



Is presence of patella baja a cause for pain and functional problems after total knee replacement ? A 10 year follow-up study

Brinda SOMANCHI, Edward BAYLEY, Simon PICKERING

From the Department of Orthopedics, Royal Derby Hospital, UK

Evidence in the literature reports that Patella baja is linked to pain and low function after Total Knee Replacement (TKR).

This study evaluates the significance of post-operative Patella baja on patient reported outcome and function after a minimum follow up of 10 years following TKR.

125 total knee replacements (in 125 patients) operated in our unit were identified retrospectively from the theatre database and were reviewed clinically and radiologically after 10 years. The Caton – Deschamps (CD) Index was used to radiological categorisation of patellar height. Pain and functional scores were recorded using Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Knee Society Score (KSS) and Oxford Knee Scoring (OKS) systems.

Of the 125 patients reviewed, 39 (31.2%) patients had radiological evidence of Patella baja and the remaining 86 (68.8 %) patients had normal patellar height. There was no significant difference in the pain and functional scores (using WOMAC, KSS and OKS scores) between the two patient groups.

We conclude that Patella baja had no long term significance with regards to patient reported pain and functional outcomes in our study. This study provides substantial opposition to the current opinion that Patella baja is commonly responsible for pain following TKR. The clinical assessment for identifying the cause of persistent knee pain and functional disability should be focused elsewhere. Patellar height abnormality should not determine the need for increasing the long term post-operative follow-up after total knee replacement.

No benefits or funds were received in support of this study.

The authors report no conflict of interests.

Keywords : Patellar height : Caton-Deschamps Index : patella baja : primary total knee replacement : pain and function : knee outcome scores.

INTRODUCTION

Total knee Replacement (TKR) is a commonly performed operative procedure with a successful outcome in more than 80 % patients. However some patients do not get a satisfactory outcome with persistent symptoms of pain and poor function (7,22). Various intra and extra articular factors have been implicated as a cause for this, with a particular focus on the patellofemoral joint (28).

After TKR, various patellar complications such as maltracking, instability, clunk syndrome, fractures, wear of polyethylene insert, and patella baja have been described (19). With regards to the latter, it has been suggested that patella baja alters

-
- Brinda Somanchi
 - Edward Bayley
 - Simon Pickering

Department of Orthopedics, Royal Derby Hospital, Uttoxeter road, Derby DE22 3NE, UK

Correspondence : Brinda Somanchi, Department of Orthopedics, Royal Derby Hospital, Uttoxeter road, Derby DE22 3NE, UK. Phone : 0044 1332 783053.

Email : sbvihari@gmail.com

© 2020, Acta Orthopædica Belgica.

the biomechanics of the normal knee joint causing decrease in the range of motion, anterior knee pain, and increase the wear of the tibial and patellar polyethylene secondary to impingement (4). The literature has shown conflicting evidence relating to the role of Patella Baja on pain, function and range of motion after TKR, however most of the studies had implicated Patella baja to be the cause of concern (8,9,14,15,17,29) but some studies have not shown such association (6,18).

The aim of this study is to identify whether presence of Patella baja can adversely affect the outcome in a cohort of patients who underwent Total Knee Replacement (TKR) performed in one center with an average follow up of 10 years.

MATERIALS AND METHODS

We retrospectively reviewed 125 patients (125 knees) who underwent Total Knee Replacements consecutively using Scorpio NRG fixed bearing prosthesis (Stryker Corporation, Kalamazoo, MI) performed by senior surgeons (between January 2000 and December 2003) in our hospital. In our hospital, all patients undergoing knee arthroplasty are routinely followed up for 10 years postoperatively. Because this study involved collecting information from patients who were routinely followed by our department, local ethical committee approval was not needed. But the study was logged into local audit department, which was the standard and accepted procedure within our department.

At the time of their 10 year follow up, all patients were assessed clinically focusing on pain, range of motion and function in the operated knee. This was undertaken under the supervision of the senior author (SAWP). Oxford Knee Score (OKS), Knee Society Score (KSS) and Western Ontario and McMaster Universities Arthritis Index (WOMAC) in relation to the operated knee were completed by the patients.

