

## EFFICACY OF ACHIEVING OPTIMUM MECHANICAL BALANCE OF THE PATELLO-FEMORAL JOINT IN REDUCING ANTERIOR KNEE PAIN AFTER TOTAL KNEE ARTHROPLASTY

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### ABSTRACT:

**Background & Objectives:** Anterior knee pain is one of the common complication after Total Knee Arthroplasty (TKA). This study is an attempt to reduce or eliminate the problem of post-operative anterior knee pain by proper mechanical balancing of the patello-femoral joint during TKA.

**Methods:** 32 Patients with osteoarthritis or rheumatoid arthritis of knee requiring TKA were enrolled for this prospective study. We have excluded patients of revision knee arthroplasty, charcot joints and patients with life expectancy less than 10 years. Bilateral total knee arthroplasty was performed in 10 patients hence 42 total knee arthroplasties were studied. Along with meticulous attention to all aspects of TKA our study focuses on restoration of patellar height of 10 – 30 mm proximal to the prosthetic joint line, change in joint line of prosthesis as compared to original joint line from tibial tuberosity of less than 8mm and Judicious retinacular release, if needed.

**Results and Interpretation:** Post-operative excellent results were seen in 91 % of cases. Good results were seen in 3 % of cases, fair results were seen in 3 % of cases and poor result in 3 % of cases. No patient complained of anterior knee pain. Achieving proper mechanical balance of the patella-femoral joint is an excellent technique in an attempt to reduce post-operative incidence of anterior knee pain after TKA.

**Keywords:** Anterior knee pain, Patello-femoral joint, Total knee arthroplasty.

### INTRODUCTION:

Anterior knee pain is one of the common complication after Total Knee Arthroplasty (TKA).<sup>1,2,3,4,5,6</sup> 4% to 49.2% of all TKA patients have anterior knee pain.<sup>1,2,3,4,5,6</sup> Amongst all complications of TKA, after joint infection, patello-femoral problems are one of the most common reasons for revision.<sup>7,8,9,10,11</sup>

Various factors which could lead to anterior knee pain are patello-femoral instability, rotational error of the prosthetic components, offset error of the femoral component, patella baja, synovial hyperplasia, chondrolysis.<sup>12,13,14,15,16</sup> All these problems could be effectively reduced if proper mechanical balance of the patello-femoral joint is achieved. This study is an attempt to reduce or eliminate the problem of post-operative anterior knee pain and other patello-femoral complications like patellar subluxation, dislocation and fracture.

### MATERIALS AND METHODS:

Patients with osteoarthritis or rheumatoid arthritis of knee with either varus, valgus and/or flexion deformity were invited to participate in the study. We have excluded patients of revision knee arthroplasty, charcot joints, patients with life expectancy less than 10 years and those patients who are not willing to participate in the study. With this criteria 35 patients were enrolled for this prospective study conducted between August 2001 to June 2005.

Bilateral total knee arthroplasty was performed in 11 patients. Posterior stabilized PFC Sigma prosthesis (DePuy, Johnson-johnson) was used in all study cases.

The study was approved by the Internal Review Board. Procedures followed are in accordance with the ethical guidelines laid down for Medical research on human participants. We obtained informed consent from all patients.

Detail history and clinical examination was performed in all patients. Examination of upper limbs, spine, hips and ankle was done to rule out other abnormalities. Weight bearing antero-posterior roentgenogram of both knee including lower half of femur and upper half of tibia and fibula were taken. Longitudinal axis of tibia and femur were drawn on these roentgenogram films. Femoral and tibial cuts were drawn on these films. Radiographic templates are overlaid on the roentgenogram films to estimate the appropriate size of the prosthesis.<sup>8,11,21,24,25</sup>

The concerned limb is prepared from groin to toes. Pre-operative prophylactic antibiotic dose of injection cefazolin 1 gm given intravenously previous night and half hour before the surgery. Tournique was applied in all patients and the joint was approached through a standard midline incision with medial para patellar approach. The patella was everted laterally. Horizontal tibial bone resection was performed using an extra medullary alignment guide and then an intramedullary alignment guide was used for the femur. The angle was kept 7° valgus and 3° external

rotation.

