ORIGINAL ARTICLE

LCS mobile-bearing total knee replacement. A 10-year’s follow-up study

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Summary
Introduction.—For the last three decades total knee arthroplasty surgery has been facing the renewed choice of using a traditional fixed-bearing design or a mobile-bearing system. A growing number of surgeons have elected to increase their use of mobile-bearing prostheses. We wanted to assess the reliability, in our hospital of this alternative choice.

Hypothesis.—Fixed-bearing and LCS mobile-bearing knees exhibit comparable long-term clinical and radiographic results.

Material and methods.—Between January 1994 and December 1996, 126 LCS prostheses (DEPUY®) were implanted by the same operator in 101 patients (mean age was 70.0 years). The predominant underlying pathology was osteoarthritis (113 prostheses); the posterior cruciate ligament was retained in 30% of these cases which permitted a tibial tray implantation using a PCR type meniscal-bearing component; 78 prostheses were cemented; 116 prostheses included a patellar button: 46 of these resurfaced patella featured a cementless metal implant and a mobile-bearing polyethylene insert. Overall function was assessed using the SF-12 and IKS scores, and on the basis of patients’ satisfaction rate.

Patients’ review process took place between 1st October 2006 and 1st December 2006. Of the 101 patients, 59 were alive, 39 were clinically examined and 20 completed a self-assessment questionnaire; 32 had died and 10 were lost to follow-up. The average age of the patients still alive was 78 years (79 years for those operated on for osteoarthritis, 67 years for those operated on for rheumatoid polyarthritis); Mean follow-up period at the time of this review was 11.4 years. Mean body mass index (BMI) was 30.8 kg/m².

Results.—No early infection was observed. Early complications included instability in one case, stiffness in six cases and resolutive patellar pain in three cases. Six prostheses necessitated to be revised.

In the 39 reviewed patients (52 prostheses), the mean IKS knee score was 78/100, (range, 20 to 100/100), mean functional score was 66/100 (range, 0 to 100/100). Mean mobility in flexion was 105.8° (range, 20° to 135°). The SF-12 quality of life score was assessed in 39 of the operated patients. Mean physical score was 37 (range, 22, 6 to 61, 2); mean mental score was
Preoperative diagnosis was osteoarthritis in 91% of surgery, with a body mass index (BMI) of 31 kg/m², mean age 70 years (range 22 to 92) at the time answered a questionnaire.

17 (23 prostheses) were seen at home and 20 of patients, 22 (29 prostheses) were examined in the clinical setting, 178 J.-C. Vogt, C. Saarbach

In this retrospective series, we reviewed the medical records of patients who had undergone LCS mobile-bearing total knee replacements (DEPUY®) during the involved period of time. Were excluded prosthetic revisions and knee replacements in the treatment of tibial plateau fractures in the elderly. The whole records were retained for evaluation of early and postoperative results and complications. Only patients who where examined by a non-operator observer (C.S) were included in long-term follow-up. However, other operated patients, their family or attending physician could give information in order to assess the good prosthetic behaviour of the non-reviewed patients for proper debate: cemented or cementless fixation, posterior cruciate ligament retention or sacrifice, positioning of a patellar implant and its fixation with cement or metallic support, axis of the lower limb.

Material and methods

The series

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The series included 76 females, 25 males (sex-ratio 75%) of mean age 70 years (range 22 to 92) at the time of surgery, with a body mass index (BMI) of 31 kg/m², (21—43). Preoperative diagnosis was osteoarthritis in 91% of cases (113 cases/126 knees) and rheumatoid arthritis in 10% (13 knees).

The mean initial clinical IKS score was 43/100 (range, 9—70/100) and the mean function score was 42/100 (range, 0—75/100). Mean initial mobility in the operated knees was 106° (range, 80—140°).

The three compartments of the knee were damaged in different ways with predominantly worn compartments: medial (98/126), femoropatellar (54/126) then lateral (42/126).

Fifteen of the studied knees had a normal axis, 92 knees had a varus deformity (55 ranging 0—10°, 32 ranging 10—20°, 5 over 20°). Nineteen of the knees had a valgus deformity (12 ranging 0—10°, seven ranging 10—20°).

