำเสนอผลการรักษาผ่าตัดเปลี่ยนผิวข้อเข่าเทียม low contact stress (LCS) ซึ่งเป็นข้อเข่าเทียมชนิดที่มีการหมุนบนฐานรองได้ โดยมี cement เป็นวัสดุประสานระหว่างข้อเข่าเทียมกับกระดูก ที่ระยะเวลา 10-13 ปี และรายงานอัตราผลสัมฤทธิ์ของการผ่าตัดในประเทศไทย โดยผู้ป่วยทั้งหมดได้รับการผ่าตัดโดยศัลยแพทย์คนเดียวกัน คือ นาวาอากาศเอก(พิเศษ) นายแพทย์ จำรูญเกียรติ ลีลเศรษฐพร*

วัสดุและวิธีการ: *เป็นการเก็บข้อมูลผู้ป่วยที่ได้รับการผ่าตัดเปลี่ยนผิวข้อเข่าเทียมครั้งแรกกับ น.อ.(พิเศษ) น.พ. จำรูญเกียรติ ลีลเศรษฐพร ในช่วงเวลา เดือนพฤษภาคม พ.ศ. 2542 ถึง ธันวาคม พ.ศ. 2545 โดยได้รับความเห็นชอบจากคณะกรรมการจริยธรรมการวิจัย โรงพยาบาลภูมิพลอดุลยเดช กรมแพทย์ทหารอากาศ แล้ว ซึ่งมีจำนวนข้อเข่าที่ได้รับการผ่าตัดทั้งสิ้น 161 เข่า จากผู้ป่วยทั้งสิ้น 138 ราย ซึ่งทั้งหมดใช้ข้อเข่าเทียม LCS ชนิดที่มีการหมุนบนฐานรองได้ โดยมี cement เป็นวัสดุประสานระหว่างข้อเข่าเทียมกับกระดูก อายุเฉลี่ยของผู้ป่วยที่ได้รับการผ่าตัดคือ 64.67 ปี (47-84 ปี) เป็นหญิง 122 ราย (141 เข่า) ชาย 16 ราย (20 เข่า) ข้อมูลทั้งหมดจะเป็นการเก็บข้อมูลแบบย้อนกลับ (retrospectively) และใช้การคำนวณอัตราผลสัมฤทธิ์โดยวิธี Kaplan-Meier survivorship และสร้างเป็นการกราฟแสดงอัตราผลสัมฤทธิ์โดยใช้การที่ผู้ป่วยได้รับการผ่าตัดแก้ไขซ้ำ (revision) เป็นจุดสิ้นสุดการเก็บข้อมูล และการเก็บข้อมูลจะเป็นไปตามวิธีของ Knee Society Score (KSS) และใช้ภาพถ่ายรังสีของเข่าที่ได้รับการผ่าตัดช่วยในการวิเคราะห์ข้อมูลเพิ่มเติม

ผลการศึกษา: *ที่จุดสิ้นสุดการเก็บผลการผ่าตัด ณ เวลา 10-13 ปี มีจำนวนผู้ป่วยที่สามารถติดตามผลการผ่าตัดได้จำนวน 101 ราย หรือ จำนวน 124 เข่า มีผู้ป่วย 13 ราย (13 เข่า) เสียชีวิต และมีผู้ป่วย 24 ราย (24 เข่า) ไม่สามารถติดต่อได้ ก่อนสิ้นสุดการเก็บข้อมูล มีผู้ป่วยเพียง 1 ราย (1 เข่า) ที่ได้รับการผ่าตัดแก้ไขซ้ำ เนื่องจากการติดเชื้อในข้อเข่าหลังการผ่าตัดประมาณ 6 ปี อัตราผลสัมฤทธิ์ที่ได้สูงถึง 99.31% ที่เวลา 13 ปี หลังการผ่าตัด ระยะเคลื่อนที่เฉลี่ยของข้อเข่าหลังการผ่าตัดคือ 127.08 องศา ค่าเฉลี่ยคะแนน knee score คือ 98.62 คะแนน และค่าเฉลี่ยคะแนน function score คือ 98.69 คะแนน*

สรุป: *การติดตามผลการผ่าตัดเปลี่ยนผิวข้อเข่าเทียม LCS ชนิดใช้ cement ที่ระยะเวลา 10-13 ปี ในประเทศไทย ให้ผลการผ่าตัดที่น่าพอใจและน่าเชื่อถือสูงมาก ผลการศึกษาอัตราการสัมฤทธิ์ผลของการผ่าตัดสูงถึง 99.31% ในภาวะทั้งหมด หรือ 100% ถ้าเป็นภาวะไม่มีการติดเชื้อ ทั้งยังให้ผลคะแนนของการรักษาในระดับดีเยี่ยม*