Indian Journal of Orthopaedics Surgery 2023;9(2):66–69

Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Orthopaedics Surgery

Journal homepage: https://www.ijos.co.in/

Original Research Article

Patella thickness in TKR- Intra operative measurement in Indian population

Ankit Kedia[1,*], **Anuj Kumar Kadian**[1]

[1] *Dept. of Orthopedics, Al Falah School of Medical Sciences & Research Centre, Faridabad, Haryana, India*

ARTICLE INFO

Article history:
Received 18-02-2023
Accepted 07-04-2023
Available online 30-05-2023

Keywords:
TKR
Patellar thickness
Patelloplasty
Patella resurfacing
Anterior knee pain

ABSTRACT

Introduction: Patellar resurfacing is one of the most contentious issues in total knee replacement, with anterior knee pain ranging from 4 to 49% post TKR. One of the important decision maker in patellar resurfacing techniques is thickness of patella. Minimum 14 mm native patella thickness is essential after 8 mm cut, to avoid patellar complications like loosening, pain and crepitus.
Materials and Methods: We present a study of patellar sizes in Indian population, taken intra-operatively while performing total knee replacement of 73 consecutive knees. We measured thickness, superoinferior and mediolateral dimensions and compared them with height, weight and implant size.
Results: The average patellar size in Indian adults was 21.7 mm with 42 knees having patellar size less than 22 mm. In males it was 24.3 mm and in Indian adult females it was 20.8 mm. The patellar size had significant direct correlation with height of the patient. And smaller femoral and tibial implant size correlated with smaller patellar thickness.
Conclusion: Average patellar thickness in Indian adults is small. Patelloplasty is a better alternative for such patients than resurfacing.

1. Introduction

Patella is a small sesamoid bone in quadriceps tendon anterior to femoral condyle. It plays a vital role in knee flexion and extension due to its pulley mechanism. Its importance grows all the more in total knee replacement. One of the most common cause of unhappy TKR is anterior knee pain[1] with almost 50% revision surgeries attributed to it. Patellar management plays an important role in managing anterior knee pain. Many surgeons favour routine resurfacing of patella to prevent anterior knee pain.

Patellar size has a very important bearing in patellar replacement. Usual knee systems have patellar button of 8 mm thickness. Resurfacing techniques aim at restoring the native thickness of patella.[2] If the patellar resection is more it results in thin and fragile patella which may lead to fracture or patellar component loosening apart from extensor weakness. On the other hand under resection of patella results in overstuffing of patello-femoral joint leading to knee pain and limited flexion.

For perfect placement and strong hold of patellar button minimum 14 mm of native bone is essential after resection. This calculates upto 22 mm of minimum patellar thickness taking 8 mm patellar button size. Hence, it is not advisable to do patellar resurfacing in thickness less than 22 mm of patella.

Bio-mechanical studies have shown that knee flexion decreases exponentially as patellar thickness increases.[3] Also chance of patellar crepitus and anterior knee pain increase with increased composite patellar thickness. Dougla A Dennis et al. in a multicenter study which received John Insall award have shown that factors associated with increased chances of patellar crepitus were

* *Corresponding author.*
E-mail address: dr.ankitk@gmail.com (A. Kedia).

https://doi.org/10.18231/j.ijos.2023.016

shortened patellar tendon length, use of smaller patellar components, decreased patellar composite thickness and increased posterior femoral condylar offset.[4] So recreating native patellar composite thickness is must for minimising patellar complications.

In western populations average thickness of patella is 25.76 mm, width 45.786 mm, length 33.53 mm.[5] However Indian adults have less average height than western counterparts.

There are multiple means to determine the patellar thickness. In vitro methods include measuring dimensions of dry patella bone obtained at autopsy. In vivo methods are logically better and include direct when we open knee joint for any cause and indirect by using radiological parameters on x-rays, Ct scans or MRI scans. In this study we want to ascertain the in vivo intra operative average thickness of patella bone in Indian adults while performing TKR to determine whether routine resurfacing in Indian population is advisable and feasible or not.

2. Materials and Methods

We have included 73 consecutive knees operated for total knee replacement at our facility. Pre-operative assessment included demographic details along with height and weight of patient. Midline incision along with mid-vastus approach was used to expose the knee joint. Patella was everted. Overhanging osteophytes which might distort the calculations of native patellar size were removed. Also, excessive synovial proliferation on sides of patella was removed. Vernier calliper was used to measure thickness of patella at the most prominent point corresponding to central ridge.(Figure 1) Then superoinferior and mediolateral dimensions of entire patella were measured. Routinely we perform only patelloplasty and do not resurface patella. All the data was analysed using SPSS software for average of patellar thickness, mediolateral and superoinferior sizes, upto 95% SD. Correlation of size with patient height and weight was assessed. Also tables for femur and tibia implant size with mean patellar thickness were made.