The operative technique

Surgery was always performed through a medial parapatellar and transquadricepital approach. No osteotomy was carried out simultaneously. The type of implant was chosen during the surgical procedure, meniscal-bearing components were placed in the youngest patients, with intact posterior cruciate ligament. Eighty-eight mobile-bearing platforms (70%) and 38 meniscal-bearing components (30%) requiring posterior cruciate ligament retention were implanted. Use of an antibiotic-impregnated bone cement (Palacos-genmycin) for prosthesis fixation was decided for females and elderly osteoporotic subjects. Seventy-eight prostheses (62%) were cemented while 38% featured a porous coated surface treatment and were impacted.

Ten patellas were unresurfaced, 70 (55%) had a simple cemented polyethylene button and 46 (37%) a cementless rotating implant with metallic support and porocoat surface treatment.

A section of the lateral patella retinaculum was associated when lateral patellar tilt was observed at the end of the procedure or systematically performed when preoperative lateral tilt of the patella was noted.
No specific precautionary measures were taken in the early postoperative period regarding the type of prosthesis fixation, cemented or cementless or patellar treatment, neither for mobilization nor weight-bearing. Continuous passive articular mobilization was used provisionally in patients with limited active mobilization. Ninety-one patients (90%) participated in a nine to 45-day rehabilitation program (mean duration 25 days) in a specialized care centre.

**Evaluation method**

For each patient, we recorded the gender, age at surgery and at follow-up, BMI, aetiology, simultaneous surgeries, possible complications, the involved knee mobility at each follow-up visit, the clinical and functional IKS scores [1], patients satisfaction and assessment of the Short Form 12 quality of life score (SF 12) [2,3], radiological findings with measurement of the limb mechanical axis when a radiographic view could be performed and analyzed. Knees were normally aligned when mechanical axis was between 2° varus and 3° valgus. With very little information at our disposal, we could not carry out detailed measurements of implant wear. A statistical analysis was performed using the paired Student t test and the analysis of variance (ANOVA).

**Results**

**Early complications**

A deep venous thrombosis was observed on 12 occasions (three femoral, nine sural, one of which evolved toward pulmonary embolism with favourable issue). A regressive confusional syndrome was reported in two elderly subjects. One case of pseudomembranous colitis and one case of melena revealing a hemorrhagic duodenal ulcer were reported.

Only one mechanical complication was observed. A female obese patient, operated on for a 35° genu varum, reported instability of the polyethylene platform thus requiring a manual operative reduction under general anaesthesia. A rigid knee support and a one-month articulated knee support were placed for knee stabilization without further consequences.

Neither early superficial nor early deep infectious complications were noted in patients.

**Knee stiffness**

Knee stiffness was found in seven patients within three months after surgery. Four patients underwent knee joint mobilization under general anaesthesia within two months after surgery showing a lower mobility at last follow-up compared with mean results of the series (90° instead of 106°). One patient refused to undergo such manipulation and was lost to follow-up. One patient had arthroscopic arthrolysis on the third postoperative month and reports similar mobility and knee score than that of the series. One female patient had unfavourable results thus requiring 8 years later implantation of a hinged knee prosthesis with satisfying functional outcome but limited flexion at 85°.

**Hydarthrosis**

Hydarthrosis was diagnosed in three knees, one of which with inflammatory aspect. The evolution was always favourable after puncture.

**Pain and patellar instability**

Three patients complained of pain and patellar instability. Two of these were relieved durably with physical rehabilitation, the third one required reoperation at one year with section of the lateral patellar retinaculum and medial soft tissue plasty. The three knees reported a similar long-term outcome to that of the series. One patient had a painful lateral patellar border and was relieved durably with local corticoid infiltration but was lost to follow-up.

One patient reported a painful cyst beneath the scar. A favourable evolution was observed after administration of tricyclic psychotropic drugs in a pain clinic, final result being similar to that of the series.

A female patient complained of severe pain suspected to be induced by reflex dystrophy thus resisting to classic medical treatment. One year later, the prosthesis needed to be revised, resulting in poor results (clinical IKS 63, function score 70, flexion 100°); this patient was lost to follow-up.

