Original Article

Mid term results of LCS knee: The Indian experience

Rajesh N Maniar, Tushar Singhi[1], Bharat Gangaraju[2], Aniket Patil[2], Parul R Maniar[3]

Abstract

Background: The low contact stress rotating platform (LCS RP) knee (DePuy Orthopedics, Inc, Warsaw, Indiana), in use for last four decades in Western population, is reported to have a survival of more than 95% at 15 to 20 years. The reported Indian experience of this knee is limited to 5 years. Our aim was to report the clinical and radiological results of the LCS RP TKA design in the Indian population with a minimum followup of 10 years.

Materials and Methods: Fifty-five LCS knees (45 patients) operated between February 1997 and October 2001 were evaluated retrospectively. LCS design was generally selected if the patient was young (≤65 years of age), active and had no severe deformity. There were 40 female (88.9%) and 5 male (11.1%) patients; 47 knees had osteoarthritis (85.5%) and 8 knees had rheumatoid arthritis (14.5%). Knee Society Scores (KSS) and outcome questionnaire were filled at followup and radiographs were analyzed using Knee Society radiographic evaluation and scoring system.

Results: Of 45 patients (55 knees) enrolled, 37 patients (44 knees; 80%) were available for followup at 10 years. Average age was 59.6 years (range 40 to 77). Minimum followup was 10 years (average 12.3 years; range 10 to 15.3 years.). Three knees (6.8%) had been revised, one each for aseptic loosening, bearing dislocation and infection. Mean preoperative KSS of 33 improved to 91 postoperatively. Mean preoperative functional score of 45 improved to 76 postoperatively. Mean preoperative flexion of 113° (90°-140°) reduced to 102° (80°-135°) postoperatively. Erratic femoral rollback and tighter flexion gap to prevent spin out are the probable factors for decreased postoperative range of motion. Five (12%) patients could sit cross-legged and sit on the floor. Anterior knee pain was present in 4.6% (2/44 knees). The survival was 93.2% at 12.3 years. One patient (1.8%) had spin-out of the rotating bearing. No knee had osteolysis or progressive radiolucent lines on X-rays.

Conclusion: LCS implant has given good survival (93.2% at 12.3 years) with low rates of spin-out and anterior knee pain and no incidence of osteolysis. Limited flexion post surgery (104°) with only 12% managing to sit cross legged on the floor is a drawback.

Key words: Knee arthroplasty, LCS, mobile bearing, rotating platform

Introduction

Mobile bearing knee design was introduced with the purpose to reduce polyethylene wear and provide for load sharing by the soft tissues. Load sharing with soft tissues reduces the loosening stresses that are transferred to the implant bone interface.

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Buechel and Pappas (1977) introduced the LCS design (Low Contact Stress; DePuy Orthopedics, Inc, Warsaw, Indiana) with different variants - both cruciate retaining meniscal bearing knee, posterior cruciate retaining meniscal bearing knee, both cruciate sacrificing rotating platform knee and meniscal bearing unicondylar knee. Clinical experience over the next two decades saw an increasing use of LCS rotating platform (LCS RP) implant with its good results and decline in the use of other variants due to a number of clinical issues mainly a high rate of dislocation of meniscal bearing.[1] In LCS RP knees, the antero-posterior flexion extension movement occurs between the femoral component and tibial insert while the rotational movements occur at the tibial insert and tibial base plate junction. This allows greater contact area at the articular surface, reducing contact stresses and thus wear. Two other advantages of doing so were realized over time. The separation of movements to two different interfaces means unidirectional movement occurring at each surface unlike the fixed bearing knees which have multidirectional movement between the femoral component and tibial polyethylene insert. It has been shown that multidirectional movement leads to a much higher wear rate than unidirectional movements.[2,3]

In fact, unidirectional movement leads to stress hardening of the polyethylene along the direction of movement, causing minimal wear.[4,5] The second advantage was that there remained no need for any locking mechanism. With fixed bearing knees, no locking mechanism was found to be 100% successful to begin with and they failed further with *in vivo* use.[6-9]

The LCS RP Knee from its introduction in 1977 is still widely used.[10,11] It has been extensively reported upon in the Western literature with survival of more than 95 % at 15 to 20 years.[12,13] This is better than or equal to the survival of most of the fixed bearing modular knees in the literature.[14-16]

In India, the LCS knee was introduced only 20 years later in the year 1997. The reported Indian experience of the LCS knee in literature is limited. One study reports 100% survival at 38 months[17] and another report a re-operation rate of 10% at a mean followup of 4.5 years.[18] The aim of this study was to report the longer experience using the LCS TKA in the Indian population by a single surgeon with a minimum followup of 10 years.