Fig. 1: Intra-operative measurement technique using Vernier Calliper

3. Results

We studied 73 consecutive knees in 43 females and 30 males who underwent total knee replacement at our institute.

In our study average thickness of patella was found to be 21.7 ± 1.4 mm upto 95% sd. Mediolateral size was found to be 38.1 ± 3.2 mm. And superoinferior size was found to be 34.3 ± 2.9 mm. 42 knees (>50% of total knees) had patellar thickness less than 22 mm (minimum patellar thickness required for patellar replacement).

30 male knees were included in the study out of which 15 were left and 15 were right. The average patellar thickness was 24.3 ± 1.2 mm. The size of patellar button in mediolateral was 43.1 ± 3.8 mm and in superoinferior aspect was 36.5 ± 3.5 mm.

For females 43 knees were included in the study of which 23 were left and 20 were right side. The average patellar thickness was 20.8 ± 1.7 mm with size in mediolateral aspect of 36.7 ± 2.8 mm and in superoinferior dimension of 33.9 ± 2.5 mm.

Table 1: Summarises the findings of this study

Population studied	Method of study	Thickness
Patellar thickness	24.3	20.8
Supero-inferior	36.5	33.9
Medio-lateral	43.1	36.7

There was no statistically significant correlation of patellar dimensions with side of knee operated. Another aspect we measured was correlation of height with patellar thickness. We found a positive correlation of height with patellar thickness with Paersons coefficient of 0.637 which was significant at 0.01 level (2 two tailed test). This can also be appreciated in the graph of height plotted with patellar thickness.(Figure 2)

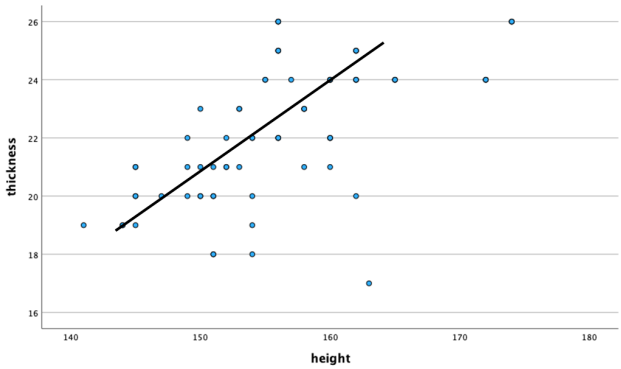

Fig. 2: Graphical representation of height correlated with patellar thickness

Weight with patellar thickness also shows positive correlation with Pearson's coefficient of 0.392 which is significant at 0.01 level (2 tailed test). However, the level of correlation is less as compared to that of height and thickness. This can be very well attributed to the fact that weight depends more on the BMI of the individual.

Table 2: Average patellar thickness correlated with femur and tibia implant size

Femur implant		Tibia iplant	
Size	**Mean thickness**	**Size**	**Mean thickness**
A	18	1	18
	21	2	21
C	23	3	24
D	23	4	24
E	25	5	25

Table 3: Patellar dimensions in Indian populations in various studies

Current Study	**North Indian**	**In Vivo direct**	**20.8 (female) 24.3 (male)**
R Muhammed [6]	South Indian	In Vivo MRI	16.2 (female) 20.3 (male)
Ravindra Kumar [7]	North Indian	In Vivo MRI	17.7 (female) 19.3 (male)
Sameen Taj [8]	South Indian	Dry Human Patellae	20.3 mm
Sudip Biswas [9]	Eastern Indian	Dry Human Patellae	19.7 (left) 19.3 (right)

Table 2 shows the average patellar thickness measured in terms of femur and tibial implant size that was used. It can be surmised from the table that smaller implant sizes correspond to smaller patellar thickness.

4. Discussion

In our study we have done in vivo measurement of patellar thickness. This is one of the most accurate means to assess patellar dimensions. Patellar thickness can be measured in vitro by dry patella taken from human bodies meant for dissection and in vivo by radiological scans of knee.

In our study average thickness of patella was found to be 24.3 in adult males and 20.8 mm in adult females.

A study performed by Reshma Muhammed et al. titled in vivo magnetic resonance imaging morphometry of patellar bone in South Indian population studied scans of 140 people and found average thickness of 20.3 mm in males and 16.2 mm in females. Patella width was measured to be 42.21 mm in males and 36.07 mm in females. [6]

Ravindra Kumar et al. studied MR scans of 60 persons of North Indian origin. They found average patellar thickness of 19.3 mm in males and 17.7 mm in females. Patellar width was 44.42 mm in males and 39.11 mm in females in their study. [7]

Another study done by Sameen Taj et al. titled Morphometric analysis of dry human patella and patellar facets studied patellar sizes in 50 dry patellar samples. The mean patellar thickness they found was 2.03 cm. Mean patellar height was 4.07 cm and width was 4.12 cm. [8]

Table 3 shows the average thickness of patella as measured by various Indian studies using different methods. The findings of this study are comparable with studies of other Indian populations, which demonstrate small size of patella in all terms i.e thickness, superoinferior and mediolateral height.

