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Original Research Article

MORPHOMETRIC EVALUATION OF ADULT HUMAN DRY PATELLA: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Patella, a largest sesamoid bone is a flat bone embedded in quadriceps femoris. As it provides protection to anterior aspect of knee joint, it can be subjected to numerous trauma. Hence, the morphometric study of patella has great clinical significance. The aim of this study is to conduct morphometric analysis of adult dry human patella and compare among the right and left sided dimensions.

Materials and Methods: This cross-sectional study comprised 60 patellar specimen (30 right sided, 30 left sided). The patellar dimensions measured included patellar height, width, thickness, weight, WMAF, WLAF, LMAF and LLAF. The measurement was taken using vernier caliper and the weight was taken with electronic balance. Statistical analysis was done by SPSS 20 and p values below 0.05 was considered statistically significant.

Results: The result was presented as mean ± standard deviation (SD). The mean weight, height, width, thickness, WLAF, LMAF and LLAF were higher in left sided patella while WMAF was higher in right sided patella. Statistically significant difference was observed in case of patellar height and LLAF ($p<0.05$). Most of the patella on both the sides had triangular shape (81% in right and 83% left sides) and the most frequent group observed was B type (86.25%).

Conclusion: The morphometric evaluation of patella may be helpful in understanding normal pathophysiology of knee joint as well as in arthroplasty implant design and forensic studies.

Keywords: Knee joint, patella, morphometry, arthroplasty.

INTRODUCTION

Patella, a largest sesamoid bone embedded in quadriceps femoris tendon is proximally curved and distally tapered flat bone.[1] The articular part of patella with femoral trochlea is present with median crest that defines medial and lateral facet of femoral sulcus which helps in normal knee movement by ensuring patella to remain centrally in trochlea.[2]

As per Wiberg, Patella can be classified into three groups based on the location of median ridge, medial facet width and lateral facet width. The three groups are:-

Type A:- Same medial and lateral facet width (symmetrical and concave)

Type B:- Medial facet width is smaller than lateral facet and may be flat or slightly convex

Type C:- Medial facet width is significantly smaller than lateral facet and may be convex or vertical.[3]

Patella is very important from anthropometric point of view because of its involvement in several methods of squatting and sitting.[4] Morphological knowledge of patella is not only essential to understand knee joint mechanisms, both normal and pathological, but also in construction of patellar prosthesis.[5] A high patella, also called as patella alta may increase the risk of patellofemoral dislocation and chondromalacia,[6] while low patella, also known as patella baja is linked with the risk of patellofemoral osteoarthritis, limited knee motion, Osgood – Schlater disease etc.[7]

As patella acts as shield to anterior aspect of knee joint, it is frequently associated with various types of trauma leading to degenerative changes. Examples include fractures, osteoarthritis, chrondromalacia

patellae, idiopathic patellofemoral pain syndrome and patellofemoral instability.[8] Knee arthroplasty or the total knee replacement is commonly used method for the treatment of various knee problems. However, the outcome of these treatments depends on the use of patella with appropriate size and thickness.[9] Therefore, morphometric knowledge of patella is important in implant design as well as reconstructive surgeries of knee joint. It is also important in normal knee joint movement, as any changes in patellar shape and size with respect to femoral or tibial condyles can hinder knee joint function. Hence, the present study was planned to determine morphometry of dry human patella as it has great clinical significance and important role is proper functioning and stability of knee joint.

MATERIALS AND METHODS

This cross-sectional study with 60 adult human patella (30 left side and 30 right side) was conducted in the Department of Anatomy at Dr. B. S. Kushwah Institute of Medical Sciences, Kanpur and Ganesh Shanker Vidhyarthi Memorial Medical College, Kanpur from 01/02/2025 to 15/08/25. With the approval from institutional ethical committee, the study was commenced with following inclusion and exclusion criteria:

Inclusion Criteria

- Patella having intact borders and articular facets.
- Patella without any physical damage or osteoporotic changes.

Exclusion Criteria

- Decalcified, damaged or osteoporosed bone.

Morphometric measurements: The morphometric parameters measured were patellar height, patellar width, patellar thickness, lateral articular facet length and width, medial articular facet length and width, and patellar weight.

1. **Patellar Height:** Distance from highest point on base to the apex of patella.
2. **Patellar Width:** Maximal horizontal distance between lateral and medial borders.
3. **Patellar Thickness:** Distance between median ridge (posterior surface) and anterior surface.
4. **Width of medial articular facet (WMAF):** Maximal distance between median ridge and median border.
5. **Width of lateral articular facet (WLAF):** Maximal distance between median ridge and lateral border.
6. **Length of medial articular facet (LMAF):** Maximal distance between upper and lower border of medial articular facet.
7. **Length of lateral articular facet (LLAF):** Maximal distance between upper and lower border of lateral articular facet.

All the measurements were taken using well calibrated vernier caliper of accuracy 0.5 mm. The weight of patella was taken using electronic weighing balance.

Statistical Analysis: The results were presented as mean±SD and compared with unpaired t-test. Data was analysed using SPSS version 20. P value less than 0.05 was considered statistically significant.

