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Original Research Article

A Osteology Study on Morphometric Analysis of Lower end of Femur and its Clinical Significance

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Abstract
Introduction: The knee joint is a complex variety of synovial joint in which lower end of femur articulates with the upper end of tibia and patella forming femorotibial and femoropatellar articulations respectively. Anteriorly articular surfaces of both femoral condyles are continuous with each other but posteriorly they are separated by the intercondylar notch
Materials and methods: An observational descriptive study with cross-sectional data collection was conducted. The study was carried out on 90 (48 right and 42 left) randomly selected, intact, dry, completely ossified femurs of unknown age, stature and sex from the Department of Anatomy of Deccan college of medical sciences, Hyderabad,
Results: We studied 90 bones,48 femur were of right side and 42 were of left side. Mean bicondylar width [BCW] was 75.95±5.87mm on right side and 76.17±5.36mm on left side. Maximum anteroposterior distance of medial condyle was 57.79±5.81mm on right side and 59.49±4.06mm on left side.
Conclusion: The values obtained in present study and comparing them with other studies from Indian and foreign authors clearly shows variances are there not only in different ethnic groups but indifferent populations in India.
Keywords: Femur, Condyles, Articular Surfaces, Notch

Introduction

The knee joint is a complex variety of synovial joint in which lower end of femur articulates with the upper end of tibia and patella forming femorotibial and femoropatellar articulations respectively. Anteriorly articular surfaces of both femoral condyles are continuous with each other but posteriorly they are separated by the intercondylar notch [1,2].The knee joint is essentially a hinge joint, with movements taking place in one direction, namely flexion and extension. The twin wheel arrangement of the condyles of femur slide, glide and roll over the concave shaped gutters, namely the patella and upper end of tibia. The knee joint also takes part in internal and external rotation of tibia in relation to femur. In addition, if the anterior and posterior ends are flattened, a rotation movement may be possible. With increase in the life span of men and women in our country, osteoporosis and degeneration of the weight bearing joints have become increasingly common these days. With improvisations in the imaging techniques and with sophistications in the prostheses used, total knee replacement is becoming more and more popular these days. The success of arthroplasty depends on a proper understanding of the morphometry and appropriate geometrically matched prosthesis [3].

It is therefore mandatory to have knowledge of proper morphometric data before selection of the implant size. The human knee is the largest and most complicated joint in the body and one of the most frequently injured [4]. The high incidence of injury to the knee may be related to many factors, but its basic diarthrodial structure together with its location between the body's two longest lever arms namely the femur and the tibia make it particularly more vulnerable to sports related injuries [5]. The complexity of the knee joint is further enhanced, as it has to perform two opposed requirements, namely mobility and stability. The distal end of femur in conjunction with the proximal end of tibia and patella functions as a knee joint that works in axial compression under the action of gravity [6]. Such complexity of this joint makes it very vulnerable in many occupations and sports.Knee replacement surgery is one of the most common procedures performed for various conditions related to knee joint. Total knee replacement is usually considered as the end point treatment of severe degenerative diseases of the knee. It is considered as the gold standard treatment for management of patients with osteoarthritis of the knee joint. It is important to design accurate knee joint implants, which would be beneficial to improve the quality of life and cause less complication after arthroplasty. The measurements obtained from this study will help to achieve proper alignment of bone fragments and safe instrumentation and fixation of bones. The study will also provide measurements of parameters for designing of implants and artificial joint components that will help in manufacturing prosthesis with ethnic specifications. Previous researchers revealed that there are differences in anatomical profilesbetween Asian and Caucasian knee, and suggested smaller size component would be more appropriate for Asian populations [7,8].Various studies have emphasized differences between genders and among ethnic groups. Therefore, quantitative anatomy of the distal femur is essential for the design of total joint replacement and internal fixation materials [8,9,10].The femur, by virtue of its position, structure and function is subjected to various traumatic, inflammatory, degenerative and neoplastic processes [11,12].A thorough knowledge of the anatomy regarding surface contours, curvatures, dimensions of the femur is essential for understanding the disease processes and for proper management and reconstruction surgery of joints and fractures[12].