Trial prostheses inserted and overall alignment was checked with alignment rod. The rod bisects the center of hip and center of ankle (aligned with second metatarsal) when the alignment is correct. Rotational positioning of the trial prosthetic components is checked. The tibial component should be aligned with the tibial tubercle. Rotational malalignment (mainly of femoral component) predisposes to patellar mal-tracking and patellar dislocation.<sup>8,10,11,21,24,25</sup> The medial-lateral positioning of both femoral and tibial components is checked. They should be positioned anatomically on their respective bones. Now with trial prosthesis in place, the knee is extended slowly; medial and lateral stability is noted. Balance is established by eliminating soft tissue contractures, not by modifying bone cuts because too much bone resection leads to change in height of prosthetic joint line and patellar height. The distal margin of patellar implant (when patella not resurfaced, inferior pole of patella considered) is maintained 10 to 30 mm proximal to the joint line of the prosthesis in our study.<sup>17</sup>

Patella was not resurfaced in every case of this study. It was replaced only in cases where there is severe destruction of articular surface and patella in rheumatoid knee.<sup>2,8,12,14,20</sup> The “no thumb rule” was performed in all patients. In all patients with tightness of the lateral retinaculum producing subluxation of patella, tourniquet was deflated and reassessment was performed. Lateral retinacular release was performed if patellar maltracking persisted.<sup>8,11,21,24</sup> Thus smooth tracking of patella and proper balance of patello-femoral joint was achieved in all cases. Then trial prosthesis were removed, bone surfaces cleaned with pulse lavage and dried and final prosthetic components cemented. Thorough attention is given to rotational alignment and medial-lateral positioning of both femoral and tibial prosthetic components.<sup>8,10,11,21,24,25</sup> Tourniquet was deflated and low volume suction drain inserted.

Physiotherapy was given to all patients from first postoperative day. All patients were given low molecular weight heparin injections for the prophylaxis of deep vein thrombosis. Patients were discharged once they achieved knee flexion more than 90° and able to walk with walker. Physiotherapy was continued at home till patients could walk independently. Patient are followed up after 4 weeks and then once every 3 months up to 1 year and then once in every year. At every follow up visit clinical and radiological evaluation was performed.

Through clinical evaluation was performed along with American knee society scoring.<sup>18</sup> At the time this study was performed, no scoring system for measuring anterior knee pain was available.<sup>19</sup> Therefore patients were specifically asked about presence or absence of anterior knee pain.

Radiological evaluation was done with standard antero-posterior and lateral radiographs. Accuracy of component placement is checked. The height of patella (or patellar implant) checked from the distal margin of patella to the prosthetic joint line. The height of patella of about 10-30 mm is considered satisfactory. The change in joint line of prosthesis as compared to original joint line is noted. A change in joint line of prosthesis – less than 8 mm as compared to original joint line is considered satisfactory in this study.<sup>17</sup> Original joint line was calculated on pre – operative radiograph from tibial tuberosity and post – operative joint line was calculated from tibial tuberosity to the new prosthetic joint line. Difference in pre – operative and post – operative joint line is noted. Figure 1A and 1B.



**Fig. 1A: (Pre-operative lateral radiograph showing joint line measurement)**



**Fig. 1B: (Post-operative radiograph showing measurement of patellar height and prosthetic joint line).**

## RESULTS:

35 patients with severe arthritis of knee were studied. 31 patients (88.5%) had osteo – arthritis and 4 patients (11.5%) were diagnosed to be rheumatoid. 11 patients had bilateral affection and they were operated on both knees. Two patients died 6 to 7 years after surgery as a result of cardiac event. One patient lost follow up as she has migrated to other place. Therefore at the end we have 42 total knee arthroplasties performed in 32 patients available for the evaluation.

In this study, the youngest case was a 42 year female and oldest was 78 years old male. Overall mean age was 62 years. Out of 32 patients 29 patients were recovered completely.