Materials and Methods

Between February 1997 and October 2001, the senior author (RNM) performed 346 knee arthroplasties, and used LCS implants in 55 knees (45 patients), whose results are reported here. In the LCS group, there were 40 female patients and 5 males; 9 female and 1 male had bilateral arthroplasty. Patients were selected to have this implant if they were young (≤65 years of age) and active and had varus deformity (Femoro-Tibial Angle of < 20°) or valgus deformity of (Femoro-Tibial Angle of < 15°) preoperatively. Young patients were selected because the surgeon wanted the improved congruence and hence the decreased polyethylene wear with the LCS knee to give his younger patients (<65 years of age) a longer implant survival. Forty-seven knees had osteoarthritis (OA) and 8 knees had rheumatoid arthritis (RA). The average BMI of these 45 patients was 22.2(range 21.5 to 42.8). There were 8 obese patients (9 knees) with BMI > 30 among these 45 patients. The average age of the overall group undergoing arthroplasty during the 5-year study period was 65.3 years (range 31 to 87 years), while that of the patients with LCS implant was 59.6 years (range 40-77 years). In the overall group, 5% (n= 18) patients were ≤50 years and 24% (n= 83) were ≤60 years of age, where as in LCS group 13% (n= 6) were ≤50 years and 40% (n= 18) were ≤60 years.

Operative procedure

A midline skin incision with a medial parapatellar arthrotomy was used in all patients. Before starting bony cuts, both cruciates were sacrificed and all osteophytes were removed. If varus or valgus deformity could be corrected to neutral alignment in full extension then cuts were made to proceed with LCS RP design. If the deformity could not be fully corrected, suggesting that further collateral release may be required during the course of surgery, then a fixed bearing knee implant was selected instead and cuts made accordingly. For LCS design, tibial cut was made first using extramedullary jigs, aiming for 90° cut to tibial anatomical axis and 7° posterior slope. Gap balancing technique was used and after completing the preparation, trials were used to check for stability of the liner in extension and flexion. If good stability was demonstrated in both flexion and extension, than the femoral and tibial implants were cemented. Patella was not resurfaced if articular surface was good. If articular surface exhibited arthritic changes, then patellar resurfacing was done using a cemented all-polyethylene anatomic patellar component.

Continuous passive motion (CPM) exercises began after 2 days with starting range being 0 to 30° for 30 min twice a day and continued with increasing range of movement till 70°, until discharge from the hospital. Weight bearing was also started with the help of a walking frame after 2 days. Patient was generally discharged from the hospital on the seventh postoperative day after regular commode and stairs training.

Clinical data collection for Knee Society Scores (KSS) and outcome questionnaire were filled at followup. Radiographs were done preoperatively and postoperatively while in hospital and at 3 months, 1 year, and for final followup. All radiographs were analyzed using Knee Society radiographic evaluation and scoring system by one of the authors (TS) and by the operating surgeon (RNM) to reconfirm the findings.

Results

Of the 45 patients (55 knees) enrolled, 4 patients (6 knees) were lost to followup, and 41 patients (49 knees) could be contacted [Figure 1]. Four patients (5 knees) had died before their 10-year followup with the implants functioning well until their demise. Three knees were revised, one each for aseptic loosening, bearing dislocation and infection. The patient revised for infection was a bilateral knee implanted patient whose other knee was functioning well. The remaining 35 patients (41 knees) were evaluated, 24 patients (28 knees) were seen in the clinic, 9 patients (10 knees) were examined at home and 2 patients (3 knees) who were from out of the country were interviewed on telephone. Radiological evaluation was complete in 32 patients (38 knees). The minimum followup was of 10 years (average 12.3 years; range 10 to 15.3 years).