Materials and methods

An observational descriptive study with cross-sectional data collection was conducted.The study was carried out on 90 (48 right and 42 left) randomly selected, intact, dry, completely ossified femurs of unknown age, stature and sex from the Department of Anatomy of Deccan college of medical sciences,Hyderabad,Telangana.bones with pathological lesions were excluded from study. Six parameters related to the lower end of Femur were studied using digital Vernier caliper. All measurements from the right and left femur were recorded separately. The data obtained were then entered in Microsoft Excel sheet and analysed using SPSS software for mean±SD.Independent t-test was used to calculate the differences in the parameters of right and left femur. The p-value < 0.05 was considered statistically significant.Following six parameters were calculated using digital Vernier caliper

1.Bicondylar width [BCW]: maximum distance between medial and lateral epicondyle.[fig.1]

2.Maximum anteroposterior distance of medial femoral condyle [MCAPD]: maximum distance between anterior and posterior surface of medial condyle.[fig-2]

3.Maximum transverse distance of medial femoral condyle [MCTD]: maximum distance between medial and lateral surface ofmedial condyle[fig-4]

4.Maximum anteroposterior distance of lateral femoral condyle [LCAPD]: maximum distance between anterior and posterior surface of lateral condyle.[fig-3]
5.Maximum transverse distance of lateral femoral condyle [LCTD]: maximum distance between medial and lateral surface of lateral condyle.
6.Intercondylar notch width [ICNW]: maximum distance between medial and lateral surface of intercondylar notch posteriorly.[fig-5]

Results:

We studied 90 bones,48 femur were of right side and 42 were of left side. Mean bicondylar width [BCW] was 75.95±5.87mm on right side and 76.17±5.36mm on left side. Maximum anteroposterior distance of medial condyle was 57.79±5.81mm on right side and 59.49±4.06mm on left side. Maximum transverse distance of medial condyle was 24.58±3.34mm on right side and 23.85±2.51mm on left side. Maximum anteroposterior distance of lateral condyle was 60.74±4.52mm on right side and 59.89±3.39mm on left side.
Maximum transverse distance of lateral condyle was 24.06±2.61mm on right side and 24.52±2.61mm on left side. Mean intercondylar notch width was 18.87±3.37mm on right side and 20.12±3.19mm on left side. These parameters have not shown ant statistically significant difference between right and left sides.
All parameters have been shown in table-1.

Table : showing results of all parameters studied from lower end of femur in present study(all values in mm)

PRESENT STUDY	RIGHT SIDE [N=48]				LEFT SIDE [N=42]			
PARAMETERS	minimum	maximum	mean	S.D	Minimum	maximum	Mean	S.D
BCW	60.07	88.19	75.95	5.78	64.25	85.42	76.17	5.36
MCAPD	30.09	66.79	57.79	5.81	49.43	68.14	59.49	4.06
MCTD	12.31	31.78	24.58	3.34	19.78	28.81	23.85	2.51
LCAPD	44.61	76.18	60.74	4.52	51.65	65.59	59.89	3.39
LCTD	15.36	30.25	24.06	2.61	17.20	31.04	24.52	2.61
ICNW	11.21	24.94	18.87	3.37	14.71	31.65	20.12	3.28

Table 2: showing statististical difference between right and left sides (SS-statistically significant,NS-statistically nonsignificant)

PARAMETERS	P-VALUE	SS/NS
BCW	0.852	NS
MCAPD	0.115	NS
MCTD	0.251	NS
LCAPD	0.323	NS
LCTD	0.408	NS
ICNW	0.075	NS

Table 3:showing comparison of present study with other authors(All values in mm)

