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Role of high flexion total knee replacement in Indian scenario

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Abstract
This study was carried out between January 2016 & December 2016 to analysis the clinical and functional outcome of total knee replacement in Indian patients with high flexion posterior stabilized knee prosthesis. The range of motion (ROM) after total knee arthroplasty is an important component of patient overall functional outcome. The ability to the store posterior femoral translation has been shown be to an important factor in enhancing knee flexion after total knee arthroplasty. Knee society scoring and functional evaluation scoring system were used to collect clinic-radiological data. The range of motion (ROM) score preoperatively and 6 months postoperative was 19.30 (SD± 3.21); 96.5º and 24.53 (SD± 1.25) 122.65º respectively. The overall complication rate was 6.6. High flex knee improved patient abilities to perform activities that require weight bearing knee flex such as kneeling squatting and rising from sitting on the floor, activities very important in Indian scenario.

Keywords: high flexion knee, total knee replacement (TKR), range of motion (ROM), knee society score (KSS)

Introduction
The range of motion after total knee arthroplasty is an important component of a patient's overall functional outcome [1]. The inability of traditional prosthetic knees to consistently achieve flexion beyond 115 degrees and increased desire among patients to pursue activities associated with greater degree of knee flexion especially in Indian population as compared to western people as most of their routine habits and customs demand squatting (130°-full hip flexion and 111°-165° (or full) knee flexion), kneeling, or sitting cross-legged (90°-100° hip flexion and 111°-165° (or full) knee flexion [2, 3] have driven the development of knee prostheses designed to accommodate better and even facilitate higher degree of flexion [4]. A reduction in posterior femoral translation has been found to cause impingement of the posterior edge of the tibial component on the femoral shaft, thus preventing a high degree of flexion on the knee [5, 6]. The ability to restore posterior femoral translation has been shown to be an important factor in enhancing knee flexion after total knee arthroplasty [7]. High flex knee system is a refinement of the original standard design. It incorporate subtle changes in the geometry of the components to allow improved contact mechanics to address issues of wear and spin-out in the high-flexion ranges compared to traditional designs factors governing the flexion range of the knee after total knee arthroplasty.

Review of literature
Factors governing the flexion range of the knee after total knee arthroplasty include the degree of preoperative knee flexion, diagnosis leading to the operation, design of the prosthesis, surgical technique, and the patient's motivation to carry out rehabilitation. Although the mechanisms that hinder more flexion are unclear. Since Posterior Stabilized prostheses are characterized by highly excessive post against cam stress, lack of axial rotation, failure in providing full flexion and other problems thus such devices are also undesirable. The femoral component has a decreasing radius of curvature posteriorly and tibial polyethylene is free to rotate within the stem of the tibial base plate. The mobile bearing LCS system is versatile, and it may be used in both primary and revision arthroplasty. Pain relief and restoration of function have been very gratifying with this system. Despite good long term result reported in some series with the LCS knee prosthesis, there is controversy about the use of mobile instead of fixed bearings in total knee replacement. The Press fit Condylar Sigma posterior stabilized rotating-platform knee (PFC Sigma -RP) was introduced to improve the kinematics of the LCS RP prosthesis by employment of a post and cam mechanism in the PFC sigma PS-RP prostheses, would lead to consistent posterior roll back which in turn would lead to better knee range of motion, reduce polyethylene wear at the articular surface and provide better stabilization of the tibial insert. However no significant difference between LCS-RP and PFC sigma-RP has been reported. Current Buechell Pappas High Flex Knee System (3rd generation New Jersey device) is a refinement of the original LCS design. The anterior aspect of tibial polyethylene insert has been modified to reduce extensor mechanism impingement in high flexion, and optimization of cam-post design of Posterior Stabilized prosthesis to reduce the risk of dislocation in high flexion. Studies of bilateral TKA with a PCL-retaining prosthesis on one side and a PCL-substituting prosthesis on the other side have failed to show significant subjective performance or patient satisfaction differences. The PCL causes the femoral condyles to glide and roll back on the tibial plateau as the knee is flexed this femoral

rollback is crucial in prosthetic design. If the cruciates are excised, a more conforming tibial polyethylene component can be used to provide some degree of anterior and posterior stability. If the PCL is retained, the tibial surface must be flat or even posteriorly sloped. If a more conforming component is used in these circumstances, posterior impingement will occur. In multiple studies comparing PCL-retaining and PCL-substituting prosthesis, the average flexion attained at long-term follow-up has been similar. The loosening rates of these two designs are similar at 10-year follow-up, however, and, at least for the initial 10 to 15 years after surgery, this argument does not seem to be valid.