**Secondary and late complications**

Two patients sustained a supracondylar fracture secondary to a fall. In both cases, no femoral anterior cortical notch was noted. One female patient died one month after satisfactory internal fixation. The second one underwent blade-plate osteosynthesis; consolidation occurred within satisfactory delays and resulted in good functional outcome.

One reoperation was required for aseptic loosening of the tibial component one year after implantation of a cemented prosthesis in a female patient with neither major obesity nor osteoporosis. This component was revised to a long cemented keeled tibial tray demonstrating early and long-term favourable evolution. A female patient was followed up on a regular basis due to a severe asymptomatic osteolysis in the sub-trochlear region with a non-progressive long-term evolution. She demonstrated better functional and clinical outcome than mean result of the series. (Fig. 1)

Only one infection of unknown origin was reported 9 years after implantation. Infection was treated with a one-stage prosthesis revision and resulted in a satisfactory clinical outcome (IKS 70, flexion 110°) however functional result was affected by other handicaps.

Three mechanical implant failures were observed in two patients. A female patient had dislocation of the polyethylene rotating platform 8 years after initial implantation. Since no femoral component malorientation was noted, only the PE rotating platform was revised resulting in favourable outcome. An hyperactive patient suffering from severe obesity (BMI 36 kg/m²), and operated on at the age of 59 years for bilateral medial condylar necrosis, presented with...
fracture of the patellar polyethylene component on the right knee at 8 years and fracture of the lateral meniscal-bearing with retained posterior cruciate ligament on the left side at 13 years. The patellar polyethylene component in the right knee, and both meniscal-bearings and patellar polyethylene component in the left knee were successfully exchanged; patient could return to normal activities and reach a 125° of flexion in both knees with no pain.

Revision surgeries

Irrespective of causes, excluding femoral fractures and simple manipulations, six prostheses out of 126 (5%) were revised to total or partial implant for early aseptic loosening (1 year), severe pain (1 year), mobile bearing dislocation (8 years), polyethylene patellar component fracture (8 years), infection (9 years) and fracture of the lateral meniscal-bearing component (12 years) (Fig. 2).

Clinical and functional outcomes

Early results

One female patient died between 6-week and 3-month follow-up. Including 100 patients and 125 prostheses, the mean IKS score was 77/100 (range, 30 to 100/100), and mean IKS function score was 71/100, (range, 30 to 100/100). The mean postoperative knee flexion was 111° (range, 80° to 135°).

Radiographic telemetry reported 94 knees (75%) in neutral alignment (2° varus–3° valgus), 14 valgus knees (12%), 12 of which under 10° valgus and two over 10°; 17 varus knees (13%) of less than 5°.

Long-term results

In the 39 patients reviewed between 1st October 2006 and 1st December 2006 at a mean follow-up period of 11.4 years (52 prostheses), the mean IKS knee score was 78/100, (range, 20 to 100/100), mean function score was 66/100 (range, 0 to 100/100). Knee flexion averaged 105,8° (range, 20° to 135°).

The SF-12 quality of life score was assessed in 39 operated patients. The mean physical score was 37 (22,6 to 61,2); the mean mental score was 47 (23,1 to 62,3).

Seventeen patients reported themselves as very satisfied, 18 satisfied (overall satisfaction rate of 90%), three rather satisfied, one unsatisfied.

Forty-three radiographs were taken in 36 patients during that follow-up visit. Thirty-nine evaluations were normal showing no sign of wear or radiolucencies, with centered patellar alignment (Figs. 3 and 4). Asymptomatic radiolucencies were found beneath the tibial component in three patients, once with a cementless implant and twice with

Figure 1 LCS meniscal-bearing total knee replacement in the treatment of osteoarthritis. At 12-year follow-up: a 6-year non-progressive osteolysis behind the trochlea.

Figure 2 Survival curve up to revision surgery.

Figure 3 Cemented rotating platform total knee replacement in the treatment of rheumatoid arthritis. At 12-year follow-up.
Figure 4  Cemented meniscal-bearing total knee replacement (PCL retention) in the treatment of osteoarthritis. At 12-year follow-up. A. AP view. B. Lateral view.

a cemented prosthesis. An asymptomatic patellar tilt was present in one knee.

