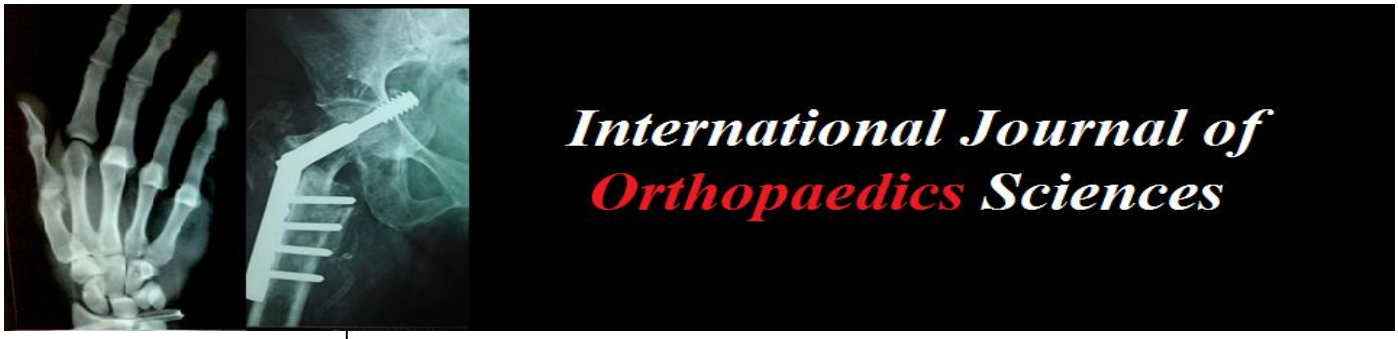

ISSN: 2395-1958
IJOS 2018; 4(3): 56-61

www.orthopaper.com
Received: 12-05-2018
Accepted: 13-06-2018

Dr. R Raj Ganesh
Senior Assistant Professor, Institute of Orthopaedics and Traumatology, Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu, India

Dr. A Saravanan
Senior Assistant Professor, Institute of Orthopaedics and Traumatology, Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu, India

RH Govardhan
Emeritus Professor of Orthopaedics, Tamil Nadu Dr. MGR Medical University, Guindy, Chennai, Tamil Nadu, India

N Deen Muhammad Ismail
Professor, Institute of Orthopaedics and Traumatology, Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu, India

Dr. M Sathish
Junior Resident MS Ortho Post graduate, Institute of Orthopaedics and Traumatology, Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu, India

Correspondence
Dr. A Saravanan
Senior Assistant Professor, Institute of Orthopaedics and Traumatology, Rajiv Gandhi Government General Hospital, Chennai, Tamil Nadu, India

Long term outcome analysis of fixed bearing total knee arthroplasty

Dr. R Raj Ganesh, Dr. A Saravanan, RH Govardhan, N Deen Muhammad Ismail and Dr. M Sathish

