

Short Term Analysis of Fixed Bearing Total Knee Arthroplasty

¹Dr. Shashikanth Bhure, ²Dr. Danduru Vasudeva Reddy, ³Dr. Rohith Jhamnani

Orthopaedic resident, Department of Orthopaedics, Father Muller Medical College, Mangalor, India

Abstract: 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.

Objective: To assess the functional and radiological results of Fixed bearing Total Knee Arthroplasty.

Materials and Methods: This was a prospective study conducted among 20 patients who underwent fixed bearing total knee arthroplasty in the age group of 32 to 65 years. Period of study was from June 2013 to September 2014. Patients were selected by purposive sampling who were admitted in the department of orthopaedics, Father Muller Medical College Hospital during the above mentioned period. The data was collected by interview, and by analysing case papers. The patients were followed up at 3 weeks and 6 weeks postoperatively and later they were called back for review at 3 months interval. At the end of the study, patients functional outcome were evaluated with Knee society scores.

Results: Out of the 20 knees 5 were in neutral, 11 in varus, 2 in valgus and flexion and 2 were in varus and flexion. The average follow up was 40 weeks (range 12 to 64 weeks). The average postoperative flexion in the rheumatoid group was 105.4 degrees and in the osteoarthritis group was 115.8 degrees. In our study all our patients showed an improvement in knee score. 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

Conclusion: Patients with rheumatoid arthritis achieved less postoperative range of flexion compared to the osteoarthritis group. But they achieve more increase in knee score.

Keywords: Knee Arthroplasty, Short Term Analysis.

1. INTRODUCTION

Arthroplasty is an operation to restore pain-free motion of a joint and function of the muscles, ligaments, and other soft tissue structures that control the joint. The goals of total joint arthroplasty are simple, to relieve pain, to provide motion while maintaining stability, and to correct deformity. The primary indication for total knee arthroplasty is to relieve pain caused by severe arthritis, with or without significant deformity.

Implanting femoral and tibial component to replace the degenerated knee joint will relieve the pain and provide mobile, pain free and a stable joint. Because knee replacement has a finite expected survival, it generally is indicated in older patients with more sedentary lifestyles⁽¹⁾. It also is clearly indicated younger patients who have limited function because of systemic arthritis with multiple joint involvement.

The total condylar prosthesis was designed by Insall⁽²⁾. The design of the total condylar prosthesis included a chrome cobalt femoral component with a symmetrical anterior flange for patellar articulation. Most current total knee designs are derivatives of the Insall-Burstein and Kinematic designs.

Numerous studies have shown a correlation between success of total knee arthroplasty and restoration of near-normal limb alignment⁽³⁾. 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.

Contraindications to total knee arthroplasty include recent or current knee sepsis, a remote source of ongoing infection, extensor mechanism discontinuity or severe dysfunction, recurvatum deformity secondary to muscular weakness, and the presence of a painless, well-functioning knee arthrodesis. Complications of Total knee Arthroplasty include deep vein thrombosis, infection instability, patellofemoral complications, neurovascular complications and periprosthetic fractures.

We are presenting the short term follow up of functional results of Total knee arthroplasty prospectively done in our institute during the last 2 years.

2. IMPLANT DESIGN

The design of the total condylar prosthesis included a chrome cobalt femoral component with a symmetrical anterior flange for patellar articulation. The symmetrical femoral condyles had a decreasing sagittal radius of curvature posteriorly and were individually convex in the coronal plane. The double-dished articular surface of the tibial polyethylene component was perfectly congruent with the femoral component in extension and congruent in the coronal plane in flexion⁽⁴⁾.

Translation and dislocation of the components were resisted by the anterior and posterior lips of the tibial component as well as the median eminence. The tibial component had a metaphyseal stem to resist tilting of the prosthesis during asymmetric loading. The tibial component was originally all-polyethylene, but metal backing was later added to allow more uniform stress transfer to the underlying cancellous metaphyseal bone and to prevent polyethylene deformation.

POLYETHYLENE ISSUES:

Ultrahigh molecular weight polyethylene (UHMWP) articular surfaces are an integral part of total knee replacement. Catastrophic wear leading to early failure and osteolysis, although seen less frequently than in total hip arthroplasty, has occurred more frequently in some total knee designs. The study of polyethylene has provided information on its varying wear characteristics after different fabrication and sterilization processes, as well as its limitations in total knee applications.