Radiological assessment consisted of undertaking weight bearing anteroposterior, 30 degree lateral flexion and skyline views of operated knee joints. The radiographs were analyzed by one of the authors (BVS) who was blinded from the results of pain and functional scores. Out of the three common

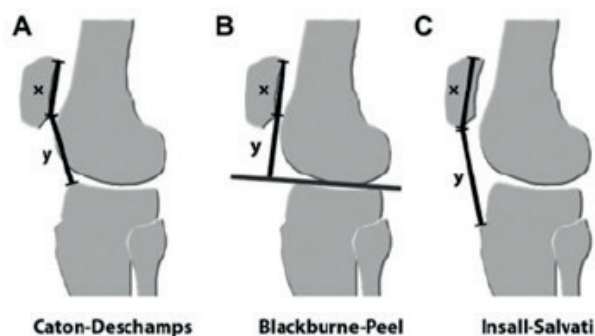


Figure 1. — The common methods used to measure patellar height.



Figures 2. — Radiograph illustrating patella baja (CDI = 0.52) using CD method.



Figure 3. — Radiograph illustrating normal patellar height (CDI = 1.1) using CD method.

methods of measuring the patellar height (Figure 1), two methods i.e, Insall- Salvati (IS) ratio as well as Caton Deschamps (CD) Index were measured to identify the presence of patella alta, true patella baja and patella norma.



Figure 4. — Radiograph illustrating the patellar height measurement using Insall-Salvati ratio method.

The Caton-Deschamps (CD) Index was derived by measuring the distance between the distal point of the patellar articular surface and the anterosuperior border of the tibial polyethylene insert (y) divided by the length of the articular surface of the patella (x) as shown in figures 2 and 3. A value of more than 1.2 is patella alta, 0.6 to 1.2 is normal patellar height and less than 0.6 is patella baja (3).

IS ratio was derived from the patella tendon length (y) divided by the length of the patella (x) as shown in figure 4. An IS ratio of more than 1.2 was considered as patella alta, less than 0.8 as baja and 0.8 to 1.2 is considered as normal patellar height (11).

The primary outcome was the relationship between patellar height and knee scores. The data

was analyzed using SPSS software. Normality assumptions were held for the data and the student t-test (for comparing two groups) and ANOVA test (for comparing three groups) was carried out to compare the quantitative values of clinical scores against the patella alta, norma and baja groups. P value of 0.05 was considered as significant for all quantitative measurements. The quantitative data were presented as mean and standard deviation. Quality check was performed by the senior author (SAWP) mainly in relation to the radiological assessment with random sampling. The power of the study was calculated and found to be adequate.

RESULTS

The demographics and clinical characteristics of all the 125 patients (125 knees) are detailed in Table I.

The radiographic analysis of 125 knees revealed that there were 39 (31.2%) cases of patella baja and 86 (68.8%) cases of normal patellar height using the Caton-Deschamps index. Whereas, there were 34 (27%) cases of patella alta, 12 (10%) cases of baja and 79 (63%) cases of normal patellar height were noted using the Insall-Savati ratio. The rela-

Table I. — Demographics of the study population

Demographic criteria	Value
Male: Female ratio	52:73
Mean age at operation (Range)	68 yrs (29 yrs to 92 yrs)
Mean years follow up since surgery	10.5 yrs

Table II. — The relation between patellar height (measured using Caton-Deschamps Index) and knee scores

Results with CD Index	Patella baja group	Patella norma group	p value using t-test
No of patients (percent)	39 (31.2%)	86 (68.8%)	
WOMAC score - mean (SD)	75.8 (20.4)	75.1(21.1)	0.86
OKS score - mean (SD)	26.8 (11.5)	28.4 (10.6)	0.47
KSS score - mean (SD)	74.7 (15.4)	73.2 (16.1)	0.64

Table III. — The relation between patellar height (measured using Insall-Salvati ratio) and knee scores

Results with IS Ratio	Patella alta group	Patella baja group	Patella norma group	P value using ANOVA test
No of patients (percent)	34 (27%)	12 (10%)	79 (63%)	
WOMAC score - mean (SD)	73.8 (21.7)	71.2 (22.8)	76.6 (20.3)	0.63
OKS score - mean (SD)	29.4 (10.4)	26.3 (12.1)	27.5 (10.9)	0.61
KSS score - mean (SD)	73.4 (16.1)	67.5 (14.7)	75.3 (15.5)	0.27

tion between patellar height and knee scores is demonstrated in table II and III.

The statistical analysis demonstrates that there was no significant difference ($p > 0.05$) in the outcome scores (WOMAC, OKS and KSS) between the patella baja, norma and alta groups as depicted in table 2 and 3.