DOI: https://doi.org/10.22271/ortho.2018.v4.i3b.12

Abstract
Introduction: Survivorship of TKA is directly related to appropriate alignment and balance. Surgeons should evaluate the biomechanics of knee alignment and determine the proper position of the implant. Malalignment of total knee prostheses has been implicated in few difficulties, including tibiofemoral instability, patellofemoral instability, patellar fracture, stiffness, accelerated polyethylene wear, and implant loosening. The aim of this study is to analyse the long term follow up of functional and radiological results of twenty cases of fixed bearing Total Knee Arthroplasty prospectively done in our institute during the period April 2008 to September 2009.
Materials & Methods: This is a prospective study done in our department form 2008- 2009 which included total knee arthroplasty done for bicompartmental osteoarthritis without gross deformity. 20 cases were included in the study. The age range was 32 to 65 years. There were 5 male patients and 15 female patients. The accuracy of component position was assessed by mechanical axis restoration, coronal tibio femoral angle, sagittal femoral angle, posterior tibial slope by X-ray and the transepicondylar line-posterior condyle component angle by CT. We used Depuy PFC fixed bearing knee in 17 patients, Stryker knee in 2 patients and Indus knee in 1 patient. Knee society score was used to measure the functional outcome of the surgery.
Results: The average postoperative flexion in the rheumatoid group was 105.4 degrees and in the osteoarthritis group was 115.8 degrees. There was no incidence of periprosthetic fractures. No patients had neurological deficit or dislocations. One case had valgus instability postoperatively. In our study all our patients showed an improvement in knee score with mean preop score of 50.4 (range: 46-57) improved to 75.6 (range: 65-88). 2 patients had excellent score (80-100).16 patients had good score (70-79) and 2 patients had fair results (60-69). No patients had maltracking of patella clinically.one patient with anterior knee pain and two patients with limited flexion post operatively were evaluated with axial view of knee. There were no evidence of patellar tilt or subluxation. No patients had loosening and osteolysis noted around the femoral and tibial components. No implant needed to be revised during the period of study. There was no incidence of superficial or deep infection. Of the 20 patients 18 cases returned to their premorbid condition. Two patients who were rheumatoid has persistent pain. The average follow up was 9.2 years (range 8.4 to 10.7 years).
Conclusion: In patients with ideal placement of the components i.e. with mechanical axis and the rotational alignment accurate better knee flexion and knee score was obtained provided other factors are normal. We conclude that the correct positioning of the components both axially and rotationally improves the functional outcome of fixed bearing knee in low demand patients with an excellent long term clinical outcome.

Keywords: Fixed bearing TKA, rotational alignment, mechanical axis, long term results, knee society score

Introduction
Total Knee Arthroplasty is the most commonly performed adult reconstructive knee procedure. Implanting femoral and tibial component to replace the degenerated knee joint will relieve the pain and provide mobile, pain free and a stable joint. The primary indication for total knee arthroplasty is to relieve pain caused by severe arthritis, with or without significant deformity. Because knee replacement has a finite expected survival that is adversely affected by activity level, it generally is indicated in older patients with more sedentary lifestyles. It also is clearly indicated in younger patients who have limited function because of systemic arthritis with

multiple joint involvement Numerous studies have shown a correlation between success of total knee arthroplasty and restoration of near-normal limb alignment [1]. Malalignment of total knee prostheses has been implicated in few difficulties, including tibiofemoral instability, patellofemoral instability, patellar fracture, stiffness, accelerated polyethylene wear, and implant loosening. Accurate component placement in axial and rotational axis in knee replacement surgery is important. The use of accurate instrumentation, as well as an understanding of the basic principles inherent to the instruments, is necessary to reproducibly implant well-aligned prostheses.

Normally, the anatomical axes of the femur and the tibia form a valgus angle of 6 degrees ± 2 degrees. The mechanical axis of the lower limb is defined as the line drawn on a standing long leg anteroposterior roentgenogram from the center of the femoral head to the center of the talar dome. This mechanical axis typically should project through the center of the knee joint, described as a "neutral" mechanical axis. During normal gait the mechanical axis is inclined 3 degrees from the vertical axis of the body, with the feet closer to the midline than the hips. When the mechanical axis lies to the lateral side of the knee center, the knee is in mechanical valgus alignment. In mechanical Varus alignment, the mechanical axis of the limb lies to the medial side of the knee center.

The amount of Varus or valgus deformity can be determined on the anteroposterior roentgenogram by first drawing the mechanical axis of the femur, a line from the center of the femoral head to the center of the intercondylar notch, and extending this line distally. The mechanical axis of the tibia runs from the center of the tibial plateau to the center of the tibial plafond, thus accounting for any bowing of the tibia. The angle formed between these separate mechanical axes of the femur and tibia determines the Varus or valgus deviation from the neutral mechanical axis. By determining the tibial mechanical axis using the center of the tibial plateau and the femoral mechanical axis using the center of the intercondylar notch, any medial or lateral subluxation through the knee joint is disregarded. Insall has argued that rotation affects the mechanical axis of the femur apparent on an anteroposterior roentgenogram, thus lessening the value of these preoperative measurements.

In a normal knee, the tibial articular surface is in approximately 3 degrees of Varus with respect to the mechanical axis, and the femoral articular surface is in a corresponding 9 degrees of valgus. Multiple studies, including those by Tew and Waugh [2], Jeffery, Morris and Denham [3], and others, demonstrated that tibial components placed in more than 5 degrees of Varus tend to fail by subsiding into more Varus.