Materials & Methods

This study was done to know the clinical and functional outcome of Total Knee Replacement using Knee society score and functional scoring system with high flexion posterior stabilized prosthesis in the department of Orthropaedics at Sir Ganga Ram Hospital, New Delhi. 30 cases who met inclusion criteria underwent bilateral TKR using High-flexion Posterior-Stabilized Prosthesis were included in this study from January 2016 to December 2016. Patients were followed up post operatively for a period of minimum 6 months for evaluation of clinical and functional outcomes at 2 weeks, 6 weeks, 3 months and 6 months. All the clinic-radiological data was collected and registered in Performa as per the Knee Society Score and Knee Society Functional evaluation and scoring system.

Patient from either sex, Primary Osteoarthritis of bilateral knee, Thigh –calf index above 90º, BMI < 30, Age >60 years were included in this study whereas patients with Unilateral Osteoarthritis, Infective arthritis, Extensor mechanism dysfunction, Rheumatoid Arthritis, Neurological Disease, Revision TKR and ankylosis knee were excluded from this study. The analysis was carried out using Statistical package for social sciences 17.00 version. Normally distributed data was presented as means ± SD, or median (Range) if data skewed, and categorical data was presented as frequencies.

All patients were assessed clinically, radiographically (figure 1 and 2) and functionally using the Knee Society Score and Functional Score. Patients were made to lie in supine position with knee flexed to 90 degree. Under Tourniquet application sterile preparation was done from thigh to toes and draped. With the knee in 90 degree of flexion an anterior midline incision of 3 cm to 5 cm above the superior pole of patella was made and extended distally to below the level of the tibial tubercle. The retinacular incision was a medial parapatellar retinacular approach and patella was everted laterally. The degenerated femoral condyle was exposed. Appropriate soft tissue and ligamentous releases were performed prior to bone cuts. The extramedullary tibial guide was assembled using the adjustment screw at the ankle to align the resection guide keeping the long axis of the tibial resection guide parallel to the tibia. A stylus is used to check the amount of tibial cut. 2 mm for medial referencing, 10 mm for lateral referencing. The final tibial cut was completed with an osteotome to prevent over penetration of saw blade posteriorly which risked popliteal artery cut. Distal femur was resected with either the standard resection slot, which provides a 9mm resection from the prominent distal condyle, Distal Resection Guide and Valgus Alignment Guide were assembled onto the intramedullary alignment rod. The 5 to 7 degree valgus cut was made in order to get a distal cut that is perpendicular to the mechanical axis. Patella was denervated circumferentially using the cautery and patelloplasty done using a patellar clamp. Extension gap was checked with Trial Tibial Base. A symmetrical and rectangular extension gap must be obtained. A-P femoral sizer was placed flush against the resected distal femur and size adjusted so the feet contact the posterior condyles and the stylus contacts the shaft of the femur. Trial tibial base, equal in size to the femoral implant with the trial base handle and was placed against the proximal tibial surface. With the knee flexed, place the appropriate size femoral trial on the distal femur using the femoral impactor. Insert the trial tibial insert of equal size and appropriate thickness onto the trial base and complete the trial reduction. Bone cement was spread over the cut surfaces of the femur and tibia for femoral and tibial components implantation. Homeostasis is then obtained by sequentially removing the sponges from the lateral and medial sides of the knee, taking care to look specifically for bleeding from the superior lateral geniculate artery. The incision was closed in 3 layers over suction drain taking great care to close the elevated periosteal tissues to the patellar tendon. The knee was flexed past 90 degrees to ensure that no part of the closure limits flexion and that the patella tracks normally. The subcutaneous tissue and skin are closed with the knee in 30 to 40 degrees of flexion to aid in skin flap alignment.

The patients were assessed clinically, radiographically (figure 3 and 4) functionally (figure 5,6 and 7) using the Knee Society Score at an interval of 2weeks, 6 weeks, 3 months and 6 months post-operative.