Thirty patients (34 knees) had OA and 5 patients (7 knees) had RA. There were three patients of polyarticular RA who had very low functional score (≤30). One of these three also had a resection arthroplasty done for a periprosthetic femoral fracture around an ipsilateral hip replacement. Another had bilateral staged LCS knees and had infection on the second operated knee for which arthrodesis was done. The third patient had severe peripheral vascular disease restraining her to walking only indoors using a support. The mean preoperative flexion deformity of 1.3° (range -2° to 10°) reduced to 0.2° (range 0 to 10°) postoperatively. The mean preoperative flexion of 113° (range 90°-140°) reduced to 102° (range 80°-135°) postoperatively. 9 (20.5%) knees had postoperative flexion of 120° or more, with 1 knee achieving 135° flexion. One patient with 95° ROM postoperatively had manipulation under anesthesia at 6 months to improve ROM to 100°. Only 5 (12%) patients could sit cross-legged, and 5 (12%) patients could sit on the floor for their activities. All patients were happy with the outcome of the surgery. In the 8 obese patients (9 knees), the average preoperative flexion was 109° and the average postoperative flexion was 94°. In the nonobese group of 27 patients (32 knees), the average preoperative flexion was 114° and the postoperative flexion was 104° [Table 1].

Patellar resurfacing was done in 40 knees and it was not resurfaced in 15 knees. No patient complained of anterior knee pain postoperatively. At the final followup twelve patients in whom the patella was not replaced were followedup and two complained of anterior knee pain which was associated with crepitus in one patient. One patient was at 10.3 years and another one was at 15 years post surgery. Both patients reported the appearance of pain in the preceding six months, which was rated 3 on VAS scale. Thus the incidence of anterior knee pain in the full cohort at final followup was 4.6% (2 knees out of 44).

There were three revisions at a minimum followup of 10 years. Two of these were early revisions done for infection and bearing dislocation each. One was a late revision done for aseptic loosening. One patient with early revision