Minor complications like numbness, paresthesia and mild intermittent pain on excessive walking were seen in 6 patients. Out of these 5 patients were relieved completely with oral medication and physiotherapy. One patient had persistent paresthesia and numbness. One patient had diffuse knee pain of moderate grade only on excessive walking. Major complication developed in one patient who had deep infection one month after surgery. She was re-operated – joint was exposed, thorough lavage with normal saline was given and polyethylene insert was changed. Patient was recovered after this procedure but she complained of pain on off. She had reduced range of motion ( $105^0$  flexion) and mild instability. All cases were followed up post – operatively from 10 years to 14 years. Average post – operative follow up 12.5 years. Knee society rating system was used to assess functional outcome.<sup>18</sup> Table 1.

Post – operative excellent results were seen in 91 % of cases. Good results were seen in 3 % of cases, fair results were seen in 3 % of cases and poor result in 3 % of cases.

Post-operative radiological evaluation was done on the basis of:

1. Post – operative height of patella measured from joint line of prosthesis to distal margin of the patella (or patellar implant when patella replaced).<sup>17</sup> Table 2.
2. A change in joint line of prosthesis – less than 8 mm as compared to original joint line was maintained in 38 of total 42 total knee arthroplasties performed in 32 patients. Original joint line calculated on pre – operative radiograph from tibial tuberosity and post – operative joint line calculated from tibial tuberosity to the new prosthetic joint line. Difference of less than 8 mm is taken as satisfactory.<sup>17</sup>
3. Alignment
4. Neutral placement of prosthetic components.
5. Radiolucent zone.

**Table 1: (Pre-operative and post-operative comparison of functional outcome)**

Parameters	Pre-operative	Post-operative
The knee society score (Average)	52	84.2
Functional score (Average)	43	61
Pain score		
None	00	29
Mild	00	01
Moderate	06	02
Severe	26	00

Walking ability		
Cannot walk	02	00
Walk less than 20 steps	24	00
Walk 20 to 100 steps	06	00
Walk more than 100 steps	00	01
Walk more than 500 steps	00	31
Range of movement		
Less than $70^0$	03	00
$70^0$ to $90^0$	05	00
$90^0$ to $110^0$	17	01
More than $110^0$	07	31
Grade of instability		
No instability	00	31
Mild( $0^0$ to $5^0$ )	00	01
Moderate( $6^0$ to $15^0$ )	23	00
Severe( $>15^0$ )	11	00

**Table 2: (Post-operative patellar height measured on radiographs)**

Post – Operative Patellar Height on Radiograph	No. of knees(42 TKA in 32 patients)	%
10 – 15 MM	8	19
16 – 20 MM	19	45.2
21 – 25 MM	15	35.8
26 – 30 MM	0	00

## DISCUSSION:

Anterior knee pain is one of the common complication after TKA. Reported incidence of anterior knee pain after TKA is 4% to 49.2%.<sup>1,2,3,4,5,6</sup> Amongst all complications of TKA, after joint infection, patello-femoral problems are one of the most common reasons for revision.<sup>7,8,9,10,11</sup>

Causes of anterior knee pain after TKA are patello-femoral instability, rotational error of the prosthetic components, patella baja, synovial hyperplasia, chondrolysis.<sup>16,22,23,26,27,28,29</sup> All these factors can lead to patello-femoral problems and anterior knee pain after TKA.<sup>12,13,14,15.</sup>

Synovitis around patella, inflammation in the Hoffa fat pad can lead to anterior knee pain after TKA.<sup>11</sup> To reduce this peripatellar synovectomy and resection of Hoffa's fat pad was performed in all patients of our study.<sup>11</sup>

Patella baja can also lead to anterior knee pain after TKR.<sup>30</sup> Inadequate soft tissue release, over-resection of bone and high inlay to achieve stability leads to elevated joint line thus leading to patella baja.. Elevated joint line leads to reduced distance between the patella and the tibia.<sup>30</sup> Therefore over-resection and high inlay are avoided as far as possible in our study and stability was achieved with adequate soft tissue balancing.

Function of knee and patello femoral symptoms were correlated with the position of implant by Figgie HE, Goldberg VM and co – workers.<sup>17</sup> They have concluded that a patellar height of between 10 to 30 mm, a change in joint line of 8 mm or less and neutral or posterior placement of tibial prosthesis are

necessary to reduce post-operative patella-femoral problems and anterior knee pain.

