PATELLAR SHAPE, NOSE PATTERN AND FACET CONFIGURATION IN 200 NORTH

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ABSTRACT

Objective: Patella, the largest sesamoid bone is bestowed with morphology having anthropological and clinical significance. The paucity of available literature regarding the morphometric characteristics of this bone prompted the present study.

Material and methods: A total of 200 patellae were obtained from male cadavers from medical colleges of Punjab, India. The morphometric parameters and position of median and secondary ridge was ascertained .The patellae were classified according to the shape patterns and facet configurations.

Results: The most predominant shape pattern emerged to be Wiberg Type 2 with Normal Nose. A lateral facet prominence (Facet ratio 1.3) was observed for median ridge with considerable individual variation in the prominence of the secondary ridge (conspicuous in 12% cases). The secondary ridge was found to run obliquely in a generally longitudinal sense, being closer to median ridge proximally than distally. The patellar dimensions in general were smaller for North Indians compared to other populations. When right and left sides were compared, only maximum width was statistically significant ($p<0.05$).

Conclusion: The study provides anthropometric data helpful for development of proper surgical techniques and prosthesis designs and addresses the significant omissions regarding the complex patellar form in standard anatomy textbooks.

Keywords: patellar dimensions, shape, facet prominence, variation.

INTRODUCTION

Patella the largest sesamoid bone, is important anthropometrically. This is because it is one of the parts, like distal end of femur, proximal end of tibia, and bones of ankle, which are concerned in the various methods of sitting and squatting, and are thus modified by cultural environment of various races. Yet, although these racial and individual differences have been recognized, very little actual work has yet been done upon this bone and the measurements are still mainly in the form of suggestion for future investigation[1].

Several standard anatomy texts contain significant omissions regarding the complex patellar form, the details of which are important

to a full understanding of the function and pathology of the patella. It would seem that the size of the patella may be influenced by the strain which is regularly borne by the quadriceps so that the small patella is associated with a small quadriceps muscle. The absence of the patella in animals which have a very powerful action of knee extension has been regarded as evidence that the patella plays no useful part in this movement [2].

The knowledge of morphology and dimensions of patella has clinical significance in the design of prosthesis and development of surgical techniques [3]. The thickness, height width ratio and relative position of median ridge are

important parameters in the selection of patellar components, Patellofemoral contact stress and patellar tracking in the trochlear groove [4, 5, 6, 7].

The morphology also has an evolutionary significance. It is a known fact that amphibians and some reptiles are devoid of patellae while lizards, birds and mammals have a patella. Based on these observations a bony patella seems important for terrestrial existence[8].

The present study aims to provide a baseline data for dimensions of patella in North Indian population. It aims to define the shape, nose pattern, facet configuration and also assesses the position of median ridge by proportion of medial facet width in whole width. The study also establishes the variation in prominence of secondary ridge & describes its pattern in North Indians.

MATERIAL AND METHODS

The design of the study was conceived in the department of Anatomy of Government Medical Colleges at Patiala and Amritsar, Punjab, India .The patellae were obtained from male cadavers .The study was conducted on 200 adult North Indian male patellae (100 each of right and left sides respectively).The measurements were taken with the help of Vernier Calipers (LeastCount0.02mm); Protractor; and divider with a fixing device(Figure 1).
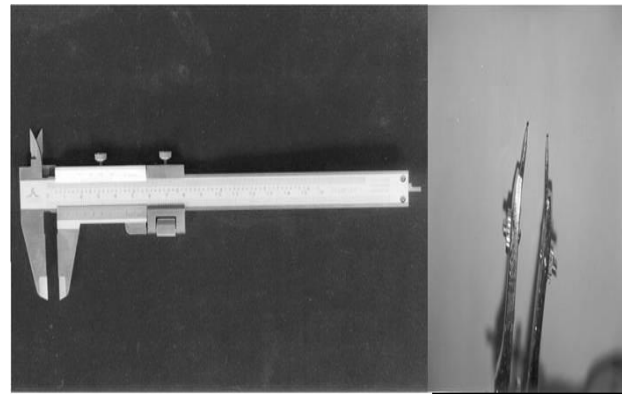