RESULTS

Table 1: Distribution of patella based on shape

Shape	Right side (N/%)	Left side (N/%)
Round	4 (14%)	3 (11%)
Triangular	24 (81%)	25 (83%)
Irregular	2 (7%)	2 (5%)
Total	30 (100%)	30 (100%)

14%, 81% and 7% of right sided patella were round, triangular and irregular in shape while 11%, 83% and 5% of left sided patella were respectively round, triangular and irregular shaped. [Table 1].

Table 2: Types of patella based on Wiberg classification.

Type	Number (%)
A	5 (8.35%)
B	52 (86.25%)
C	3 (5.4%)
Total	60 (100%)

Of the total patellar specimens, 8.35%, 86.25% and 5.4% of patella were respectively of type A, B and C [Table 2].

Table 3: Comparison of patellar morphometry (right side and left side)

Parameter	Right side Mean ± SD (mm)	Left side Mean±SD (mm)	P
Patellar height	36.83 ± 2.07	38.16 ± 2.97	0.04 *
Patellar weight	38.04 ± 2.28	39.09 ± 2.69	0.17
Patellar thickness	18.91 ± 1.19	19.44 ± 1.35	0.22
WMAF	21.28 ± 0.75	20.05 ± 1.44	0.62
WLAF	22.56 ± 0.73	23.22 ± 1.24	0.13
LMAF	22.61 ± 0.13	22.9 ± 0.38	0.51
LLAF	27.4 ± 0.3	29.8 ± 0.45	0.01 *

*: Statistical significance (p<0.05).

[Table 3] depicts the morphometrical measurement of patellar height, width, thickness, WMAF, WLAF, LMAF and LLAF. When compared between left and right sided patellar parameter, statistically significant difference was observed in case of patellar height and LLAF (P<0.05).

Table 4: Comparison of weight of patella (right side and left side)

Patellar side	Weight (gm)	P value
Right	7.1	0.73
Left	7.3	

There was no significant difference in the weight of right and left sided patella (P>0.05 table 4).

DISCUSSION

Any changes in the morphometry of patella affect biomechanics of patellofemoral joint. Hence, patella has a great significance from physiological, clinical and surgical point of view. In this study, 60 dry human patella (30 right and 30 left sided) were evaluated morphometrically. The mean height of right and left sided patella was respectively 36.83 ± 2.07 mm and 38.16 ± 2.97 mm which was comparable to the study of Paramesh G *et al* who reported mean height of right and left sided patella to be 38.7 ± 5 mm and 40 ± 7 mm respectively.[10] Our findings were also supported by the study of Murugan M *et al* who showed mean patellar height to be 38.07 ± 3.79 mm.[11] A study of Agnihotri G *et al* conducted on 200 patella showed mean height to be 35 ± 8 mm,[12] which was lower than that reported in this study.

In this study the mean width of patella on right side was 38.04 ± 2.28 mm and on left was 39.09 ± 2.69 mm which was in accordance to that of Murugan M *et al* who reported patellar width of 38.58 ± 3.81 mm in their study.[11]

Similarly, patellar thickness was found to be 18.91 ± 1.19 mm and 19.44 ± 1.35 mm respectively on right and left sides. The result of this study was similar to that of Murugan M *et al* who reported mean patellar thickness of 18.29 ± 1.73 mm.[11] It was also similar to that of Chhaparwal R *et al*.[13]

In the studies of Shang Peng *et al* in Chinese population,[14] and Oladrin I *et al* in South African population,[15] the patellar widths were reported to be 44.13 mm and 45.14 mm respectively which was higher than that compared to the present study. Such difference in the patellar morphometry may be attributed to the racial difference, age, gender, BMI and method of measurement.

In the present study, WMAF and WLAF were 21.28 ± 0.75 mm and 22.56 ± 0.73 mm on the right side respectively while on the left side the same were respectively 20.05 ± 1.44 mm and 23.22 ± 1.24 mm. WLAF was larger than WMAF on the both sides. This finding was in accordance to that of Chhaparwal R *et al*,[13] and Murugan M *et al*.[11]

Similarly, LMAF and LLAF on the right side were 22.61 ± 0.13 mm and 27.4 ± 0.3 mm while on the left side were 22.9 ± 0.38 mm and 29.8 ± 0.45 mm respectively. Based on WMAF and WLAF, the patella was categorised as type A, type B and type C. Most of the patella corresponded to type B which was the most stable form of patella than the other types. Similar to this study, study of Koyuncu E *et al* on fetal cadaver reported more frequency of type B patella. They reported 50% type B, 30% type C and 20% type A patella.[16]

CONCLUSION

This study provides the morphometrical analysis of patellar dimensions which can be fruitful in designing implants, orthopaedic surgeries, anthropology, forensic evaluation and comparative anatomy. This study may also aid in understanding of normal biomechanics of patellofemoral unit which should be considered during knee repair.

The limitation of this study is that the age and gender were not taken into account and the sample size was also limited to 60. Hence, further study with increased sample size considering diverse racial groups is recommended to get more useful and significant outcome.

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