In our series total 42 knee replacement were performed in 32 patients (in 10 patients bilateral total knee arthroplasty was done) were studied. Intra-operative and post-operative meticulous attention was given to the criteria defined by Figgie HE, Goldberg VM and co – workers. Post – operative follow up period in our study was 10 years to 14 years. Average follow up was 12.5 years.

After average follow up of 12.5 years results of our series are –

- Excellent in 91 % of cases.
- Good in 3 % of cases.
- Fair in 3 % of cases.
- Poor in 3 % of cases.

Post-operatively no patient had complications referable to patella-femoral joint in the form of anterior knee pain, patellar impingement, subluxation, dislocation or fracture. Our study has limitation in the form of small sample size but data shows that restoration of proper mechanical balance of the patello-femoral joint is very important in optimizing functional result after TKA even at long term follow up.

## CONCLUSION

Successful outcome of total knee replacement depends upon –

- Alignment and accurate positioning of femur, tibia, patella and prosthetic knee components. Restoration of mechanical axis.
- Varus and valgus balancing.
- Flexion and extension balancing.
- Accurate cementation technique.

Along with meticulous attention to all these aspects our study focuses on restoration of

- Patellar height of 10 – 30 mm proximal to the prosthetic joint line.
- Joint line of prosthesis as compared to original joint line from tibial tuberosity of less than 8mm.
- Judicious retinacular release (if needed – especially in valgus knee).

Post-operatively no patient had complication referable to patello – femoral joint in the form of anterior knee pain, patellar impingement, subluxation, dislocation or fracture. Thus “achieving proper mechanical balance of the patella-femoral joint” is an excellent technique in an attempt to reduce post – operative incidence of anterior knee pain after TKA.

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## REFERENCES:

1. Scuderi GR, Insall JN, Scott NW. Patellofemoral pain after total knee arthroplasty. *J Am Acad Orthop Surg.* 1994;2:239–246
2. Wood DJ, Smith AJ, Collopy D, White B, Brankov B, Bulsara MK. Patellar resurfacing in total knee arthroplasty: a prospective, randomized trial. *J Bone Joint Surg Am.* 2002;84:187–193.
3. Muoneke HE, Khan AM, Giannikas KA, Hagglund E, Dunningham TH. Secondary resurfacing of the patella for persistent anterior knee pain after primary knee arthroplasty. *J Bone Joint Surg Br.* 2003;85:675–678.
4. Pagnano MW, Trousdale RT, Stuart MJ, Hanssen AD, Jacofsky DJ. Rotating platform knees did not improve patellar tracking: a prospective, randomized study of 240 primary total knee arthroplasties. *Clin Orthop Relat Res.* 2004;428:221–227.
5. Price AJ, Rees JL, Beard D, Juszczak E, Carter S, White S, de Steiger R, Dodd CA, Gibbons M, McLardy-Smith P, Goodfellow JW, Murray DW. A mobile-bearing total knee prosthesis compared with a fixed-bearing prosthesis: a multicentre single-blind randomised controlled trial. *J Bone Joint Surg Br.* 2003;85:62–67.
6. Callaghan JJ, Insall JN, Greenwald AS, Dennis DA, Komistek RD, Murray DW, Bourne RB, Rorabeck CH, Dorr LD. Mobile-bearing knee replacement: concepts and results. *Instr Course Lect.* 2001;50:431–449.
7. Mochizuki RM, Schurman DJ. Patellar complications following total knee arthroplasty. *J Bone Joint Surg Am.* 1979;61:879–883.
8. Eisenhuth SA, Saleh KJ, Cui Q, Clark CR, Brown TE. Patellofemoral instability after total knee arthroplasty. *Clin Orthop Relat Res.* 2006;446:149–160.
9. Sharkey PF, Hozack WJ, Rothman RH, Shastri S, Jacoby SM. Insall Award paper. Why are total knee arthroplasties failing today? *Clin Orthop Relat Res.* 2002;404:7–13.
10. Berger RA, Crossett LS, Jacobs JJ, Rubash HE. Malrotation causing patellofemoral complications after total knee arthroplasty. *Clin Orthop.* 1998;356:144–153.
11. van Jonbergen HP, Reuver JM, Mutsaerts EL, Poolman RW (2012) Determinants of anterior knee pain following total knee replacement: a systematic review. *Knee Surg Sports Traumatol Arthrosc.*
12. ENIS JE, GARDNER R, ROBLEDO MA et al: Comparison of patellar resurfacing verses non resurfacing in bilateral total knee arthroplasty. *Clin Orthop* 1990; 38,.
13. HIRSH DM, SALLIS JG: Pain after total knee arthroplasty caused by soft tissue impingement. *J Bone Joint Surgery [Am]* 1989 ; 71.
14. RAND JA: Patellar Resurfacing in total knee arthroplasty. *Clin Orthop* 1990; 110.
15. SETH S LEOPLOD, CRIG D, SILVERTON, RM BARDEN, AG ROSENBERG: Isolated revision of the patellar component in total knee arthroplasty. *J Bone Joint Surgery [Am]* 2003 85A: 41.
16. SHOJI H, YOSHINO S, KAJINO A:- Patellar replacement in bilateral total knee arthroplasty: a study of patients who had rheumatoid arthritis and no gross deformity of the patella. *J Bone Joint Surgery*