Figure1: **Vernier** **Callipers (LeastCount0.02mm); Divider with a fixing device**

The following parameters were measured (Figure2):

1. Maximum height or Length:
2. Maximum breadth
3. Maximum thickness
4. Medial facet width
5. Ridge thickness
6. Lateral facet width
7. Height of upper articular facet
8. Height of lower articular facet
9. Angle of apex

The position of the median ridge was taken as represented by the proportion of the medial facet width (MFW) in the whole width of the patella (WW). This is depicted in figure 2.
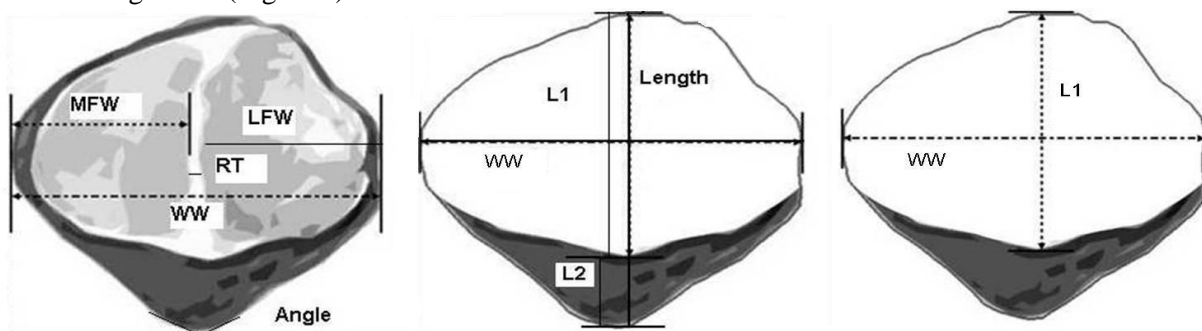

Figure 2: MCF -Medial facet width ; LFW-Lateral facet width ; RT-Ridge thickness; WW-Maximum width; L1-Height of upper articular facet ;L2- Height of lower articular facet; Angle-Angle of Apex; Length-Maximum length/height.

The patellae were classified into three different nose patterns (figure 3) as described by Grelsamer et al [9].

Figure 3: From left to right

Normal, Short (<9mm) and Cyrano nose (>14mm<27mm) patella

They described the "Cyrano" long nosed patella, in which distal nonarticular portion of the patella is particularly long. The lower pole is elongated with articular surface length abbreviated. The normal nosed patella has a rounded lower pole with articular surface of normal length.

The patellae were also classified according to different facet configurations as described by Wiberg[10].

Figure 3: From left to right Patella Wiberg types I, II and III

(Wiberg I-Left/Right facet ratio<1.1; Wiberg II - Left/Right facet ratio in range1.1-1.5 Wiberg III-Left/Right facet ratio>1.5.)

The patellar index was determined according to the formula given by Vallois[11]. The index value nearly always exceeds 100 and has been described for some populations.

Patellar Index [I] = (Width X 100/Length).

The presence and predisposition of secondary ridge was carefully noted (Figure4).

Figure 4: Green line-Median ridge (Patellar Ridge), Red line Secondary ridge.

RESULTS

Table 1 Showing Patellar dimensions for right and left sides

Parameters	Side		Significance
	Right	Left	
Maximum height/length	36.2+ 4.6	35.4+3	p>0.05
Maximum width	38.0+4	36.3+4.1	p<0.05
Maximum thickness	17.2+2	1 6.7+2	p>0.05
Angle of apex	126.4+11.7	124.6+12.9	p>0.05
Medial facet width	13.1+2.4	14.3+1.44	p>0.05
Ridge thickness	11.2+2.5	10.5+1.7	p>0.05
Lateral facet width	18.1+2.6	17.3+2.9	p>0.05
Height of upper articular facet	27.6+0.31	13.9+0.29	p>0.05
Height of lower articular facet	27.7+0.30	12.4+0.22	p>0.05