We also performed statistical analysis for inter and intraobserver variability with regards to the radiographic interpretation of patellar height using kappa coefficient. We noted that the coefficient was found to be 0.85 and 0.94 (i.e. almost perfect agreement) for inter and intraobserver variability respectively.

DISCUSSION

There were several studies in the literature to find the incidence and cause for patella baja after primary Total Knee Replacement (TKR). Our study showed an incidence of patella baja of 31.2% using Caton-Deschamps (CD) index. The incidence reported in various studies varied from 10 – 40 % after primary TKR (6,9,12,15,19). Some studies showed variation in the incidence depending on the time since the procedure was performed (6,15), on the type of radiological method used for measuring the patellar height (1,12,18) as well on the type of knee replacement i.e. medial and lateral Unicompartamental, primary and revision Total knee replacements (26,29).

Various causative factors for development of postoperative patella baja were studied in the literature. Infrapatellar fat pad excision has shown mixed results. Chougule et al in their retrospective review of 133 patients noted that the patella infera (baja) developed in 18% patients who had total infrapatellar fat pad excision at one year follow up (5). In comparison, Pinsornsak et al, through randomization of 90 patients to have either fat pad excision or no excision, have identified that the patellar tendon length has not changed but concluded that Infrapatellar fat pad excision in TKR resulted in an increased percentage of patients with anterior knee pain after surgery (21). Lemon et al followed 73 patients and noted that the group of patients who had total fat pad excision demonstrated

statistically significant patellar tendon shortening at 3 year radiographic follow up (16). All the patients in our study underwent partial excision of fat pad sufficient enough for adequate visualization of lateral articular surface of tibia.

Lateral retinacular release and patellar eversion were also studied by many investigators in the context of patella baja. Weale et al randomized patients to receive UKR or TKR and found that patella infera, defined as shortening of the patellar tendon of 10% or more, developed in most patients undergoing TKR with lateral release, and in about 25% of patients having this procedure without lateral release. They also noted that patella infera (baja) rarely occurred in the UKR group (5%) (29). Floren et al noted that incidence of patella baja was significantly high (37%) in patients who underwent TKR with standard medial parapatellar capsular approach with patella eversion, in comparison to the patients who underwent TKR with mini midvastus approach (12%) (9). But some randomised controlled studies (13,23) did not find any difference in either incidence of patella baja or functional outcomes after patellar eversion in comparison to lateral retraction of patella in TKR. In our study, all patients had medial parapatellar approach with eversion of patella and lateral release was not performed on any patients. We do not support either lateral retraction or minimally invasive approach. There are studies in the literature which support our observations (27).

As far as radiological measurement of patella baja is concerned, the terms true patella baja (PB) and pseudo patella baja (PPB) were described in the literature (10,14), the former is due to a shorter patellar tendon and the latter is due to a raised joint line. Theoretically, true Patella baja can be detected by Insall-Savati and modified Insall-Salvati ratios, whereas pseudo patella baja can detected by Caton-Deschamps and Blackburn-Peel indices (20) which use prosthetic joint line. There has been a debate in the literature with regards to the best radiological method for patellar height after TKR that is not only reliable but also has a least interobserver variability.

Among the various studies that compared the patellar height measurement indices (2,20,24,25) in the context of TKR, the study by Rogers et al

illustrated a pragmatic approach. It was noted in their study that the inter observer variation was greater when using either the Insall-Salvati or modified Insall-Salvati ratios than when using the Caton-Deschamps or Blackburne-Peel methods both preoperatively as well as postoperatively. This was because of difficulty in identifying the insertion of the patellar tendon consistently in the former methods in comparison to the latter which rely on the prosthetic joint line, which is a consistently reproducible radiological landmark. They conclude that, although the former two measurements identify true patella baja, the variability outweighs the theoretical benefit. In our study, we identified a similar problem as far as IS ratio is concerned in contrast to CD index (24).

Most importantly, with regards to the primary outcome of our study, i.e. impact of patella baja on the outcome of TKR, the literature contained mixed reports. Davies et al studied patellar tendon length in the subset of UKR and TKR patients and noted that, although the TKR group showed increased incidence of Patella baja, change in patella tendon length within individual groups did not correlate with Oxford Knee Score (OKS) at 5 years (6). Seon et al found no correlation between the joint line position and patellar height to the knee function after revision TKR cases (26). On the other hand, there are studies which showed that there was a decrease in stair climbing and functional score although the range of movement (ROM), Knee Society Score (KSS) and pain scores were not affected. These findings were noted in studies involving TKR patients (17) as well as in the UKR patients (18). There are other studies which implicated patella baja as the cause of concern, especially with regards to the development of decreased range of motion (ROM), a decreased lever arm, extensor lag, impingement of the patella against the tibial polyethylene, anterior knee pain, increased energy expenditure, and rupture of the patellar or quadriceps tendons following TKR (4,8,9,29).