- [Am]1989; 71:.
17. FIGGIE HE, GOLDBERG VM, HEIPLE KG et al: The Influence of Tibial patello – femoral location on function of the knee in patients with posterior stabilized condylar knee prosthesis. *J Bone Joint Surgery* [AM]1986; 1035.
  18. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system. *Clin Orthop Relat Res.* 1989;248:13–14.
  19. Baldini A, Anderson JA, Zampetti P, Pavlov H, Sculco TP. A new patellofemoral scoring system for total knee arthroplasty. *Clin Orthop Relat Res.* 2006;452:150–154.
  20. Fu Y, Wang G, Fu Q. Patellar resurfacing in total knee arthroplasty for osteoarthritis: a meta-analysis. *Knee Surg Sports Traumatol Arthrosc.* 2011;19(9):1460–1466.
  21. Mosis EK, Paschos N, Pakos EE, Georgoulis AD. Patellar instability after total knee arthroplasty. *J Orthop Surg (Hong Kong)* 2009;17:351–357.
  22. Sanchis-Alfonso V, Roselló-Sastre E, Monteagudo-Castro C, Esquerdo J. Quantitative analysis of nerve changes in the lateral retinaculum in patients with isolated symptomatic patellofemoral malalignment. A preliminary study. *Am J Sports Med.* 1998;26(5):703–709.
  23. Sanchis-Alfonso V, Roselló-Sastre E. Immunohistochemical analysis for neural markers of the lateral retinaculum in patients with isolated symptomatic patellofemoral malalignment. A neuroanatomic basis for anterior knee pain in the active young patient. *Am J Sports Med.* 2000;28(5):725–731.
  24. Sanchis-Alfonso V. Patellofemoral pain. *Orthopade.* 2008;37(9):835–836.
  25. Seil R, Pape D. Causes of failure and etiology of painful primary total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc.* 2011;19(9):1418–1432.
  26. Yoshii I, Whiteside LA, Anouchi YS. The effect of patellar button placement and femoral component design on patellar tracking in total knee arthroplasty. *Clin Orthop Relat Res.* 1992;275:211–221.
  27. Becher C, Heyse TJ, Kron N, Ostermeier S, Hurschler C, Schofer MD, Fuchs-Winkelmann S, Tibesku CO. Posterior stabilized TKA reduce patellofemoral contact pressure compared with cruciate retaining TKA in vitro. *Knee Surg Sports Traumatol Arthrosc.* 2009;17(10):1159–1165.
  28. Li N, Tan Y, Deng Y, Chen L (2012) Posterior cruciate-retaining versus posterior stabilized total knee arthroplasty: a meta-analysis of randomized controlled trials. *Knee Surg Sports Traumatol Arthrosc.*
  29. Aglietti P, Baldini A, Buzzi R, Lup D, De Luca L. Comparison of mobile-bearing and fixed-bearing total knee arthroplasty: a prospective randomized study. *J Arthroplasty.* 2005;20:145–153.
  30. Chonko DJ, Lombardi AV, Jr, Berend KR. Patella baja and total knee arthroplasty (TKA): etiology, diagnosis, and management. *Surg Technol Int.* 2004;12:231–238.