Author		BCW		MCAPD		MCTD		LCAPD		LCTD		ICNW	
		R	L	R	L	R	L	R	L	R	L	R	L
Shweta et.al 2017 [26]		73.1±6.14	72.16±6.58	-	-	-	-	-	-	-	-	20.82±2.57	21.0±3.13
Biswas et.al. 2017[22]		71.71±4.5	70.17±5.25	52.97±3.77	54.74±3.85	25.48±2.05	27.80±2.91	56.20±3.36	56.05±4.29	27.80±2.91	28.03±2.56	20.86±2.52	19.45±2.57
Zalawadia et.al [25]	Male	74.48±1.9	74.59±2.75	57.21±2.53	57.77±2.51	30.31±1.66	31.32±1.35	58.36±3.03	59.68±2.16	31.32±1.72	31.99±1.15	20.31±2.94	20.91±1.32
	Female	67.45±193	66.7±2.59	53.44±1.82	54.37±2.20	27.47±1.33	27.91±1.52	54.98±1.89	54.66±2.87	28.76±1.47	28.96±1.33	19.42±2.32	19.27±2.74
Dr .Vinay G et.al. [2019][18] N=180		71.8±5.91	70.8±5.95	56.3±4.73	55.7±4.38	28.6±3.83	28.1±3.07	56.6±4.4	56.9±4.26	31.1±3.02	30.5±3.21	21.5±3.01	21.7±2.85
Kalpana et.al.[2020] N=100 [27]		72.82±3.89	71.62±5.67	56.62±4.19	57.14±4.82	22.64±3.96	23.12±2.17	58.52±3.44	56.92±3.14	22.86±3.12	23.12±2.17	21.66±2.69	21.5±4.64
Present study [2021] N=90		75.95±5.87	76.17±5.36	57.79±5.81	59.49±4.06	24.58±3.34	23.85±2.51	60.74±4.52	59.89±3.39	24.06±2.61	24.52±2.61	18.87±3.37	20.12±3.28

Table 4: showing comparison of present study with foreign authors(all values in mm)

	Author	Region /population		BCW	MCAPD	LCAPD	MCTD	LCTD	ICNW
1.	Terzidius et.al[20]	Greek	male	88.6±0.42	61.1±0.34	61.1±0.33			22.0±0.18
			female	78.5±0.30	55.9±0.29	55.4±0.21			18.7±0.10
2.	Cheng FB et.al.[21]	Chinese	male	74.4±2.90					
			female	66.8±3.11					
3.	Hussain F et.al [24]	Malaysian	male	74.91±3.2					
			female	64.53±3.07					