Compared with the perfectly conforming articulations of total hip replacements, the tibiofemoral articulations in modern total knee replacements are nonconforming with the femoral condyles, having a decreasing radius of curvature posteriorly. PCL-retaining prostheses require an even greater degree of sagittal plane nonconformity because the tibial surface must remain relatively flat to allow femoral roll-back without excessive PCL tension. This nonconformity creates areas of high contact stress within the polyethylene⁽⁵⁾.

Tibial polyethylene thickness also is correlated with accelerated wear⁽⁶⁾. Bartel, Bicknell, and Wright recommended a minimal polyethylene thickness of 8 mm to avoid the higher contact stresses that occur with thinner polyethylene. Collier et al⁽⁵⁾ also recommended a minimal 8-mm thickness on the basis of finite element modeling.

Retrieval studies demonstrating accelerated wear in knees implanted with thin polyethylene have validated this recommendation. The introduction of highly cross-linked polyethylene produced by high-dose gamma irradiation with subsequent annealing has produced dramatic decreases in wear in simulated hip studies⁽⁷⁾.

COMPONENT FIXATION:

Prosthetic fixation with polymethylmethacrylate (PMMA) in total knee replacement gained widespread use in the 1970s and has continued through the present cemented fixation has produced more uniformly reliable long-term fixation with less osteolysis in multiple prosthesis designs⁽⁸⁾.

3. AIM

The aim of this study is to analyse the short 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 June 2013 to September 2014.

4. MATERIALS AND METHODS

This is a prospective study conducted at the Department of Orthopaedic surgery, Father Muller Medical College Hospital June 2013 to September 2014. 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. Bicompartamental Arthritis of knee – OA, R.A
2. Neutral, Varus, Valgus and Flexion deformity <math><30^\circ</math>

The exclusion criteria were :-

1. Severe varus and Valgus >math>30^\circ</math>
2. Flexion deformity > 30°

PREOPERATIVE EVALUATION:

A detailed preoperative medical evaluation of the patients for comorbid diseases were done. A routine preoperative cardiac evaluation, pulmonary evaluation was done by appropriate medical consultants.

Routine preoperative laboratory evaluation including complete blood cell count, electrolytes, including coagulation profile, urinalysis and chest roentgenogram was done.

Preoperative knee roentgenograms including a standing anteroposterior view, a lateral view and a long leg standing AP view was taken. The long leg standing anteroposterior view is beneficial in determining the mechanical axis of the limb and is also useful to determine any significant bowing of the tibia or femur. Templates are used to anticipate approximate component size and bone defects that will need to be treated intraoperatively.

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.

SCORING:

Preoperatively all patients are functionally evaluated using Knee society knee score. The Knee Society clinical rating system has a separate knee score with 50 points for pain, 25 points for range of motion, and 25 points for stability. Points are deducted for flexion contracture, extension lag, and malalignment.

Patient category

- A. Unilateral or bilateral (opposite knee successfully replaced)
- B. Unilateral, other knee symptomatic
- C. Multiple arthritis or medical infirmity

Objective Scoring

Pain Points

None 50

Mild or occasional 45

Stairs only 40

Walking & stairs 30

Moderate

Occasional 20

Continual 10

Severe 0

Range of motion

(5° = 1 point) 25

Stability

(maximum movement in any position)

Anteroposterior

<5 mm 10

5-10 mm 5

10 mm 0

Mediolateral

<5° 15

6° -9° 10

10° -14° 5

15° 0

Flexion contracture

5° -10° -2

10° -15° -5

16° -20° -10

>20° -15

Extension lag

<10° -5

10° -20° -10

>20° -15

Alignment

5° -10° 0

0° -4° 3 points each degree

11° -15° 3 points each degree

Functional Scoring

Walking 50

Unlimited 40

>10 blocks 30

5-10 blocks 20

<5 blocks 10

Housebound 0

Stairs

Normal up & down 50

Normal up,down with rail 40

Up & down with rail 30

Up with rail; unable down 15

Unable 0

Functional Deductions

Cane -5

Two canes -10

Crutches or walker -20

Other 20

Knee Score

(If total is a minus number, score is 0)

5. SURGICAL PROCEDURE

We used Depuy PFC fixed bearing knee in 17 patients, Stryker knee in 2 patients and Indus knee in 1 patient.