An important conclusion which can be drawn from all studies is that patella size is small in Indian population especially females. So routine resurfacing in all Indian populations should not be practised as it can be disastrous in small patellae. Also, chances of knee complications like anterior knee pain, patellar crepitus, patellar component loosening and patellar fracture increase if resurfacing is done on thin patella. [10] Anoop Jhurani et al. has published early reports of a thin 6.2 mm patellar button for such small patellae, which might be an alternative option. [11]

Another conclusion which can be drawn is that when femur implant size is small, the patellar thickness also tends to be less. So with smaller femur implant size more inclination should be kept for patelloplasty rather than resurfacing.

5. Conclusion

Patellar size is an important factor to determine type of patellar management. This is especially true for Indian population where average patellar thickness and size is small. In many cases patellar thickness is less than the minimum required for resurfacing. In thin patellae it is advisable to avoid patellar resurfacing and go for patelloplasty.

6. Abbreviation

TKR - Total Knee Replacement.

7. Source of Funding

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

8. Conflict of Interest

None.

9. Institutional Ethical Committee Approval

Taken.

10. Authors Contribution

Conceptualization, Data Curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project Administration, Resources, Software, Supervision, Validation, Visualisation, Writing - Original draft preparation, Writing- Reviewing and Editing done by the corresponding author.

Acknowledgments

None.

References

1. Nakano N, Shoman H, Olavarria F, Matsumoto T, Kuroda R, Khanduja V. Why are patients dissatisfied following a total knee replacement? A systematic review. *Int Orthop*. 2020;44:1971–2007. doi:10.1007/s00264-020-04607-9.
2. TKR: Patellar Resurfacing Technique. Wheeless' Textbook of Orthopedics- Duke Orthopedics. Available from: https://www.wheelessonline.com/joints/tkr-patellar-resurfacing-technique/.
3. Abolghasemian M, Samiezadeh S, Sternheim A, Bougherara H, Barnes CL, Backstein DJ, et al. Effect of Patellar Thickness on Knee Flexion in Total Knee Arthroplasty: A Biomechanical and Experimental Study. *J Arthroplast*. 2014;29(1):80–4.
4. Dennis DA, Kim RH, Johnson DR, Springer BD, Fehring TK, Sharma A. The John Insall Award: control-matched evaluation of painful patellar Crepitus after total knee arthroplasty. *Clin Orthop Relat Res*. 2011;469(1):10–17.
5. Kerdari M, Rastegar, Shima, Mustafa, Abbassian MAY, Harandi, et al. 2020.
6. Muhamed R, Saralaya VV, Murlimanju BV, Chettiar GK. In vivo magnetic resonance imaging morphometry of the patella bone in South Indian population. *Anat Cell Biol*. 2017;50(2):99–103.
7. Kumar R, Grover R, Goyal J, Gupta P, Meena N, Kumar D. Morphometric analysis of the patella bone as assessed by magnetic resonance imaging in north Indian population. *Int J Med Sci Educ*. 2020;7(6):88–92.
8. Taj S, Raghunath G, Gurusamy K, Begum Z, Kaveripakkam V, Dharshini P, et al. Morphometric Analysis of Dry Human Patella and Patellar Facets. *Cureus*. 2022;14(3):e22879.
9. Biswas S, Sharma S. Morphometric Study of Patellar Measurement: An Overview from Eastern Zone of India. *Int J Contemp Med Res*. 2019;6(3):5–9.
10. Molfetta L, Casabella A, Palermo A. The Patellar Resurfacing in Total Knee Prosthesis: Indications for Bone Stock and Patellar Morphology. *Front Med (Lausanne)*. 2021;7:405.
11. Jhurani A, Agarwal P, Aswal M, Saxena P, Singh N. Safety and Efficacy of 6.2 mm Patellar Button in Resurfacing Less than 20 mm Thin Patella: A Matched Pair Analysis. *Knee Surg Relat Res*. 2018;30(2):153–60.

Author biography

Ankit Kedia, Professor Orthopedics https://orcid.org/0000-0002-1017-7358

Anuj Kumar Kadian, Assistant Professor

Cite this article: Kedia A, Kadian AK. Patella thickness in TKR- Intra operative measurement in Indian population. *Indian J Orthop Surg* 2023;9(2):66-69.