Consequently, tibial components generally are implanted perpendicular to the mechanical axis of the tibia in the coronal plane, with varying amounts of posterior tilt in the sagittal plane, depending on the articular design of the component to be implanted. The femoral component usually is implanted in 5 to 6 degrees of valgus, the amount necessary to reestablish a neutral mechanical axis of the limb.

Rotational alignment of total knee components is difficult to discern roentgenographically, making the assessment of rotation primarily an intraoperative determination. The rotation of the femoral component has effects not only on the flexion space but also on the patellofemoral tracking. Because the proximal tibial cut is made perpendicular to the mechanical axis of the limb instead of in the anatomically correct 3 degrees of Varus, rotation of the femoral component also must be altered from its anatomical position to create a symmetrical flexion space.

To create this rectangular flexion space, with equal tension on the medial and lateral collateral ligaments, the femoral component usually is externally rotated approximately 3 degrees relative to the posterior condylar axis. In a normal femur, this technique rotationally places the femoral component with the posterior condylar surfaces parallel to the epicondylar axis. This technique fails when the posterior aspect of either the native femoral condyle has significant wear or when the lateral femoral condyle is hypoplastic, as is frequently seen in knees with valgus deformity. In these instances, the surgeon can rely on palpation of the epicondylar axis or the anteroposterior axis popularized by Whiteside.

Each of these techniques of determining femoral component rotation is based on the geometry of the femur primarily, with subsequent ligamentous releases to create symmetrical flexion and extension gaps. The older gap technique of performing cuts and the rotational alignment based on creating a symmetrical flexion space in the partially released knee frequently created rotational malalignments of the femoral component with regard to the epicondylar axis and the patellofemoral joint.

Notably, some prostheses have been developed that include external rotation of the femoral component by incorporating a thicker lateral posterior femoral condyle in combination with a thinner medial posterior femoral condyle. Reis *et al* [4] argued that external rotation of the femoral component lateralizes the trochlea in extension yet medialise it in flexion past 90 degrees. They emphasized deepening the trochlea with lateralization of only the proximal end of the trochlea. Kaper, Woolfrey, and Bourne [5] noted that the Genesis II prosthesis of this design had a lower rate of lateral retinacular release compared with the more traditional Genesis I design.

The aim of this study is to analyse the long term follow up of functional and radiological results of twenty cases of Fixed bearing Total Knee Arthroplasty prospectively done in our institute during the period April 2008 to September 2009.

Materials and methods

This is a prospective study conducted at the Institute of Orthopaedics & Traumatology from April 2008 to September 2009. Out of the 25 cases of Total Knee Arthroplasty done in our department during this period, we selected 20 Total Knee Arthroplasty which fulfilled the selection criteria for our study.

The inclusion criteria were:-

1. Bicompartmental Arthritis of knee – Osteoarthritis, Rheumatoid Arthritis, Post trauma.
2. Neutral; Varus, Valgus and Flexion deformity<30°

The exclusion criteria were: -

1. Patients who lost follow-up
2. Flexion deformity > 30°

A detailed preoperative medical evaluation of the patients for comorbid diseases, neurovascular anomalies and infections were done. Quite a number of reference parameters like transepicondylar line, whiteside's line and posterior condylar line of femur have been suggested to get proper rotational alignment of femoral component.

These axes are assessed preoperatively by CT where the difference in angle between the posterior condylar line and the transepicondylar line is calculated which gives the angle of posterior condylar cut during surgery to place it parallel to epicondylar axis.

The accuracy of component position was assessed by mechanical axis restoration, coronal tibio femoral angle, sagittal femoral angle, posterior tibial slope by X-ray and the transepicondylar line-posterior condyle component angle by CT.

We used Depuy PFC fixed bearing knee in 17 patients, Stryker knee in 2 patients and Indus knee in 1 patient. Knee immobilizer and compression bandage are applied postoperatively. Ankle and toe movements are encouraged from day one. Physiotherapy is started from first day.