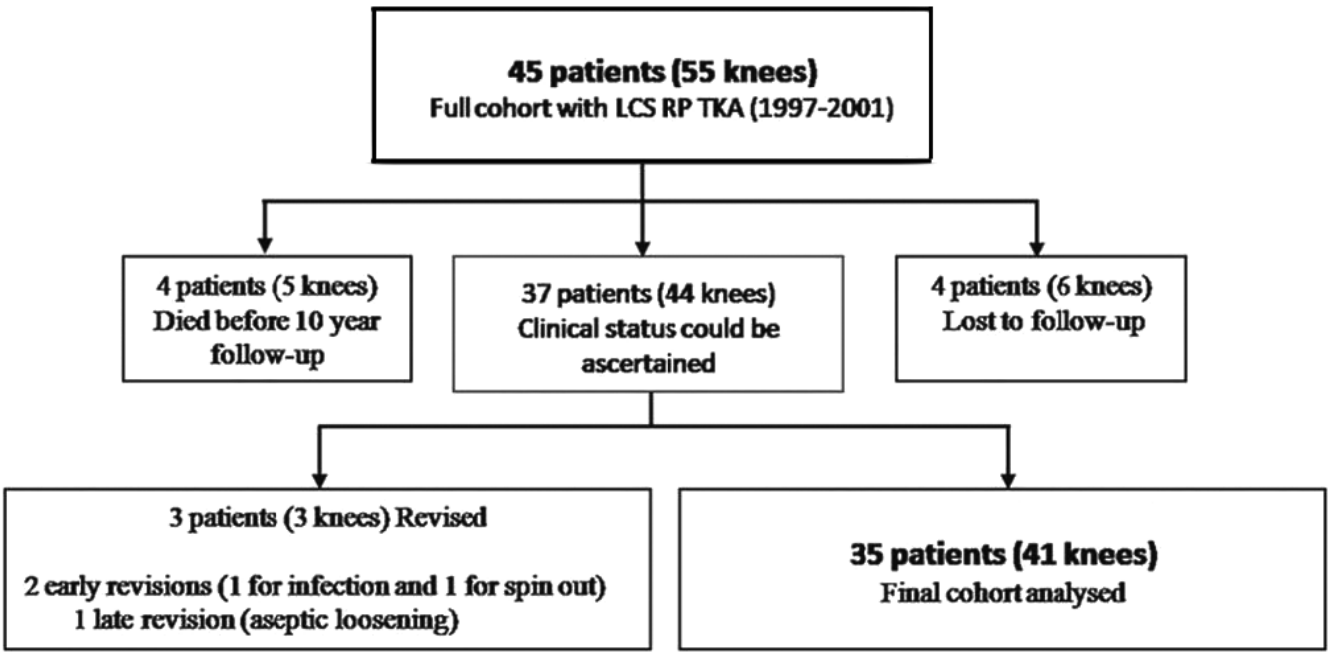

Figure 1: Flowchart to depict followup of enrolled knees

Table 1: Knee and function scores

	Number of patients (knees)	Knee score		Function score	
		Preoperative mean (range)	Postoperative mean (range)	Preoperative mean (range)	Postoperative mean (range)
All knees	35 (41)	33 (15 to 56)	91 (75 to 100)	45 (5 to 60)	76 (10 to 100)
OA knees	30 (34)	34.8 (19 to 56)	92.9 (79 to100)	47 (5 to 60)	82 (55 to 100)
All RA knees	5 (7)	25 (15 to 54)	87 (75 to 94)	37.9 (5 to 60)	49.3 (0 to 80)
RA knees after excluding 3 patients with very low function post op due to medical comorbidities	2 (4)	21.5 (15 to 25)	89.3 (84 to 94)	46 (30 to 60)	76 (70 to 80)

had infection six months after surgery and conversion to arthrodesis was done. The second patient with early revision had a spin out of the rotating bearing on the fifth day after surgery. Closed reduction was done, but the bearing re-dislocated 3 months later. Revision of the bearing to deep dished insert was done. The patient was comfortable for 4 years after the revision when the bearing dislocated again. This was then revised to a fixed bearing constrained knee (TC3, Deputy Inc. Cranford, NJ). The patient remained symptom free at the last followup, 6 years post revision surgery. The patient with late revision had aseptic loosening of the femoral component which was revised to a mobile bearing revision implant 8 years after the primary surgery. There was no osteolysis seen peroperatively in this patient. Considering revision surgery as the end point, the survival of LCS RP design was 93.2% at 12.3 years. If we disregard the early failures the survival was 97.6% at 12.3 years.

Thirty-eight knees had all 3 sets of preoperative, postoperative, and final followup radiographs. Preoperative deformity was varus in 31 knees and valgus in 7 knees. Femoro-tibial angle varied from 15° valgus to 17° varus. The postoperative femoral tibial angle was 1° to 7° valgus, with an average of 4.3° valgus. Only one patient has aseptic loosening of the femoral implant and was revised 8 years after surgery. Nonprogressive radiolucent lines were seen in 1 patient (1 knee) below the tibial implant in zone 1 and 3. These lines were seen at 1 year after surgery and were nonprogressive in X-rays done subsequently. No osteolysis was observed in any patient at the final followup [Figures 2 and 3], including the patient where late revision was required for aseptic loosening.

Discussion

LCS Mobile bearing knee was introduced (1977) with the idea of reducing polyethylene wear and improve survival. Callaghan *et al.*,[12] reported 100% survival at a minimum of 15 years and Buechel *et al.*,[13] reported 97.7% survival at 20 years.

LCS Knee was introduced much later in India (1997) and hence this is the first report with minimum 10 years followup of this design in Indian patients. The survival in our series was 93.2% at 12.3 years; comparatively less than that reported by Callaghan *et al.*,[12] and Buechel[19] at this time period. This difference may be explained by two facts, one that our patient population was 10 years younger, Callaghan's study had average age of 70 years and in Buechel's study it was 68 years for patients without prior knee surgery and 70 years for patients with prior knee surgery. If we compare the survival of LCS knee in western population of young patients, our survival of 93.2% is comparable to the series by Sorrels *et al.*, (88% survival at 14 years.) and Kim *et al.*, (97% survival at 12 years.).[20,21] This is also comparable to the survival of modular fixed bearing knees in young patients reported by Duffy *et al.*, (96% at 10 years and 85% at 15 years).[22] Secondly, if we disregard the two early failures in our study (early infection