Fig.1-Measurement of bicondylar width

Fig:1

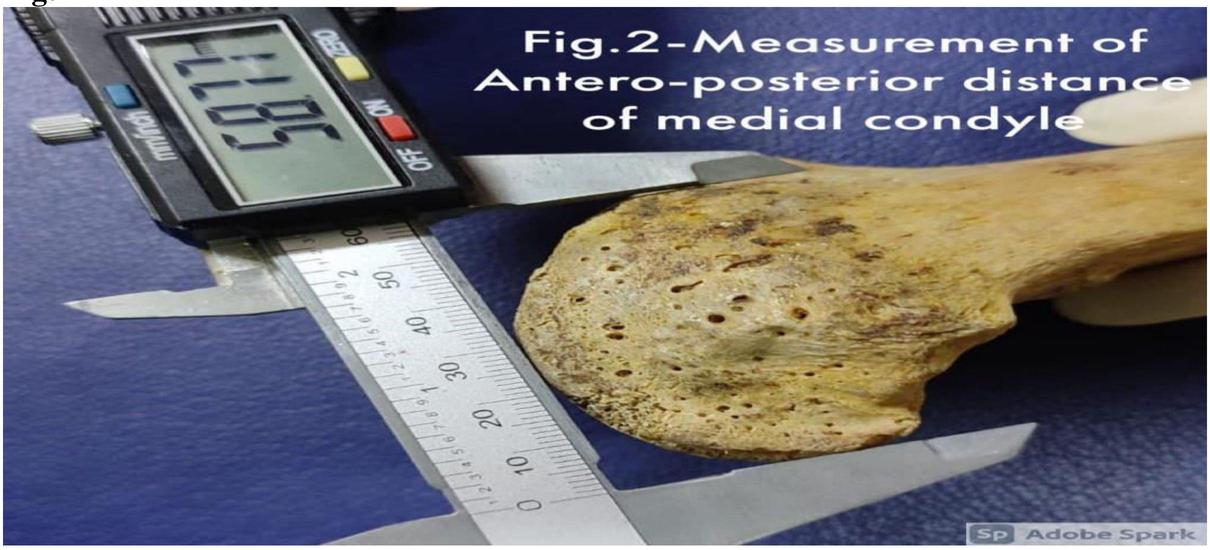

Fig.2-Measurement of Antero-posterior distance of medial condyle

Fig:2

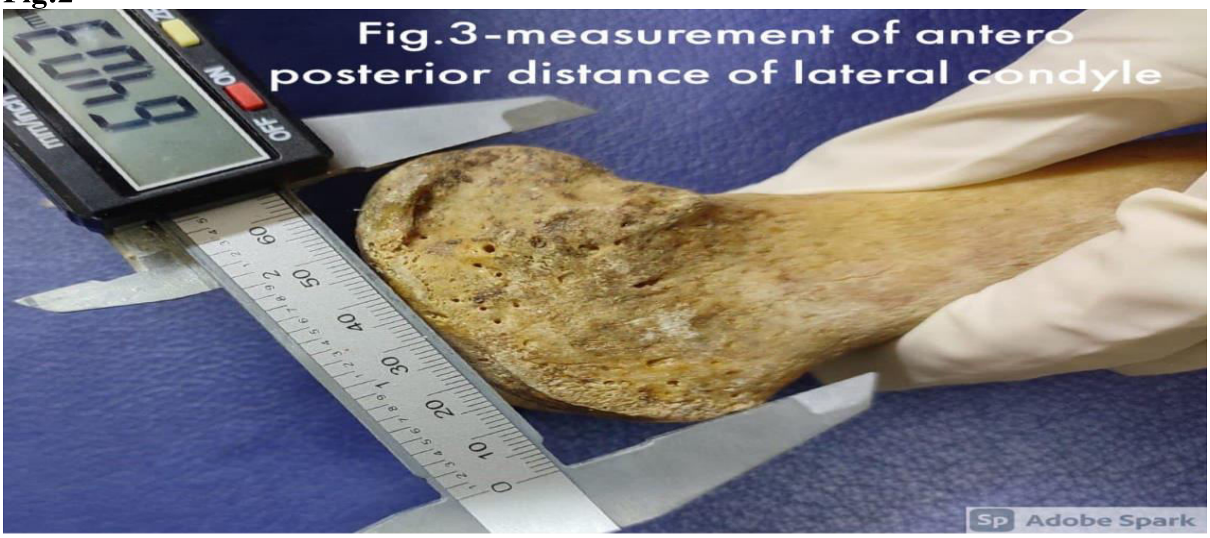

Fig.3-measurement of antero posterior distance of lateral condyle

Fig:3

Fig:4

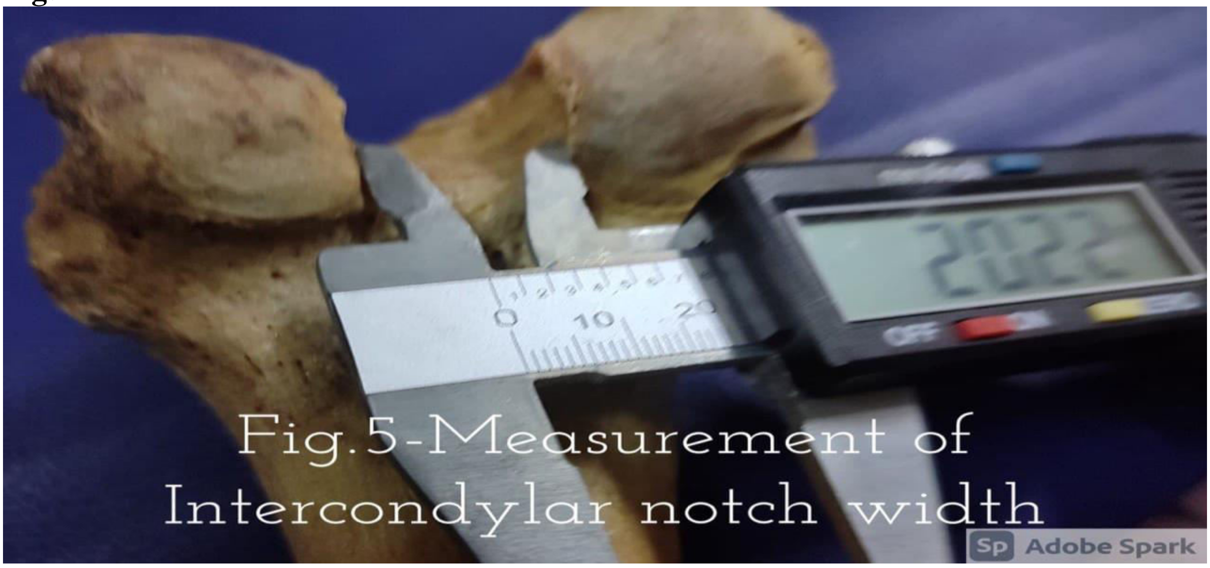

Fig:5

Discussion:

The femur is the largest bone in the human body. Its proximal part and the pelvis constitute the hip joint, and its distal part constitutes part of the knee joint. Therefore, the femur is widely researched in fields such as physical and forensic anthropology, human kinematics, and orthopedics. Physical and forensic anthropology research involves using metric or nonmetric methods to determine differences in the femur with respect to populations, sex, and age. In addition, orthopedics research involves analysis of the femoral head,neck, and the proximal part of the medullary canal for hip joint studies [13,14] as well as the shape of the distal part of the femur for knee joint studies [15,16].The main objective of our study was to study the various anatomical parameters of the lower end of femur that would facilitate in designing appropriate knee prosthesis based on the anthropometric data obtained. In our study the mean bicondylar width was 75.95±5.87mm on right side and 76.17±5.36mm on left side.

Ravichandran et al. has mentioned bicondylar width as 74.58±0.57 on right side and 73.97±0.16 on left side and inter condylar width 18.89±0.29 on right side and18.65±0.27mm on left side.[17]. Vinay G et al. has studied 180 femur bones in Telangana region of india ,all parameters have shown lower values compared to our study and there is no statistically significant difference between right and left sides in their study [18]. Selvapriya et al.[19] studied 72 femur bones ,bicondylar width was 74.85±5.14mm on right side and 73.37±5.04mm on left side.intercondylar notch width was 21.98±2.52mm on right side and 21.01±2.06mm on left side,these values are comparable to our study. All other parameters had shown lower values compared to present study as shown in table-3. Terzidius et al.[20]studies femur from greek population and values are on higher side as compared to Indian population. Cheng FB et al.[21] femur from Chinese population and values are comparable with Indian population.table-3 Biswas et al.[22] studied femur bones from west Bengal population and all values are on lower side and bicondylar width has shown statistically significant difference between right and left side. Chavda HS et al.[23] studied femur bones from Gujrat region ,bicondylar width was 72.82±3.89mm on right side and 71.62±5.67mm on left side and these values has shown significant difference between right and left sides. there is significant difference in morphometric data of the lower end of femur in various populations across the world as well as populations within India.

Conclusion:

The values obtained in present study and comparing them with other studies from Indian and foreign authors clearly shows variances are there not only in different ethnic groups but indifferent populations in India also.proper selection of knee implant is the key for success of knee joint replacement surgeries.this morphometric date will be helpful to surgeons in inserting intramedullary nails,plates,screws and pins by avoiding injury to ligaments blood vessels and nerves.

Conflicts of Interests: None

Reference:

1. Standring S. Gray's Anatomy. The Anatomical basis of clinical practice. 40[1] thedition.Elsevier Churchill Livingstone. 2008: 1362,1397.
2. Mistri S. A study of femoral condylar morphometry. Indian Journal of Basic and Applied Medical Research. 2015;4(4):500-10.
3. Mistri, S., Majumdar, S., Biswas, S. Morphometric study of some lower femoral anatomy in Eastern Indian population. Indian Journal of Basic and Applied Medical Research. 2014; 3(4): 182-190.
4. Pope, M. H., Crowninshield, R., Miller, R., Johnson, R. The static and dynamic behaviour of the human knee in vivo. J Biomech. 1976; 9: 449-452.
5. Thorndike, A. Frequency and nature of sports injuries. The American Journal of Surgery. 1959; 98(3): 316-324.
6. Loudon, J. K. Biomechanics and pathomechanics of the patellofemoral joint. Int J Sports Phys Ther. 2016; 11(6): 820-830.
7. Cheng C.K., Lung C.Y., Lee Y.M., Huang C.H. (1999) A new approach of designingthe tibial base plate of total knee prostheses. Clin. Biomech. 14: 112-117
8. Shah D.S., Ghyar R., Ravi B., Hegde C., Shetty V. (2014) Morphoogical measurement of knee joints in Indian population: Comparison to current knee prostheses. OpenJ. Rheumatol. Autoimmune Dis. 4: 75-85.
9. Dargel J., Feiser J., Gotter M., Pennig D., Koebke J. (2009) Side differences in the anatomyof human knee joints. Knee Surg. Sports Traumatol. Arthrosc. 17: 1368–1376.
10. Igbigbi P.S., Sharrif M. (2005) The bicondylar angle of adult Malawians. Am. J.Suryanarayan P., Navneet J., Ashok P. (2014) CT evaluation and study: Anthropometricmeasurement of knee joint in Asian population. Int. J. Sci. Res. Publ. 4: 1-12.