Results and Observation

- In this study there were 30 patients with average age of 67.93 years (SD± 6.51). The mean ROM score preoperatively and 6 months postoperatively was 19.80 (SD ± 2.78); 99^0 and 24.33 (SD ± 1.37); 121.65 ^{0} respectively. The mean value of range of motion continued to increase up-to 6 month of follow up.
- Preoperatively no patient had flexion contracture of more than 20 degrees 80% of the patients (24/30) had extension lag of less than 10 degrees, 20% of patients (6/30) no extension lag preoperatively. Postoperatively, 17 patients at 2 weeks and 26 patients at 6 weeks had no extension lag, 28 patients had no extension lag at 6 month of follow up.
- The mean pain score preoperative and postoperative at final follow was respectively 9.67 and 40.85 according to the knee society knee score.
- The mean walking capacity score preoperatively and 6 months postoperatively was 26.67 (SD ± 7.30); and 47.33 (SD ± 4.66). The Walking capacity continued to increase up-to 6 month of follow up.
- The mean stairs function score preoperatively and 6 months postoperatively was 20.83 (SD ± 4.56); and 41 (SD ± 4.03).
- The mean preoperative and at 6 month KSS was respectively 43.30 (SD ± 4.98) and 89.20 (SD ±5.0).
- The mean preoperative and 6 month postoperative KFS

was 44.00 (SD ± 9.23) and 88.00 (SD ± 7.14)

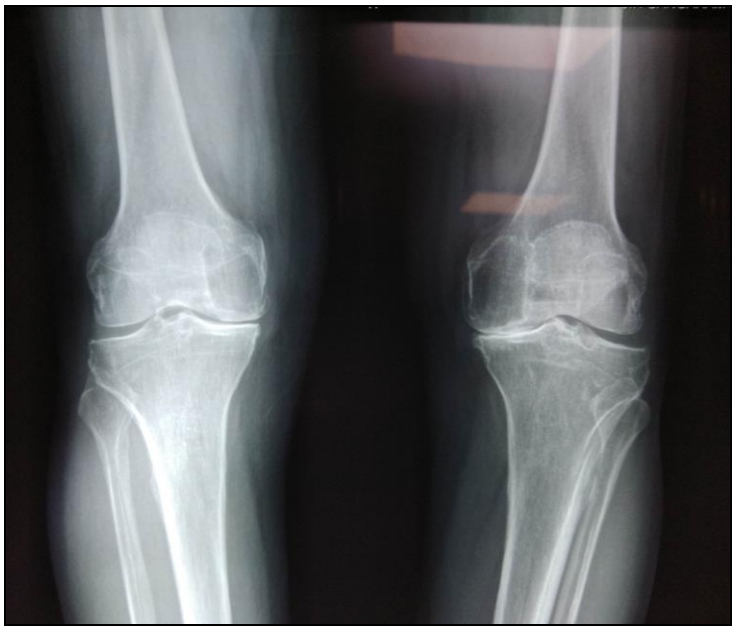

Fig 1: X-Pre Operative X Ray Bilateral Knee Ap View Weight Bearing

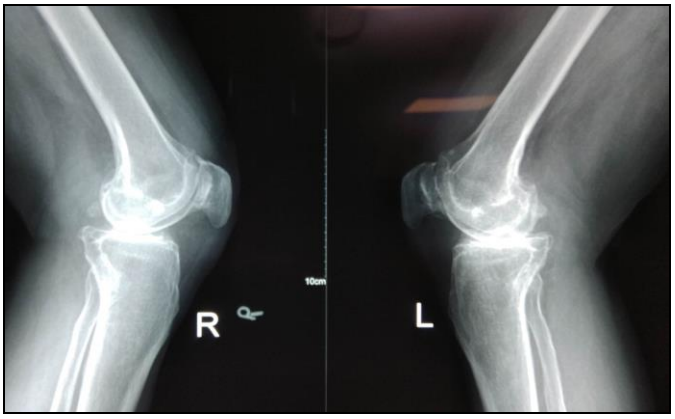

Fig 2: Pre Operative X Ray Bilateral Knee Lateral View

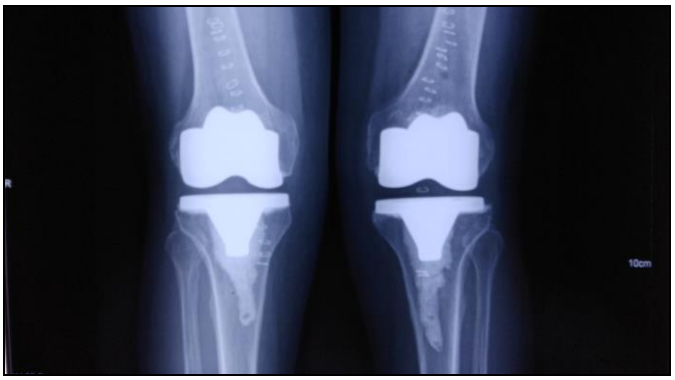

Fig 3: Post Operative X-Ray Bilateral Knee: Bilateral Total Knee Replacement (High Flexion Knee

