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Original Research Article

Morphometric analysis of tibial plateau

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ABSTRACT

Background: Arthritis and injuries of the knee are frequently managed by knee arthroplasty. Knee prosthesis thus used needs population specific appropriate sizing. The aim of the study is to analyse tibial plateau morphometrically.
Methods: The study included 46 human tibia bones (28 left and 18 right). The anteroposterior length and transverse width of superior articular surface of both tibial condyles along with the anteroposterior length and transverse measurements of the intercondylar area were noted with digital Vernier caliper. The data was tabulated and analysed.
Results: For the superior articular surface of medial condyle, anteroposterior length was found to be 4.12±0.42cm on left side and 4.17±0.50cm on right side; maximum width was found to be 2.81±0.59cm on left side and 2.78±0.34cm on right side. For the superior surface of lateral condyle, the anteroposterior length was found to be 3.92±0.30cm on left side and 3.66±0.31cm on right side whereas maximum width was found to be 3.12±0.68cm on left side and 2.87±0.55cm on right side. Anteroposterior length of intercondylar area was measured to be 4.31±0.40cm on left side and 4.18±0.44cm on right side. The transverse measurement was recorded to be 3.12±0.68cm (left side), 2.87±0.55cm (right side) anteriorly; 1.25±0.23cm (left side), 1.31±0.20cm (right side) in the middle and 1.28±0.39cm (left side), 1.85±0.42cm (right side) posteriorly.
Conclusions: The results will be helpful in orthopaedic surgical procedures involving knee.

Keywords: Lateral condyle, Medial condyle, Prosthesis, Tibia, tibial plateau, Total knee replacement

INTRODUCTION

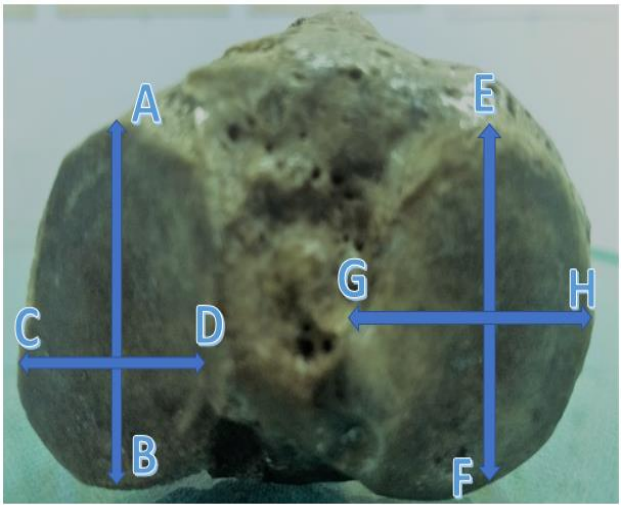
The human inferior extremity is primarily involved in weight transmission and locomotion. These functional requirements in addition to attainment of erect, bipedal posture resulted in greater strength and stability of the inferior extremities when compared to superior extremities.[1] In humans the extended knees help in weight bearing. The relationship between the different weight bearing situations and anteroposterior and mediolateral dimensions of tibial plateau is well established.[2] Morphometry of tibial plateau is used to guide treatment and monitor outcome of total knee replacement. Measurements of tibial plateau are of immense help in designing tibial prosthesis.[3] As the dimensions of tibial plateau are of utmost importance in total knee replacement and meniscal transplantation, the present study was undertaken to determine the various measurements of tibial plateau in dry tibia bones.

METHODS

The study included 46 dry tibia bones (28 left and 18 right) of unknown age and sex. Broken and deformed bones and those with pathological features were excluded from the study. The following measurements were done with digital Vernier calipers:[4]

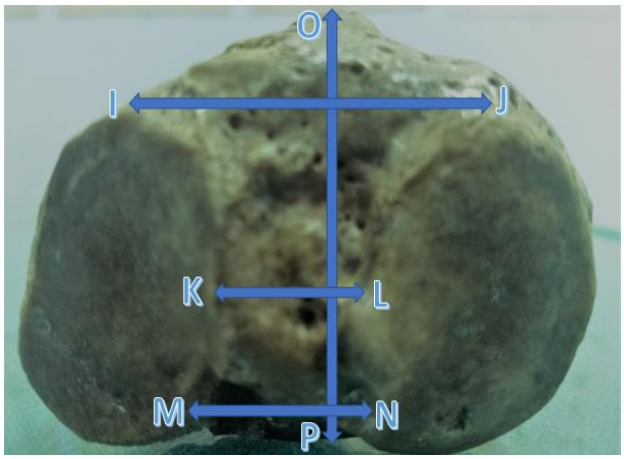
Anteroposterior measurement of superior articular surface of medial condyle: The maximum distance

between anterior and posterior borders of superior articular surface of medial condyle (AB in Figure 1 and Table 1).