Patients reported for follow up at 3 weeks and 6 weeks during immediate post-operative period. At this time patient is self-ambulatory without any support. The patients were called back for review at 3 months interval. After 1 year they were called yearly and knee society score was used to evaluate the functional results.

Follow up X rays were taken to evaluate loosening, bone resorption and any implant failure. CT of the distal femur is taken during follow up and the rotational orientation of the epicondylar line with posterior aspect of femoral component is evaluated.

Observation & results

In our study we have analysed the functional results of fixed bearing Total Knee Arthroplasty, done in 20 patients in our institute during April 2008- September 2009. Eight patients in this series had bilateral TKA. In the study period 28 knees were operated and 20 patients satisfying the inclusion criteria were taken into the study. The age range was 32 to 65 years, average 48.5 years. There were 5 male patients and 15 female patients. The diagnosis leading to surgery was Osteoarthritis in 13 cases and Rheumatoid arthritis in 7 cases. Out of the 28 knees 5 were in neutral, 11 in Varus, 2 in valgus, 2 in flexion, 2 in valgus and flexion and 6 were in Varus and flexion, preoperatively. The average follows up was 9.2 years (range 8.4 to 10.7 years).

Table 1: showing the Pre-operative radiological assessment

Angle	Range	Average
Lateral distal femoral angle	80 - 92	84.06
Medial proximal tibial angle	75 - 88	82.4
Tibial slope	4 - 14	7
Transepicondylar Line-Posterior condylar line angle	2° - 7°	4.82°

The average postoperative flexion in the rheumatoid group was 105.4 degrees and in the osteoarthritis group was 115.8 degrees. There was no incidence periprosthetic fractures. No patients had neurological deficit or dislocations. One case had valgus instability postoperatively.

In our study all our patients showed an improvement in knee score with mean preop score of 50.4 (range: 46-57) improved to 75.6 (range:65-88). 2 patients had excellent score (80-100).16 patients had good score (70-79) and 2 patients had fair results (60-69). The mean increase in Knee score was 34.2. In the osteoarthritis group it was 34 and in rheumatoid group it was 35.8.

Fig 1: showing the component position analysis by dividing the tibial component into 5 zones.

The accuracy of component position was assessed by mechanical axis restoration, coronal tibio femoral angle, sagittal femoral angle, posterior tibial slope by X-ray and the transepicondylar line-posterior condyle component angle by CT.

The mechanical axis restoration after surgery was assessed using long leg X ray of the operated limb. The tibial component is divided into 5 zones and the zone in which mechanical axis intersects is noted as shown in Figure 1. Out of the 28 knees operated 12 knees had alignment to the center zone, 2 had alignment in zone 1, 12 had alignment in zone 2 and 2 had alignment in zone 3.

No patients had maltracking of patella clinically.one patient with anterior knee pain and two patients with limited flexion post operatively were evaluated with axial view of knee. There were no evidence of patellar tilt or subluxation. No patients had loosening and osteolysis noted around the femoral and tibial components. No implant needed to be revised during the period of study. There was no incidence of superficial or deep infection. Of the 20 patients 18 cases returned to their premorbid condition. Two patients who were rheumatoid has persistent pain.

Table 2: showing the post-operative radiological assessment for component positioning

Postop angles	Average
Coronal femoral component angle	91.4
Coronal tibial component angle	88.5
Coronal tibio femoral angle	177.5
Sagittal femoral angle	88.8
Posterior tibial slope	2.8
Transepicondylar-Posterior condyle component angle	1.28