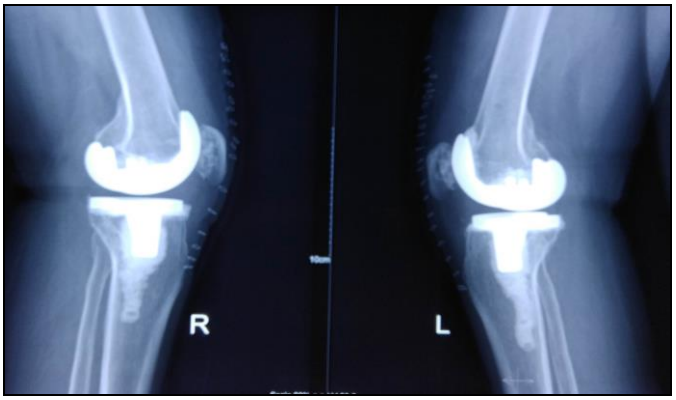

Fig 4: Post-Operative X Ray Bilateral Knee Lateral View

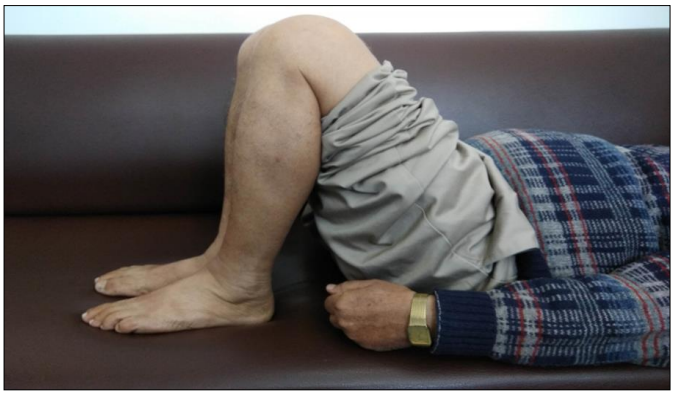

Fig 5: Flexion Up To 140 Degree Possible With High Flexion Knee

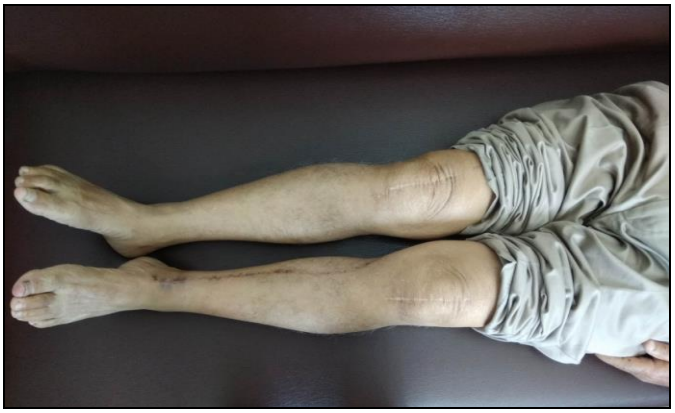

Fig 6: Varus and Valgus Deformity and Good Alingment after Total Knee Replacement

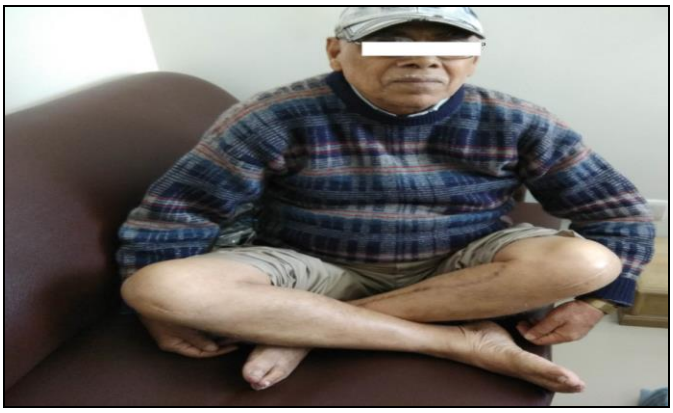

Fig 7: Follow UP Patient Can Do Squatting

Discussion

The High flexion design prosthesis is a modification of standard version posterior stabilized prosthesis. The modification is intended to allow deep knee flexion to be exerted safely and, hopefully, also lead to e better knee flexion range after total knee replacement. An additional 2 mm of bone is removed from the posterior condyle during preparation of distal femur. This allows an extension of articular surface in the high flexion design to facilitate deep flexion. The cam-post mechanism was modified to minimize the chance of posterior dislocation during deep flexion [8].