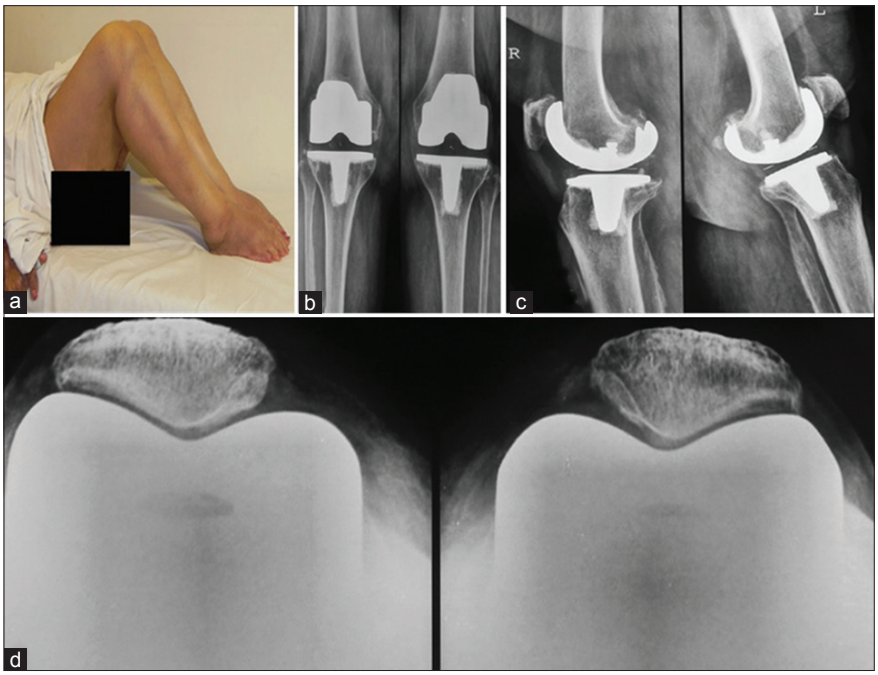

Figure 2: (a) Clinical photograph with good range of motion (b) Weight bearing radiographs - anteroposterior views (c) lateral views (d) skyline views showing bilateral LCS Knees implanted patient at 14 year post knee arthroplasty with no osteolysis and good bone implant interface

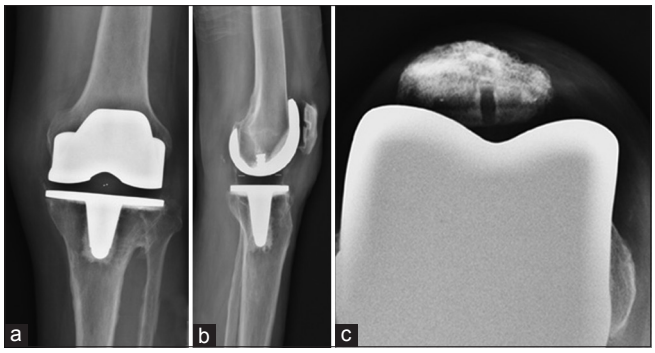

Figure 3: Weight bearing radiographs - anteroposterior view (a) lateral view (b) and Skyline view (c) of LCS Knee implanted patient at 13.5 years followup showing no osteolysis and good bone implant interface. (High Tibial Osteotomy was done 11 years prior to knee arthroplasty, and LCS anatomical patellar resurfacing is in place)

and subluxation of the bearing), the long term failure occurred in only one patient, with survival in our series then being 97.6% at 12.3 years.

