Morphometric study of patella and its role in sex determination

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Abstract:

INTRODUCTION: Patella is the largest sesamoid bone which develops in the of the quadriceps femoris muscle tendon. Morphometric study of patella has great importance for surgical orthopedic procedures, forensic evaluations, and evolutionary biology. Also in the non availability of complete skeletal remains patella can be useful for sex determination.

AIM: The aim of this study was to gather a baseline data for dimensions of patella and determination of its significance in sex identification.

METHODOLOGY: We studied 60 patella bones (30 male and 30 female) of both sides from the bone bank in the Department of Anatomy, Sakshi Medical College, Madhya Pradesh. Parameters measured were maximum thickness, maximum width and maximum height.

RESULTS: The mean value of patellar thickness in male and female was 20.01 mm & 18.56 mm respectively; while mean of patellar width in male and female were 41.23 mm & 39.11 mm respectively. For patellar height means for male and female were 42.89mm and 40.21mm respectively. Comparison in male and female for all parameters shows high statistical significance (p>0.001).

CONCLUSION: Patella can be taken into consideration for determination of sex particularly non availability of long bones, skull, and pelvis. The average value and its standard deviations from mean for all three parameters will help much more to orthopedic surgeons, forensic experts, clinicians.

Keywords: patella, sex determination, basic dimensions

Introduction:

Patella is also called as kneecap. In the human body patella is the largest sesamoid bone which develops in the of the quadriceps femoris muscle tendon. Patella has two anterior and posterior surfaces and superior, medial & lateral borders while its apex is pointing inferiorly.[1]

The posterior surface of the patella shows presence of two parts i.e. superior surface which is articulating and inferior surface which is non-articulating. The inferior part forms the apex of the patella which serves as a site of attachment for the patellar ligament.[2] In medicolegal context determination of sex with the help of skeletal study is one of the big challenge. Determination of sex is possible more accurately if the complete skeleton is available for analysis but in most of forensic cases skeletal remains are either defragmented, damaged or incomplete.[3] The long bones, skull, mandible, pelvis are frequently not available or defragmented so sex determination can be carried out from other

available parts of skeleton.[4] However the accuracy of sex determination from other available skeletal bones depends on the degree of sexual dimorphism exhibited by the skeleton.[5]

The imparting strain of quadriceps may be influence the size of patella so that the small patella is generally associated with a small quadriceps femoris. There are very few studies on morphology of patella and the knowledge of morphology and dimensions of patella performs very important role in the design of prosthesis and development of surgical techniques.[6,7,8]

Materials and Method:

We studied 60 patellas from each side obtained from 15 male and 15 female bodies. The study done at the Department of Anatomy, Sakshi Medical College, Madhya Pradesh. The parameters taken in to consideration were maximum thickness, maximum width and maximum height. Maximum thickness was calculated as the maximum linear distance between the anterior and posterior surfaces. Maximum width was calculated as the maximum distance between the medial and lateral borders of patella and maximum height of patella was calculated as maximum distance between apex tip and base of patella. All measurements were taken by digital sliding vernier caliper upto 0.001cm accuracy. All statistical analysis was done with the help of Standard SPSS software.

Fig 1: Measurements of Patella
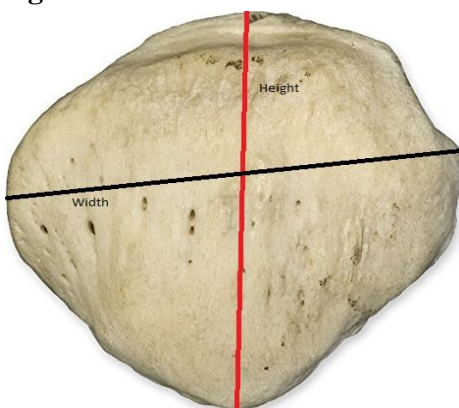
Results:

The results of descriptive statistical analysis were shown in Table 1. It shows mean, standard deviation (SD), t value and p value of all three parameters of the patella of both male and female sexes on each right and left side in combination. It also shows combined sexes mean and SD of patellar parameters. Descriptive statistical analysis shows that mean of all parameters are greater in males as compare to females. On comparison male and female with the help of unpaired t-test of significance patellar thicknes, patellar width, patellar height showed highly significant p values (0.001).

Table 1: Descriptive statistics of measurements of the patella.

Measurements	Male		Female		Male Vs Female		Combined sexes	
	Mean (mm)	SD	Mean (mm)	SD	t-value	p-value	Mean (mm)	SD
Patellar Thickness	20.01	1.71	18.56	1.49	6.31	0.001	19.29	1.52
Patellar Width	41.23	3.01	39.11	2.14	3.69	0.001	40.17	2.59
Patellar Height	42.89	2.71	40.21	2.34	3.42	0.001	41.55	2.84

Discussion:

Different measuring techniques were used in previous studies, like as measurements taken with the use of radiographs, measurements taken during total knee arthroplasty. But these measurement methods have some limitations and also there are more chances of errors.[1,2,9-15] In the present study all measurements are taken on bones which are totally cleared from other muscles and tissues to avoid measurement errors. These measurements could be very beneficial for surgeries of the knee and for the anthropological records.

In present study mean of patellar thickness in male and female was 20.01 mm & 18.56 mm respectively and in combination with male and female it was 19.29mm ,mean of patellar width in male and female was 41.23 mm & 39.11 mm respectively while combined mean was 40.17mm. For patellar height mean for male and female was 42.89mm and 40.21mm respectively. The combined mean for patellar height was 41.55mm.

Table 2: Summary of studies which report patella dimensions

Author Name	Patella Height		Patella Width		Patella Thickness	
	Mean (mm)	SD	Mean (mm)	SD	Mean (mm)	SD
Yoo et al[16]	44.6	3.7	45.8	3.6	22.3	1.9
Schlenzka D et al[17]	54.4	3.5	50.3	4	--	--
Iranpour et al[18]	34.3	4.8	44.8	4.8	22.4	2.3
Baldwin JL et al[19]	--	--	46.1	--	22.6	--
Oladiran I et al[20]	43.7	3.6	45.1	3.9	23.9	2.1
Kayalvizhi I et al[21]	42.9	4.8	42.1	3.1	19.7	1.1
Agnihotri G et al[22]	35.8	--	37	--	16.95	--
Present Study	41.55	2.84	40.17	2.59	19.29	1.52

The Table 2 shows studies done for patellar height, width and thickness by other researchers. The values of parameters in previous studies are around the values in present study. The values of

parameters in study done by Yoo et al[16], Schlenzka D et al[17], Iranpour et al[18], Baldwin JL et al[19] and Oladiran I et al[20] were more deviated from values of present study as compare to study done by Kayalvizhi I[21], Agnihotri G et al[22]. This might be due geographical and racial variation. All these studies along with present study patellar bone gains importance in determination of sex.

Conclusion:

A fine detail morphometric study of patella established a simple and well studied approach for sex determination from small bones also. This got more value in the non-availability of complete skeleton. Present study concludes that the mean values for males were slightly higher than those for the females. As there was highly statistical significance (p>0.001) seen in comparison for all three parameters in male and female, patella can be taken in consideration for sexual dimorphism. This study compares the patellar morphometric dimensions with population from other countries, continents and describes basic values and its deviation from normal values, so that orthopedic surgeons, clinicians, forensic experts, anthropologists and academicians in Asian continents can performs well handling of patella.

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