In contrast, the results in our study clearly demonstrated that there was no significant difference ($p > 0.1$) in the outcome scores (WOMAC, OKS and KSS) between the patella baja, norma and alta groups. Because these scores incorporate pain, range

of motion as well as function, it can be concluded that there was no detrimental effect on these parameters by the altered patellar height. We used Caton-Deschamps index as well as Insall-Salvati ratio to study the patellar height, so as to identify whether there is any difference in the outcomes between the patient groups with the pseudo and true patella baja respectively. We did not identify any difference in the outcomes between the groups with either of these radiological methods.

We acknowledge that there are strengths and limitations to our study. It is a well conducted retrospective study of a large group of patients with a long follow up period of at least 10 years after TKR using a single prosthesis operated in one center. Systematic clinical and radiological evaluations were undertaken. The radiological analysis was performed independently with blinding of other clinical measurements and outcome scores. High inter and intraobserver correlation of radiological parameters also strengthens this study. However, the limitations of this study are that it is not a randomized study and it is a retrospective review of cases. We also acknowledge the fact that the study does not compare the patient characteristics as well as preoperative functional scores and radiographs to those undertaken at the 10 years follow up. However, we would like to emphasize that the chosen methodology is aimed at comparing the patellar height in relation to the current level of function and pain in each patient following total knee replacement.

CONCLUSION

Our study provides substantial opposition to the current opinion that patella baja is commonly responsible for pain and functional limitation following knee replacements. It provides a compelling argument that revision surgery of painful knee replacement in these cases should therefore be reconsidered. Clinical assessment of this cohort of patients should therefore be focused elsewhere. Patella height abnormality should not determine the need for increased long term post-operative follow-up.