The average postoperative ROM in our series was 102° which is comparable to other studies on LCS which report average ROM from 94-114°.[1,19,20,23] The average preoperative ROM in our series was 113°, which dropped by 11° post surgery. This is a major limitation for the use of these implants in our patients. This may be due to the fact that LCS RP is a cruciate sacrificing design which in fluoroscopic studies has shown erratic anterior roll-forward rather than posterior roll-back.[24,25] Secondly, being mobile bearing, one aims for relatively tighter flexion gap for assuring stability which could hamper flexion. Only 5 (12%) of patients could sit cross-legged and were able to sit on the floor, which is a significant limitation considering the requirement of patients on this side of the globe. The modification of LCS RP design into post and cam design to substitute posterior cruciate has improved the consistency of posterior femoral roll-back.[24,25] In a posterior stabilized design, the post of the tibial insert engages the cam of the femoral component beyond 70° flexion and guides posterior roll-back of the femoral component increasing flexion.[26] This has resulted in clinically better flexion postoperatively.[27-29] Maniar *et al.*,[28] reported an average ROM of 120° (range 80-155°) with PFC Sigma RP and 67% of patients could sit cross legged, and 57% of patients could sit on the floor. Another study done by Meftah *et al.*,[27] showed an average postoperative ROM of 119° with the PFC Sigma RP knee and 64% of patients could squat and 69% of patients could kneel postoperatively. Maniar *et al.*,[29] in a highly select group of patients with good preoperative flexion reported an average ROM of 130° (95°-155°) with a high-flex rotating platform design using post and cam (PFC Sigma RPF) and in this study 81% patients could sit cross legged, 53% could sit on floor, and 21% could squat. Meftah *et al.*,[30] showed an average postoperative ROM of 124° with the PFC Sigma RPF knee and squatting and kneeling were achieved in 62% and 60% of patients respectively. The midterm survival of PFC RP with mechanical failure as end point has been reported as 100% at a mean of 6.8 years[28] and 10 years.[27] The same for the PFC Sigma RPF has been reported as 100% at 4.5 years.[30] Only time will tell whether the survival of these posterior stabilized rotating platform knees with their higher range of motion and increased activity levels will match the survival of the LCS knee.

There was one patient (1.8%) with spin-out of the rotating bearing on the fifth day after surgery. This complication has been reported in various studies to vary from 0% to 11.76%.[1,12,13,23] Good balance in flexion is a prerequisite to prevent this complication. Overall low incidence (1.8%) of spinout in our study is attributed to strict selection criteria based on adequate balancing intraoperatively.

The incidence of anterior knee pain in our series was low (4.9%). None of the 40 patients with resurfaced patella complained of anterior knee pain. Two of the 15 unresurfaced patella patients reported anterior knee pain at 10 and 15 years after the surgery. This is probably related to progression of degenerative changes in the patellar cartilage. The two factors that may have contributed to the low incidence of anterior knee pain post surgery in the full cohort are patellar friendly trochlear design of the LCS femoral component and a relatively less flexion.

In conclusion, it can be said that LCS RP implant has given good survival (93.2%) at an average followup of 12.3 years with low rates of spinout (1.8%) and anterior knee pain (4.9%) and no incidence of osteolysis (0%). Limited flexion post surgery (104°) with only 12% managing to sit cross-legged on the floor is a drawback.

References

1. Bert JM. Dislocation/Subluxation of meniscal bearing elements after New-Jersey low-contact stress total knee arthroplasty. Clin Orthop Relat Res 1990;254:211-5.
2. Bragdon CR, O'Connor DO, Lowenstein JD, Jasty M, Biggs SA, Harris WH. A new pin-on-disk wear testing method for simulating wear of polyethylene on cobalt-chrome alloy in total hip arthroplasty. J Arthroplasty 2001;16:658-65.
3. Wang A. A unified theory of wear for ultra-high molecular weight polyethylene in multidirectional sliding. Wear 2001;248:38-47.
4. Pooley CM, Tabor D. Friction and molecular structure: The behaviour of some thermoplastics. Proc R Soc London 1972;329:251-74.
5. Jasty M, Goetz DD, Bragdon CR, Lee KR, Hanson AE, Elderf JR, *et al.* Wear of polyethylene acetabular components in total hip arthroplasty: An analysis of one hundred and twenty eight components retrieved at autopsy or revision operations. J Bone Joint Surg Am 1997;79:349-58.