AB- The maximum distance between anterior and posterior borders of superior articular surface of medial condyle, CD- Maximum transverse width of superior articular surface of medial condyle, EF-Maximum anteroposterior distance between anterior and posterior borders of superior articular surface of lateral condyle, GH- Maximum transverse width of superior articular surface of lateral condyle

Figure 1: Superior articular surface of right tibia.



IJ- Maximum transverse width of intercondylar area at anterior end, KL- Maximum transverse width of intercondylar area at the middle, MN- Maximum transverse width of intercondylar area at posterior end, OP- Maximum distance between anterior and posterior borders of intercondylar area

Figure 2: Superior articular surface of right tibia.

Transverse measurements of superior articular surface of medial condyle: The maximum transverse diameter of superior articular surface of medial condyle (CD in Figure 1 and Table 1).

Anterior measurements of superior articular surface of lateral condyle: The maximum distance between anterior and posterior borders of superior articular surface of lateral condyle (EF in Figure 1 and Table 1).

Transverse measurements of superior articular surface of lateral condyle: The maximum transverse diameter of superior articular surface of lateral condyle (GH in Figure 1 and Table 1).

Transverse measurements of intercondylar area: The maximum transverse widths of intercondylar area at following three levels-

- IJ (Maximum transverse width at anterior end of intercondylar area) (Figure 2, Table 1)
- KL (Maximum transverse width at middle of intercondylar area) (Figure 2, Table 1)
- MN (Maximum transverse width at posterior end of intercondylar area) (Figure 2, Table 1)
- Anteroposterior measurements of intercondylar area: Maximum distance between anterior and posterior borders of intercondylar area. (OP in Figure 2, Table 1).

Table 1: Measurements of different parameters of superior articular surface of tibia in current study.

Distance	Value (Mean±SD) in cm on left side	Value (Mean±SD) in cm on right side	Value (Mean±SD) in cm on both sides	P value
AB	4.12±0.42	4.17±0.50	4.14±0.45	0.73
CD	2.81±0.59	2.78±0.34	2.80±0.50	0.85
EF	3.92±0.30	3.66±0.31	3.82±0.33	<0.01
GH	2.96±0.28	2.95±0.29	2.96±0.28	0.92
IJ	3.12±0.68	2.87±0.55	3.02±0.64	0.19
KL	1.25±0.23	1.31±0.20	1.27±0.22	0.35
MN	1.28±0.39	1.85±0.48	1.85±0.42	0.96
OP	4.31±0.40	4.18±0.44	4.26±0.42	0.34

All the measurements were taken twice to avoid interobserver variation. The data was tabulated and statistically analysed using Microsoft Excel software.

RESULTS

Various observations obtained are tabulated in Table 1. In our study, superior articular surface of medial condyle of tibia was found to have greater anteroposterior length on right side whereas greater transverse width on left side. The superior articular surface of lateral condyle of tibia was found to have greater anteroposterior length and transverse width on left side. The anteroposterior length of intercondylar area was greater on left side in our study. Transverse width of intercondylar area was found to be more on left side at anterior end whereas the transverse width of intercondylar area was found to be more on right side at middle and posterior ends of intercondylar area. However, the difference was found to be statistically

significant only for maximum anteroposterior length of superior articular surface of lateral condyle.

DISCUSSION

Many authors have measured dimensions of tibial plateau before. Servien et al, have studied medial and lateral tibial plateau and analysed the adoptability of tibial component design.[5] Kwak et al, have performed studies on upper end of tibia for abetting total knee arthroplasty in Korea.[6] Cheng et al, have done similar studies in China.[7] Gandhi et al, (Table 2) have established greater anteroposterior length and transverse diameter of superior articular surface of medial condyle of tibia on right side.[4]

Table 2: Measurements of parameters of superior articular surface of tibia as per Gandhi et al.[4]

Parameter	Value on left side (Mean±SD) in mm	Value on right side (Mean±SD) in mm
Medial condyle (AP length)	47.73±4.37 (M)	48.45±4.14 (M)
	42.36±4.65 (F)	42.39±4.19 (F)
Medial condyle (Transverse width)	29.38±3.14 (M)	30.18±2.83 (M)
	26.96±2.18 (F)	27.25±3.05 (F)
Lateral condyle (AP length)	40.69±4.13 (M)	40.86±3.79 (M)
	37.30±3.81 (F)	36.78±3.03 (F)
Lateral condyle (Transverse width)	28.82±3.12(M)	28.62±3.10 (M)
	26.00±3.06 (F)	26.14±2.51 (F)
Intercondylar area (AP length)	49.11±3.97 (M)	47.19±2.93 (M)
	44.64±3.94 (F)	43.09±3.62 (F)
Intercondylar area width at anterior end	22.61±2.41 (M)	24.82±3.22 (M)
	25.40±4.28 (F)	22.33±3.48 (F)
Intercondylar area width in middle	7.41±0.96 (M)	7.18±1.14 (M)
	6.38±0.79 (F)	6.72±1.06 (F)
Intercondylar area at posterior end	7.41±0.95(M)	7.18±1.14 (M)
	6.38±0.79 (F)	6.72±1.06 (F)