Mean tibial slope was 8° (range, 1° to 11°).

Statistical analysis

Postoperative IKS knee score was significantly enhanced. (43 to 77/100) \( p < 10^{-6} \) and did maintain after 10 years (78/100) \( p < 10^{-6} \). A significant improvement in the function score was observed (42 to 71/100) \( p < 10^{-6} \) but did not maintain after 10 years (66/100) however it was higher than the initial score \( p < 10^{-6} \). Mean flexion was postoperatively improved (106° to 111°) but did not maintain in the long-term (105,8°). No correlation was found between patients’ gender, method of fixation, type of prosthesis (platform or meniscal-bearings), patellar option, tibial slope, member axis, IKS or mobility scores at 10 years. However, IKS knee and function scores were significantly better in patients operated for rheumatoid arthritis (158/200) than in those with osteoarthritis (144/200) \( p = 0,004 \).

There was a correlation between BMI and range of motion in flexion of the operated knees; mean flexion in thin or normal weighed patients was 120° whereas it was 100° in obese patients (\( p = 0,048 \)).

Discussion

This series is of great interest since all procedures were performed by a single operator having a 3-year-experience of that implant. Mobile-bearing knee replacements appeared an attractive option because they were designed to overcome the damaging effects of component wear, although this specific point is currently under debate [4]. As in many retrospective studies involving elderly patients at the time of surgery, this long-term review suffers from the substantial number of participants who were lost to follow-up. However, detailed and reliable information on how the implant had evolved up to the patients’ death was given by their family circle and attending physician.

Complications encountered in this series correlate those commonly reported in other published studies regarding total knee replacements [5–8]. Except the only case of late infection and very early unexplained loosening episode, late revision surgeries to partial or total knee joint replacements are rare and involve one single obese and hyperactive patient. Currently, this kind of prosthesis would feature a polyethylene-rotating platform, since mobile meniscal-bearings are no longer used; there is no need for an additional patellar component since patella retention is well tolerated once osteophytes have been resected as demonstrated by Keblish in that specific prosthesis [9].

Two cases of rotating platform dislocation were reported in our series: early dislocation was manually reduced in one patient and late dislocation required revision of the prosthesis at 8 years in another patient. This complication, specific to mobile-bearing knees, might be induced by any malrotation or inadequate ligament balance.

The IKS score is highly adapted for evaluation of this type of patients although assessment of knee stability (25/100 points of the clinical score) proves difficult in the elderly. This knee scoring system was adopted since we could compare our results with those obtained in other series. A statistically significant clinical and functional improvement was observed in our series which correlates the results of other published series [9–13].

It was interesting to observe that despite this significant improvement, only 90% of the operated patients reported themselves as satisfied which is lower than in hip-operated patients. These findings have already been acknowledged in other published works which reported a satisfaction rate of less than 85% [14–16].

No significant differences were found between results according to the type of implant, the method of fixation.
and patellar options, which contradicts the findings of J.F. Kempf [17], and might be attributed to an unprecise evaluation. Moreover, mobile-bearing knees demonstrate a good behaviour in case of slight malrotation of the tibial and femoral components and postoperative axis deviations. Actually, axis deviations up to $10^\circ$ of valgus or $4^\circ$ of varus after implantation did not interfere either with clinical or functional results or long-term radiographic outcome of the involved prostheses. Therefore, these findings seem to question the current interest in navigated knee arthroplasty [18].

**Conclusion**

In this series of 101 patients, 126 knees were treated with a LCS mobile-bearing knee system, demonstrating satisfying overall results with few and well-controlled complications. The lack of mobility obtained with this implant, and mentioned by other authors, have no major consequences in the involved studied population since a significant correlation was found between last mobility score and BMI in high BMI patients. Axis deviations, method of fixation and patellar options did not have significant impact. No improvement should be brought to this already well-proven reliable implant design, any minor change would therefore compromise its performances and induce unexpected complications as demonstrated in other implant systems, featuring Buechel and Pappas ‘‘low-friction’’ concept, and which were rapidly removed from the market.

**Conflicts of interests**

The authors report no conflict of interest

**References**