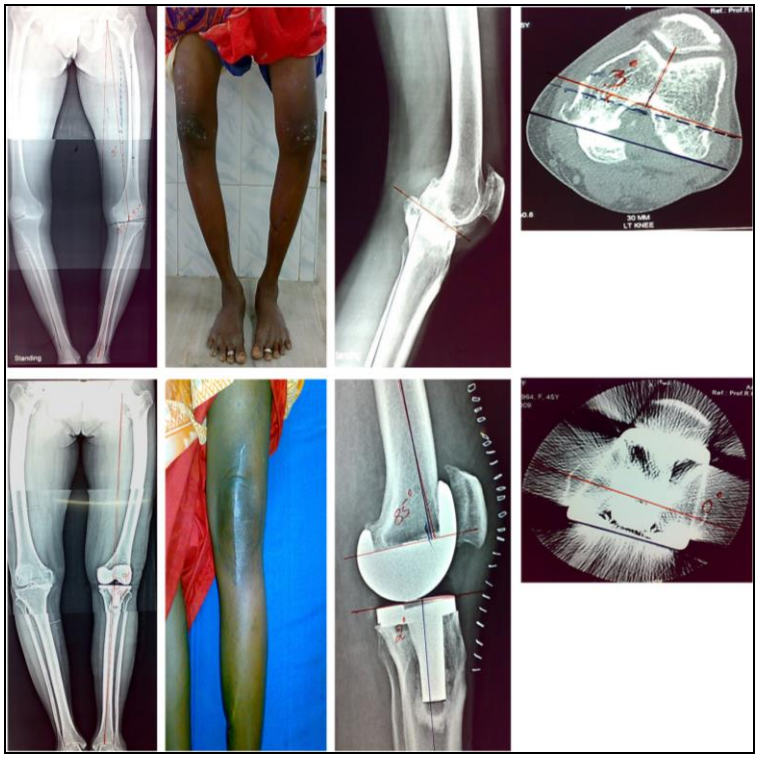

Fig 2: shows a 45/F presented with osteoarthritis left knee. Her preoperative knee score was 55. She underwent left sided TKA and had knee score of 86 at follow up. The results were graded as excellent with anatomical restoration of the components which was confirmed by post op CT.

Fig 3: shows a 36/F presented with Rheumatoid arthritis both knee. Her preoperative knee score was 46. She underwent single stage bilateral TKA and had knee score of 78 at follow up. The results were graded as good with 2 degree of component offset in the post0-op CT.

Discussion

Total knee arthroplasty has had a renaissance in the last decade. The total condylar prosthesis was designed by Insall and others at the Hospital for Special Surgery in 1973. This prosthesis followed the philosophy that mechanical considerations should outweigh the desire to anatomically reproduce the kinematics of normal knee motion. Both cruciate ligaments were sacrificed, with sagittal plane stability maintained by the articular surface geometry. The original cemented total condylar prosthesis dramatically reset the standard for survivorship of total knee replacements; Ranawat *et al*. reported a prosthetic survivorship of 94% at 15-year follow-up.

The evolutions on the designs of prosthesis resulted in posterior cruciate retaining prosthesis and the rotating platform prosthesis. The rotating platform prosthesis has a polythene insert which is capable of a rotatory movement within the tibial component during movements of knee. They have a claimed benefit of better patellofemoral tracking and better function. We in our study used the fixed bearing prosthesis as is done in our institution.

Since the tibial component is fixed, the rotational placement of femoral component is important. Our study included this aspect and we measured the angle between epicondylar line and posterior condylar line for aiding intraoperative placement of the femoral component in correct rotational alignment.

Some conventional fixed-bearing TKAs have been proved to be clinically successful. Survivorship of the Genesis (Smith and Nephew, Memphis, TN) TKA was 96% at 10 years follow-up [6]. Ritter *et al* reported a survivorship of 98.8% at 15 years [7] with the Anatomic Graduated Components (Biomet, Warsaw, IN) TKA. The survival rate of the Total Condyle knee prostheses (Howmedica, Rutherford, JN) was 95% at 15 years [8], 98% at 20 years and 91% at 23 years in different studies [9]. In our long term follow up, we observed a 100 percent survival rate at 5 years follow up in both osteoarthritic group and rheumatoid group and 10-year survival was 100% in osteoarthritic group and 100% in the rheumatoid group. Some patients had symptoms of restricted range of movements but nothing amounting to revision was reported.

There is a debate about the range of motion achieved with Total knee arthroplasty. In one report by Wyled *et al* (2008) the mean flexion range was 112.8° in 142 cases of fixed bearing knees [9]. Study in fixed bearing knee in Indian population by Attique Vasdev reported 101° ± 7.8° in 60 patients [10]. The mean range of flexion in our study is 110.6°. The average postoperative flexion in the rheumatoid group was 105.4 degrees and in the osteoarthritis group was 115.8 degrees.