Table 2 Showing Patellar ratios for right and left sides

Parameters	Side		Significance
	Right	Left	
Length width ratio	.98±0.16	.98±0.11	p>0.05
Width thickness ratio	2.21±0.16	2.18±.21	p>0.05
Height thickness ratio	2.07±0.23	2.15±0.21	p<0.05
Patellar ridge position(MCF/WW)	0.35±.06	0.34±.06	p>0.05
Upper lower articular facet ratio	1.99	2.23	p>0.05

Table 3 Patellar nose classification for North Indians

Classification	Side		Total(%)
	Right	Left	
Short	2	6	4
Normal	92	88	90
Cyrano	6	6	6

Table 4 Patellar shape classification for North Indians

Classification	Total (%)
Wiberg type I	16
Wiberg type II	60
Wiberg type III	24

Avg. Lateral facet width/Medial Facet width =1.3

Table 5 Showing secondary ridge prominences for sides

Secondary Ridge	Side	
	Right	Left
Conspicuous	13	11
Indistinct	87	89

Table 6 Comparison of patellar dimensions for North Indians with other populations

Authors, population and year of study	Maximum height/length	Maximum width	Maximum thickness	Ridge position
Kim TK et al[12] Koreans;2009. n=39	36.2	45.6	23.1	0.44
Baldwin and House[13] Americans ;(2005) n=35	39.4	49.5	23.9	0.42
Iranpour F et al[13] British ; 2008 n=37	34.3	44.8	22.4	-
Present study North Indians; 2013 n=200	35.8	37	16.95	0.34

n is number of cases

DISCUSSION

The present study is the pioneer study in India which has described the morphometric characteristics and the phenotype of the bone. The patellar dimensions were found to be smaller for the North Indians as compared with other populations (Table 6). The maximum width and height thickness ratio (Tables 1 and 2) came out to be statistically significant (p<0.05). Patellar height/width ratios and the position of the median patellar ridge have clinical implications for total knee arthroplasty with patellar resurfacing. The position of the median ridge is another factor to consider when selecting the size of a patellar component. The median ridge can act as a fulcrum for patellofemoral tracking and thus can influence restoration of normal kinematics after TKA with patellar resurfacing[12].

The width thickness ratio came out to be 2.2 which is in agreement with the ratio of 2 determined in British population. The lateral and medial facet width ratio came out to be 1.3.This is also in consonance to the findings for British population[14].

The predominant phenotype for North Indians emerged to be a Wiberg type II(60%) normal nosed patella(90%).The average patellar index value for the North Indians came out to be 104 which is quite close to the value of 100 arrived in American Indians and 106 for the Madagascar native population [11].

The secondary ridge was less prominent compared to the primary patellar ridge and exhibited a considerable individual variation in its predisposition. The secondary ridge was found to run obliquely in a generally longitudinal direction closer to the median ridge proximally than distally (Figure 4).This ridge may develop after birth in response to functional loads applied to knee. There is considerable individual variation in prominence of the secondary ridge and in present study the secondary ridge was found to be conspicuous in 14% cases.

CONCLUSION

Several standard anatomy texts contain significant omissions regarding the complex patellar form, the details of which are important to a full understanding of the function and pathology of the patella. The present pioneer study quantifies the Indian patella which is impacted by a distinct lifestyle and cultural plethora. It compares the patellar dimensions and morphometric characteristics with Western and Asian populations and describes keystone ratios vital for anthropologists, clinicians and academicians in the North Indian setup. The patella-related morbidities are issues of concern after surgical procedures are performed on patella and the detailed anthropometric information provided in present study is bound to be helpful for development of proper surgical techniques and prosthesis designs. The study is expected to provide significant backdrop and generate enthusiasm for further studies on of patella in both sexes.

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