6. Conditt MA, Stein JA, Noble PC. Factors affecting the severity of backside wear of modular tibial inserts. J Bone Joint Surg Am 2004;86:305-11.
7. Engh GA, Lounici S, Rao AR, Collier MB. *In vivo* deterioration of tibial baseplate locking mechanisms in contemporary modular total knee components. J Bone Joint Surg Am 2001;83:1660-5.
8. Parks NL, Engh GA, Topoleski LD, Emperado J. Modular tibial insert micromotion-a concern with contemporary implants. Clin Orthop Relat Res 1998;356:10-5.
9. Wasielewski RC, Parks N, Williams I, Surprenant H, Collier JP, Engh G. Tibial insert undersurface as a contributing source of polyethylene wear debris. Clin Orthop Relat Res 1997;345:53-9.
10. Kastner N, Gruber G, Aigner BA, Friesenbichler J, Pechmann M, Fürst F, *et al*. Sex-related outcome differences after implantation of low-contact-stress mobile-bearing total knee arthroplasty. Int Orthop 2012;36:1393-7.
11. Sadoghi P, Leithner A, Weber P, Friesenbichler J, Gruber G, Kastner N, *et al*. Radiolucent lines in low-contact-stress mobile-bearing total knee arthroplasty: A blinded and matched case control study. BMC Musculoskelet Disord 2011;12:142.
12. Callaghan JJ, O'Rourke MR, Iossi MF, Liu SS, Goetz DD, Vittetoe DA, *et al*. Cemented rotating-platform total knee replacement-a concise followup, at a minimum of fifteen years, of a previous report. J Bone Joint Surg Am 2005;87:1995-8.
13. Buechel FF Sr, Buechel FF Jr, Pappas MJ, D'Alessio J. Twenty-year evaluation of meniscal bearing and rotating platform knee replacements. Clin Orthop Relat Res 2001;388:41-50.
14. Dixon MC, Brown RR, Parsch D, Scott RD. Modular fixed-bearing total knee arthroplasty with retention of the posterior cruciate ligament: A study of patients followed for a minimum of fifteen years. J Bone Joint Surg Am 2005;87:589-603.
15. Brassard MF, Insall JN, Scuderi GR, Colizza W. Does modularity affect clinical success? A comparison with a minimum 10 year followup. Clin Orthop 2001:388:26-32.
16. Laskin RS. The genesis total knee prosthesis: A 10 year followup study. Clin Orthop Relat Res 2001:388:95-102.
17. Maini PS, Kailey PV, Talwar N. Hybrid fixation in rotating platform mobile bearing total knee arthroplasty using low contact stress knee. Indian J Orthop 2006;40:219-23.
18. Bhan S, Malhotra R. Results of rotating-platform, low-contact-stress knee prosthesis. J Arthroplasty 2003:18: 1016-22.
19. Buechel FF Sr. Long term followup after mobile-bearing total knee replacement. Clin Orthop Relat Res 2002;404:40-50.
20. Sorrells RB, Stiehl JB, Voorhorst PE. Midterm results of mobile-bearing total knee arthroplasty in patients younger than 65 years. Clin Orthop Relat Res 2001;390:182-9.
21. Kim YH, Kim JS, Choi Y. Osteolysis after unidirectional and multidirectional mobile bearing total knee arthroplasty in young patients. J Arthroplasty 2009:24:586-93.
22. Duffy GP, Crowder AR, Trousdale RR, Berry DJ. Cemented total knee arthroplasty using a modern prosthesis in young patients with osteoarthritis. J Arthroplasty 2007:22:67-70.
23. Callaghan JJ, Squire MW, Goetz DD, Sullivan PM, Johnston RC. Cemented rotating-platform total knee replacement a nine to twelve year followup study. J Bone Joint Surg Am 2000;82:705-10.
24. Dennis DA, Komistek RD, Mahfouz MR, Haas BD, Stiehl JB. Multicentre determination of *in vivo* kinematics after total knee arthroplasty. Clin Orthop Relat Res 2003;416:37-57.
25. Haas BD, Komistek RD, Stiehl JB, Anderson DT, Northcut EJ. Kinematic comparison of posterior cruciate sacrifice versus substitution in a mobile bearing total knee arthroplasty. J Arthroplasty 2002;17:685-92.
26. Maniar R. Rationale for the posterior-stabilized rotating-platform knee. Orthopedics 2006;29:S23-7.
27. Meftah M, Ranawat AS, Ranawat CS. Ten-year followup of a rotating-platform, posterior-stabilized total knee arthroplasty. J Bone Joint Surg Am 2012;94:426-32.
28. Maniar RN, Gupta H, Singh A, Johorey AC, Singhi T. Five- to eight-year results of a prospective study in 118 arthroplasties using posterior-stabilized rotating-platform knee implants. J Arthroplasty 2011;26:543-8.
29. Maniar RN, Singhi T. High-flex rotating platform knee implants two- to 6-year results of a prospective study. J Arthroplasty 2012;27:598-603.
30. Meftah M, Ranawat AS, Ranawat CS. Safety and efficacy of a rotating-platform, high-flexion knee design three- to five-year followup. J Arthroplasty 2012;27:201-6.

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