It is important to choose the correct femoral implant size and avoid using oversized femoral or tibial component [9, 10, 11, 12]. In our study 30 patients were taken meeting inclusion criteria. Post TKR follow upto 6 months all the patients had an improvement in knee function as assessed by the Knee Society and Knee functional score. The average gain in range of motion was 25.35^0 at 6 months follow up after TKR using high flexion prostheses. Steven H. Weeden MD and Robert Schmidt MD assessed 50 patients at 6 months and 1 year follow up after TKR significantly more patients had flexion greater than 135 degree in high flexion group than in standard group (P <. 05) [13]. Young-Hoo Kim, *et al*, study 50 patients received a Standard fixed bearing prosthesis in one knee and a High flexion fixed bearing knee prosthesis in the contra lateral knee. At the time of final follow up, mean ROM with High-flexion prosthesis was 138.6 degree. They found no significant difference between the groups with regard to ROM (P = 0.41) [14].

To compare the preoperative ROM and deformity to achieve final functional ROM, we divide the each variable into group like Stiff knee ($0\text{-}60^0$), Mobile knee ($61\text{-}90^0$), and Flexible knees ($>90^0$). 33.33% belongs to the mobile knee whereas rest (66.66%) belongs to flexible knee. In our study the over-all improvement in ROM was greater in knees with poor preoperative ROM because elimination of Flexion contracture contributed to the ROM. The mean preoperative and 6 month postoperative range of motion in Standard knee group were 84.5^0 and 115^0 degrees for the mobile knee, 105^0 and 124.5^0 for the flexible knees, compared to 82.5^0 and 119^0 degrees for mobile, 112^0 and 126^0 for flexible knee in High flexion knee group. Harvey *et al*. [15] observed that less mobile knees gained movement, but the more mobile knees lost mobility. McAuley, Harrer and Ammeen [16] assessed 21 patients with 27 stiff knees (< 50 degree ROM), out of which, 18 showed improved quality of life after total knee arthroplasty, as depicted by the increased walking tolerance, increased functional abilities, and decrease in pain. Mullen *et al*. in their study found little difference between the final post op ROM in comparing the stiff and the flexible knee groups with probable reason being small sample size and stiff knee being defined as < 90 degrees [17]. Pain relief was seen in all the patients irrespective of stiff, mobile or flexible knees and deformity. The overall complication rate was 6.66. Delayed wound healing was found in 1 patient. Complication rate was comparable to other studies. In our study there was no case of aseptic loosening of implants, deep infections, migration, synovitis, instability, extensive osteolysis and subluxation or dislocation of mobile bearing, as seen in other author's cases [18].

Our study had few limitations. First, possible limitation is that we measured the knee range of motion with the patients in the supine position, rather than under weight-bearing conditions. A second the knee scoring systems are prone to inter-observer variability and we have no inter-observer variability to ensure reliability. Dennis *et al*. [19] reported that weight-bearing ranges of motion differed significantly between high flex and standard TKR implants with similar passive non-weight-bearing ranges of motion. Nevertheless, the patients' abilities to perform activities that required weight-bearing knee flexion, such as kneeling, squatting, and rising after sitting on the floor. Third, accuracy of measurement of ROM of the knee with a clinical goniometer would be less than that compared with using an electro-goniometer or fluoroscopic guided radiographic measurement [20]. We recommend that long term studies of both clinical and functional outcomes are needed to determine the efficacy of high-flex knee prosthesis.

Conclusion

The high flex knee is a boon to patients in Indian scenario seeking increased function after TKR. It provides on an average 140^o of bending which allows activities requiring increased range of motion(ROM) like squatting sitting cross leg, kneeling, climbing and coming down the stairs and getting up from the ground.

High flexion knee is achieved through combination of prosthetic design, patient selection, surgical technique and special physiotherapy.

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