We used the anterior midline incision for skin and a medial parapatellar retinacular approach for the retinaculum. The medial side of the knee is exposed by subperiosteally stripping the anteromedial capsule and deep medial collateral ligament off the tibia to the posteromedial corner of the knee.

The knee is extended and the patella is everted along with routine release of lateral patellofemoral plicae. The knee is again flexed, the anterior cruciate ligament and the anterior horns of the medial and lateral menisci are removed along with any osteophytes that may lead to component malposition or soft tissue imbalance. The posterior horns of the menisci can be excised after the femoral and tibial cuts have been made.

The tibia can now be sublaxed anteriorly and externally rotated. The initial tibial cut is usually perpendicular to the shaft with a slight posterior angulation according to the system that is being used. Tibial stem preparation is done.

Femoral preparation is done using intramedullary alignment jig. Complete the distal femoral preparation for by making anterior and posterior chamfer cuts for the implant. Varus-valgus balance can be fine tuned with further medial or lateral releases. Remove any medial or lateral osteophytes that tent the collateral ligaments. Remove posterior condylar osteophytes with a curved osteotome because they can tent the posterior capsule and narrow the extension gap or impinge during knee flexion. The flexion and extension gaps must be equal.

The cut bone surfaces are cleaned with a pulsatile lavage irrigator using saline. The surfaces are then dried with clean sponges. The tibial tray is implanted first. Doughy PMMA cement is applied to the cut surface of the tibia. Excess cement is removed from the periphery of the component. The femoral components is cemented in a similar fashion with a few additional considerations. The wound is closed in layers with drain in situ.

Knee immobilizer and compression bandage are applied postoperatively. Ankle and toe movements are encouraged from day one. Epidural analgesia is administered for 48 hrs. Drain removal done after 24-48 hrs. Intravenous antibiotics are given for 5 days. Low molecular weight heparin is administered for 10 days.

Physiotherapy is started from first day. Static gluteal and quadriceps exercises are taught. Passive and active knee mobilization is started after drain removal. The patient is made to sit up in bed and also with legs hanging by the side of the bed. Weight bearing with crutch support is allowed with knee in an immobilizer after drain removal.

6. FOLLOW UP

The patient reports for follow up at 3 weeks and 6 weeks. At this time patient is self-ambulatory without any support. The patients were called back for review at 3 months interval. At the end of this study, they were evaluated with Knee society scores.

X rays of knee in anteroposterior, lateral and long leg weight bearing views were taken and the alignment of component evaluated. Follow up X rays were taken to evaluate loosening, bone resorption and any implant failure.

7. RESULTS

The age range was **32 to 65 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 20 knees 5 were in neutral, 11 in varus, 2 in valgus and flexion and 2 were in varus and flexion. The average follow up was 40 weeks (range 12 to 64 weeks). 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. 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.

Mechanical axis restoration:

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 the picture.



Out of the 20 knees operated 12 knees had alignment to the centre zone, 2 had alignment in zone 1,4 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. This was not significant because our study is a short term study. 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 pre-morbid condition. Two patients who were rheumatoid has persistent pain.

8. OBSERVATION AND DISCUSSION

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^(4, 9). Ritter et al reported a survivorship of 98.8% at 15 years⁽¹⁰⁾ 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 years³³, 98% at 20 years and 91% at 23 years in different studies⁽¹¹⁾. Since our study was short term,we observed a 100 percent survival rate.

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⁽¹²⁾.Study in fixed bearing knee in Indian population by Attique Vasdev reported 101° ± 7.8° in 60 patients⁽¹³⁾.

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. Reported results in The Knee by J. Lim, K. Luscombe, P. Jones, S. White⁽¹⁴⁾ 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⁽¹⁵⁾.

In our study we observed that the return to function is excellent to good at short 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 short term study by D. Parsch et al⁽¹⁶⁾ evaluated the outcome of 65 knees and the mean score in these patients were 76 and average knee flexion was 118 degrees.

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⁽¹⁷⁾. This was not significant as this is a short term study. Of the 20 patients 18 cases returned to their pre-morbid condition. Two patients who were rheumatoid had persistent pain.