Table 3: Measurements of superior articular surface of tibia as per Vasanthi and Rao.[8]

Parameter	Value (Mean±SD) in mm
Medial condyle (AP length)	49.66±1.3937 (L)
	45.48±0.523 (R)
Medial condyle (Transverse width)	22.509±1.0491 (L)
	24.277±1.0107 (R)
Lateral condyle (AP length)	41.547±0.4259 (L)
	40.057±0.4252 (R)
Lateral condyle (Transverse width)	22.38±1.048 (L)
	23.26±1.02 (R)
Intercondylar area (AP length)	51.0754±0.6250 (L)
	51.319±0.7190 (R)
Intercondylar area (Transverse width)	18.6603±0.623 (L)
	17.7021 0.3438 (R)

AP length- Anteroposterior length, L- Left side, R- Right side.

In their study, the superior articular surface of lateral condyle of tibia showed greater anteroposterior length on left side and more transverse width on left side in males and right side in females. They have established greater anteroposterior length of intercondylar area on left side. Gandhi et al, have established the transverse width of anterior part of intercondylar area to be more on left side. However, in their study the middle and posterior transverse widths of intercondylar area were found to be more on right side in females and on left side in males. In another Indian study by Vasanthi and Rao (Table 3) superior articular surface of the medial condyle showed greater anteroposterior length on left side and greater transverse width on right side.[8] In the same study, superior articular surface of lateral condyle showed greater anteroposterior length on left side and greater transverse width on right side. Intercondylar area was found to have greater anteroposterior length on right side and greater transverse width on left side. The difference was found to be statistically significant only for anteroposterior length of superior articular surface of medial condyle. The difference was also found to be statistically significant for anteroposterior length and transverse width of intercondylar area.

Osteoarthritis of knee joint is one of the most common causes of disability of adults. The damage is a result of complex interplay between biochemical, mechanical and genetic factors. Osteoarthritis is the most common indication for total knee arthroplasty.[9] Total knee replacement is basically a realignment procedure that results in pain free stable knee joint while ensuring comfortable mobility. In total knee arthroplasty, about 9 mm of tibial and femoral articular surfaces are removed

from the ends of respective bones followed by their replacement with metal and plastic caps.[4] The designing of knee prosthesis is basically aimed at reducing wear and tear and achieving greater longevity.[10] The current study will provide necessary and adequate information for designing appropriate sized unicompartmental and total knee prosthesis.

CONCLUSION

This study will be highly relevant in designing appropriate sized prosthesis for total knee replacement in Indian population.

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REFERENCES

1. Newell RLM. Pelvic girdle and lower limb. In: Standring S, Ellis H, Johnson D, Williams A. Gray's Anatomy. 39th ed. Edinburgh, London, Churchill Livingstone; 2005:1399.
2. Ljunggren AE. The Tuberositas Tibiae and Extension in the knee joint. Acta Morphol Neerl Scand. 1976;14:215-39.
3. Mark DG. Consistency and accuracy of measurement of lower limb amputee anthropometrics. JRRD. 2005;42:131-40.
4. Gandhi S, Singla RK, Kuller JS, Suri RK, Mehta V. Morphometric analysis of upper end of tibia. J Clin Diag Res. 2014;8(8):AC 10-AC13.
5. Servien E, Saffarini M, Lusting S, Chomel S, Nevret P. Lateral versus medial tibial plateau. Morphometric analysis and adaptability with current tibial component design. J Knee Surg. 2008;16:1141-5.
6. Kwak DS, Surendran S, Pengalleeri YH, Park SE, Choi KN, Gopinathan P, et al. Morphometry of the proximal tibia to design the tibial component of total knee arthroplasty for Korean population. Knee. 2007;(14):295-300.
7. Cheng FB, Ji XF, Lai Y, Feng JC, Zheng WX, Sun YF, et al. Three dimensional morphometry of the knee to design the total knee arthroplasty for Chinese population. Knee. 2009;(16):341-7.
8. Vasanthi A, Rao BN. Study of condylar parameters of tibiae an analysis pertaining to North Costal Andhra Pradesh population. IOSR. 2017;16(8):4-9.
9. Zanasi S. Innovations in total knee replacement: new trends in operative treatment and changes in peri-operative management. Eur Orthop Traumatol. 2011;2:21-31.
10. Zalawadia AZ, Patel SM. Morphometric study of upper end of tibia in Gujrat region and its clinical implication in knee arthroplasty. Int J Anat Res. 2018;6(1.1):4871-5.

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