REFERENCES

1. **Anagnostakos K, Lorbach O, Reiter S, Kohn D.** Comparison of five patellar height measurement methods in 90° knee flexion. *Int. Orthop.* 2011 : 35 : 1791-1797.
2. **Berg EE, Mason SL, Lucas MJ.** Patellar height ratios. A comparison of four measurement methods. *Am. J. Sports Med.* 1996 : 24 : 218-21.
3. **Caton J, Deschamps G, Chambat P, et al.** Patella infera : a propos of 128 cases. *Rev. Chir. Orthop. Reparatrice Appar. Mot.* 1982 : 68 : 317-25.
4. **Chonko DJ, Lombardi AV Jr, Berend KR.** Patella baja and total knee arthroplasty (TKA) : etiology, diagnosis, and management. *Surg. Technol. Int.* 2004 : 12 : 231-8.
5. **Chougule SS, Stefanakis G, Stefan SC, Rudra S, Tselentakis G.** Effects of fat pad excision on length of the patellar tendon after total knee replacement. *J. Orthop.* 2015 : 12 : 197-204.
6. **Davies GS, van Duren B, Shorthose M, Garfjeld Roberts P, Morley JR, Monk AP, et al.** Changes in patella tendon length over 5 years after different types of knee arthroplasty. *Knee Surg. Sports Traumatol. Arthrosc.* 2016 : 24 : 3029-35.
7. **Dunbar MJ, Richardson G, Robertsson O.** I can't get no satisfaction after my total knee replacement : rhymes and reasons. *Bone Joint J. Br.* 2013 : 95 : 148-52.
8. **Figgie HE, Goldberg VM, Heiple KG, Moller HS, Gordon NH.** The influence of tibial-patellofemoral location on function of the knee in patients with the posterior stabilized condylar knee prosthesis. *J. Bone Joint Surg. Am.* 1986 : 68 : 1035-40.
9. **Flören M, Davis J, Peterson MG, Laskin RS.** A minimidvastus capsular approach with patellar displacement decreases the prevalence of patella baja. *J. Arthroplasty* 2007 : 22 : 51-7.
10. **Grelsamer RP.** Patella baja after total knee arthroplasty : is it really patella baja? *J. Arthroplasty.* 2002 : 17 : 66-9.
11. **Insall J, Salvati E.** Patella position in the normal knee joint. *Radiology* 1971 : 101 : 101.
12. **Jawhar A, Sohoni S, Shah V, Scharf HP.** Alteration of the patellar height following total knee arthroplasty. *Arch. Orthop. Trauma Surg.* 2014 : 134 : 91-7.
13. **Jenkins D, Rodriguez J, Ranawat A, et al.** A randomized, controlled, prospective study evaluating the effect of patellar eversion on functional outcomes in primary total knee arthroplasty. *J. Bone Joint Surg. Am.* 2014 : 96 : 851-8.
14. **Kazemi SM, Besheli LD, Ejazi A, Sajadi MRM, Okhovatpoor MA, Zanganeh RF, et al.** Pseudo-Patella Baja after total knee arthroplasty. *Med. Sci. Monit.* 2011 : 17(5) : 292-296.
15. **Koshino T, Ejima M, Okamoto R, Morii T.** Gradual low riding of the patella during postoperative course after total knee arthroplasty in osteoarthritis and rheumatoid arthritis. *J. Arthroplasty* 1990 : 5 : 323-7.
16. **Lemon M, Packham I, Narang K, Craig DM.** Patellar Tendon Length After Knee Arthroplasty With and Without Preservation of the Infrapatellar Fat Pad. *J. Arthroplasty* 2007 : 22 : 574-580.
17. **Meneghini RM, Ritter MA, Pierson JL, Meding JB, Berend ME, Faris PM.** The Effect of the Insall-Salvati ratio on outcome after Total Knee Arthroplasty. *J. Arthroplasty* 2006 : 21 : 116-120.
18. **Neogi DS, Bae JH, Seok CW, Lim HC.** Impact of patellar height on unicompartment knee arthroplasty : does patella baja lead to an inferior outcome?. *J. Orthopaed. Traumatol.* 2014 : 15 : 47-54.
19. **Petersen W, Rembitzki IV, Brüggemann GP, et al.** Anterior knee pain after total knee arthroplasty : a narrative review. *Int. Orthop.* 2014 : 38 : 319-328.
20. **Phillips CL, Silver DAT, Schranz PJ, Mandalia V.** The measurement of patellar height - A review of the methods of imaging. *J. Bone Joint Surg (Br).* 2010 : 92 : 1045-53.
21. **Pinsornsak P, Naratrikun K, Chumchuen S.** The effect of infrapatellar fat pad excision on complications after minimally invasive TKA : a randomized controlled trial. *Clin. Orthop. Relat. Res.* 2014 : 472 : 695-701.
22. **Potty AG, Tzeng TH, Sams JD, Lovell ME, Mihalko WM, Thompson KM, et al.** Diagnosis and Management of Intra-articular Causes of Pain After Total Knee Arthroplasty. *Instr. Course Lect.* 2015 : 64 : 389-401.
23. **Reid MJ, Booth G, Khan RJ, Janes G.** Patellar eversion during total knee replacement : a prospective, randomized trial. *J. Bone Joint Surg. Am.* 2014 : 96 : 207-13.
24. **Rogers BA, Thornton-Bott P, Cannon SR, Briggs TWR.** Interobserver variation in the measurement of patellar height after total knee arthroplasty. *J. Bone Joint Surg. (Br)* 2006 : 88-B : 484-8.
25. **Seil R, Müller B, Georg T, Kohn D, Rupp S.** Reliability and interobserver variability in radiological patellar height ratios. *Knee Surg. Sports Traumatol. Arthrosc.* 2000 : 8 : 231-6.
26. **Seon JK, Song EK.** Joint line and patellar height restoration after revision total knee arthroplasty. *Indian J. Orthop.* 2016 : 50 : 159-165.
27. **Sharma V, Tsailas PG, Maheshwari AV, Ranawat AS, Ranawat CS.** Does Patellar Eversion in Total Knee Arthroplasty Cause Patella Baja?. *Clin. Orthop. Relat. Res.* 2008 : 466 : 2763-2768.
28. **Van Jonbergen HP, Reuver JM, Mutsaerts EL, Poolman RW.** Determinants of anterior knee pain following total knee replacement : a systematic review. *Knee Surg. Sports Traumatol. Arthrosc.* 2014 : 22 : 478-99.
29. **Weale AE, Murray DW, Newman JH, Ackroyd CE.** The length of the patellar tendon after unicompartmental and total knee replacement. *J. Bone Joint Surg. Br.* 1999 : 81 : 790-5.