9. SUMMARY AND CONCLUSION

- The mean preoperative Knee society score was 50.4, While the mean postoperative score was 75.6 indicative of the overall good short term clinical outcome.
- 2 patients had excellent score(80-100), 16 patients had good score(70-79) and 2 patients had fair results(60-69).
- The average postoperative flexion in the rheumatoid group was 105.4 degrees and in the osteoarthritis group was 115.8 degrees
- Patients with rheumatoid arthritis achieved less postoperative range of flexion compared to the osteoarthritis group. But they achieve more increase in knee score.
- No implant needed to be revised during the period of study.

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

REFERENCES

- [1] Duffy GP, Trousdale RT, Stuart MJ. Total Knee Arthroplasty in Patients 55 Years Old or Younger: 10-to 17-Year Results. *Clinical orthopaedics and related research*. 1998;356:22-7.
- [2] Scuderi GR, Insall JN, Windsor RE, Moran MC. Survivorship of cemented knee replacements. *Journal of Bone & Joint Surgery, British Volume*. 1989;71(5):798-803.
- [3] Jeffery RS, Morris RW, Denham RA. Coronal alignment after total knee replacement. *Journal of Bone & Joint Surgery, British Volume*. 1991;73(5):709-14.
- [4] Laskin R, Rieger M, Schob C, Turen C. The posterior stabilized total knee prosthesis in the knee with a severe fixed deformity. *Am J Knee Surg*. 1988;1(4):199-205.
- [5] Collier JP, Mayor MB, McNamara JL, Surprenant VA, Jensen RE. Analysis of the failure of 122 polyethylene inserts from uncemented tibial knee components. *Clinical orthopaedics and related research*. 1991(273):232-42.
- [6] Landy MM, Walker PS. Wear of ultra-high-molecular-weight polyethylene components of 90 retrieved knee prostheses. *The Journal of arthroplasty*. 1988;3:S73-S85.
- [7] Tsao A, Mintz L, McRae C, Stulberg S, Wright T. Failure of the porous-coated anatomic prosthesis in total knee arthroplasty due to severe polyethylene wear. *The Journal of Bone & Joint Surgery*. 1993;75(1):19-26.
- [8] Amstutz HC, Campbell P, Kossovsky N, Clarke IC. Mechanism and clinical significance of wear debris-induced osteolysis. *Clinical orthopaedics and related research*. 1992;276:7-18.
- [9] Laskin RS. The Genesis total knee prosthesis: a 10-year followup study. *Clinical orthopaedics and related research*. 2001;388:95-102.

- [10] 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. *Clinical orthopaedics and related research*. 2001;388:51-7.
- [11] Huang C-H, Su R-Y, Lai J-H, Hsieh M-S. Long-Term Results of the Total Condylar Knee Arthroplasty in Taiwan A 10-to 15-Year Follow Up. *Journal of Orthopedic Surgery Taiwan*. 1996;13(1):1-10.
- [12] Wylde V, Blom A, Dieppe P, Hewlett S, Learmonth I. Return to sport after joint replacement. *Journal of Bone & Joint Surgery, British Volume*. 2008;90(7):920-3.
- [13] Vasdev A, Kumar S, Chadha G, Mandal SP. Fixed-versus mobile-bearing total knee arthroplasty in Indian patients. *Journal of Orthopaedic Surgery*. 2009;17(2).
- [14] Lim J, Luscombe K, Jones P, White S. The effect of preoperative symptom severity on functional outcome of total knee replacement—patients with the lowest preoperative scores achieve the lowest marks. *The Knee*. 2006;13(3):216-9.
- [15] Schai PA, Thornhill TS, Scott RD. Total knee arthroplasty with the PFC system results at a minimum of ten years and survivorship analysis. *Journal of Bone & Joint Surgery, British Volume*. 1998;80(5):850-8.
- [16] Parsch D, Krüger M, Moser M, Geiger F. Follow-up of 11–16 years after modular fixed-bearing TKA. *International orthopaedics*. 2009;33(2):431-5.
- [17] ECKER ML, LOTKE PA, WINDSOR RE, CELLA JP. Long-term results after total condylar knee arthroplasty: significance of radiolucent lines. *Clinical orthopaedics and related research*. 1987;216:151-8.