Functional analysis was done by Knee society knee score [11]. Reported results in The Knee by J. Lim, K. Luscombe, P. Jones, S. White [12] showed a postoperative mean KSS was 86.7 and mean function score was 85.0. Study conducted in Orthopaedic and Trauma Clinic, Kaunas Medical University reported significant improvement in quality of life and a better Knee Society score [13].

In our study we observed that the return to function is excellent to good at short term follow up and good at long term follow up. 2 patients had excellent score (80-100).16 patients had good score (70-79) and 2 patients had fair results (60-69). The mean increase in Knee score was 25.2. In the osteoarthritis group it was 34 and in rheumatoid group it was 22.

The radiological outcome was reported in many series [14-16]. Pleser M. and Woersdoerfer. O (2005) reported a mechanical-axis-range of 180 ± 3 was achieved in 76.8% of the patients [17]. The tibial component was placed in a 2.1 ± 1.3 Varus position. A 0.3 ± 2.7 femoral valgus position was noted. The internal rotation (relative to epicondylar axis) of the femoral component was 2.1 ± 1.5 (0–5.9) [18].

In our long term study the mechanical axis range as measured by the coronal tibio femoral angle averaged 177.5 and a femoral component internal rotation of 1.28° as measured by the Transepicondylar-Posterior condyle component angle.

Component position and functional outcome

The patients with ideal placement of the components i.e. with mechanical axis in zone C&2 and the rotational alignment accurate(Transepicondylar-Posterior condyle component angle- 0 and 1 degree) were assessed for knee flexion and knee score including 10 knees in this group resulted in postop knee flexion average of 113.5 deg and Knee score average of 78.5 indicating an increase in knee flexion of 3.5 degrees and knee score of 3 in this group of patients from the general group.Our study is comparable to a mid-term study done on Fixed bearing and mobile bearing Total Knee Arthroplasty by Attique Vasdev. [11]

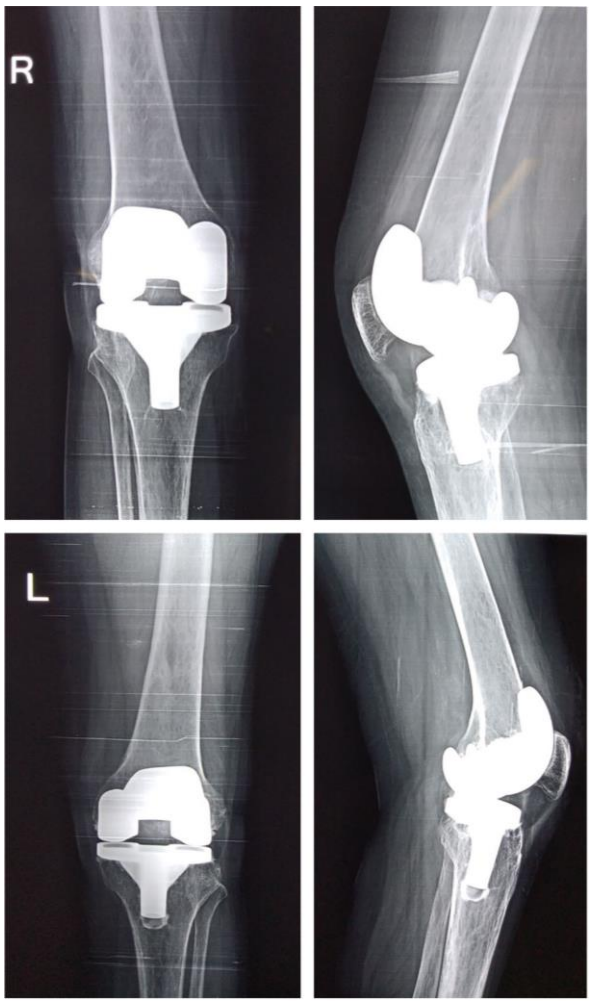

Fig 4: showing the component positioning at the final 10 yrs follow up in a patient with Rheumatoid Arthritis. Note that there is no component malposition or aseptic loosening.

In our study we noted a similar outcome except for a less postoperative Knee score. No patients had loosening and osteolysis noted around the femoral and tibial components [19]. No implant needed to be revised during the period of study.

There was no incidence of superficial or deep infection. Of the 20 patients 18 cases returned to their premorbid condition. Two patients who were rheumatoid has persistent pain.

In the Rheumatoid group, 5/7 has excellent outcome but 2 patients who discontinued the rheumatoid treatment has reduced scores due to pain and involvement of other joint of the limb being tested. But still the component position remained stable in all the patients test at follow-up.

Conclusion

In patients with ideal placement of the components i.e. with mechanical axis in zone C and zone 2 and the rotational alignment accurate (Transepicondylar – Posterior condyle component angle: 0 and 1 degree) better knee flexion and knee score was obtained provided other factors are normal. We conclude that the correct positioning of the components both axially and rotationally improves the functional outcome of fixed bearing knee in low demand patients with an excellent long term clinical outcome.

Further evaluation with more number of patients is essential to come out with a definitive conclusion.

References

1. Scuderi GR, Insall JN, Windsor RE, Moran MC. Survivorship of cemented knee replacements. J Bone Joint Surg. 1989; 71B:798.
2. Tew M, Waugh W. Tibiofemoral alignment and the results of knee replacement. J Bone Joint Surg. 1985. 67B:551.
3. Jeffery RS, Morris RW, Denham RA. Coronal alignment after total knee replacement. J Bone Joint Surg. 1991; 73B:709.
4. Reis MD, Salehi A, Laskin RS *et al*. Can rotational congruity be achieved in both flexion and extension when the femoral component is externally rotated in total knee arthroplasty? Knee. 1998; 5:37.
5. Kaper BP, Woolfrey M, Bourne RB. The effect of built-in external femoral rotation on patellofemoral tracking in the Genesis II total knee arthroplasty. J Arthroplasty 2000; 15:964.
6. Laskin RS. The Genesis total knee prosthesis: A 10-year followup study. Clin Orthop. 2001; 388**:**95-102.
7. Ritter MA, Berend ME, Meding JB, Keating EM, Faris PM, Crites BM. Long-term followup of Anatomic Graduated Components posterior cruciate-retaining total knee replacement. Clin Orthop. 2001; 388:51-57.
8. Gill GS, Joshi AB, Mills DM. Total condylar knee arthroplasty: 16- to 21-year results. Clin Orthop. 1999; 367**:**210-215.
9. Huang CH, Su RY, Lai JH, Hsieh MS. Long-term results of the total condylar knee arthroplasty in Taiwan: A 10 to 15 year follow-up. J Orthop Surg ROC. 1996; 13**:**1-10.
10. Wylde V. Journal of Bone and Joint Surgery – British. 90-B(9):1172-1179.
11. Attique Vasdev. Journel of Orthopaedic Surgery. 2009; 17(2):179-82.
12. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system, Clin Orthop. 1989; 248:13.
13. Lim J, Luscombe K, Jones P, White S. The Knee. 2004; 1(4):251-57.
14. Schai PA, Thornhill TS, Scott RD. Total knee arthroplasty with the PFC system: results at a minimum of ten years and survivorship analysis. J Bone Joint Surg. 1998; 80B:850.
15. Whiteside LA, Arima J. The anteroposterior axis for femoral rotational alignment in valgus total knee arthroplasty, Clin Orthop. 1995. 321:168.
16. Windsor RE, Scuderi GR, Moran MC, Insall JN. Mechanisms of failure of the femoral and tibial components in total knee arthroplasty, Clin Orthop. 1989; 248:15.
17. Sikorski JM, Bone J Joint Surg [Br]. 2008; 90-B:1121-7.
18. Pleser M, Woersdoerfer O. Journal of Bone and Joint Surgery – British. 88-B(I):29.
19. Arun Mullaji B. Journal of Orthopaedic Surgery. 2009; 17(2):166-9.
20. Ecker ML, Lotke PA, Windsor RE *et al*: Long-term results after total condylar knee arthroplasty: significance of radiolucent lines, Clin Orthop. 1987; 216:151.