11. Standring S., Newell R.L.M., Collins P., Healy J.C. (Eds.) (2008) In: Gray's Anatomy,The Anatomical Basis of Clinical Practice. 40th Edn. Churchill Livingstone Elsevier,Spain. Pp. 1362-1363.
12. Taner Z., Awadh M.K. (2002) An analysis of Anatolian human femur anthropometry.Turk. J. Med. Sci. 32: 231-235.
13. B. Atilla, A. Oznur, O. Caglar,M. Tokg¨ozoglu, and M. Alpaslan, "Osteometry of the femora in Turkish individuals: a morphometric study in 114 cadaveric femora as an anatomic basis of femoral component design," Acta Orthopaedica et TraumatologicaTurcica, vol. 41, no. 1, pp. 64–68, 2007.
14. K. Haraguchi, N. Sugano, T. Nishii et al., "Comparison of fit and fill between anatomic stem and straight tapered stem using virtual implantation on the ORTHODOC workstation,"Computer Aided Surgery, vol. 6, no. 5, pp. 290–296, 2001.
15. K. L.HermannandN. Egund, "CT measurement of anteversion in the femoral neck: the influence of femur positioning," ActaRadiologica, vol. 38, no. 4, pp. 527–532, 1997.
16. C. Chaichankul, A. Tanavalee, and P. Itiravivong, "Anthropometric measurements of knee joints in Thai population: correlation to the sizing of current knee prostheses," The Knee,vol. 18, no. 1, pp. 5–10, 2011.
17. Ravichandran. D., Melanie, R. Morphology of the intercondylar notch and its clinical significance. International Journal of Anatomical Sciences. 2010; 1: 26-30.
18. Vinay, G., Vikram, S. A study of morphometric analysis of distal end of femur and its clinical importance. IP Indain Journal of anatomy and surgery of head, neck and brain. 2019; 5(4): 114-117.
19. selvapriyaSivaramalingam,sasi Krishnan gunasekaran.Morphometric analysis of lower end of femur and its clinical significance.J Evid Based Med Healthc 2020;7(35),1844-1847.DOI:10.18410/JEBMH/2020.383.
20. Terzidis, I., Totlis, T., Papathanasiou, E., Sideridis, A., Vlasis, K., Natsis, K. Gender and side-to-side differences of femoral condyles morphology. Osteometric data from 360 Caucasian dried femori. Anatomy Research International. 2012; 679658.
21. Cheng, F. B., Ji, X. F., Lai, Y., Feng, J. C., Zheng, W. X., Sun, Y. F., et al. Three dimensional morphometry of the knee to design the total knee arthroplasty for Chinese population. Knee. 2009; 16(5): 341-347.
22. Biswas, A., Bhattacharya, S. A Morphometric and Radiological study of the distal end of femur in West Bengal population. Italian Journal of Anatomy and Embryology. 2017; 122(1): 39-48.
23. Chavda, H. S., Jethva, N. K., Gupta, S. A study of Morphometric analysis of condyles of adult femur of humans in Gujarat region. International Journal of Anatomy, Radiology and Surgery. 2019; 8(3): AO01-AO05.
24. Hussain F, Kadir Md RA, Zulkifly AH, Sa'at A, Aziz AA, Hossain Md. G, Kamarul T, Syahrom A. Anthropometric Measurements of the Human Distal Femur: A Study of the Adult Malay Population. Biomed Research International Published online 2013 November 5. doi:10.1155/2013/175056 [15].
25. Zalawadia, A. Z., Parekh, D. H., Patel S. M. Morphometric study of lower end of dry femur in Gujarat region and its Clinical implication. Int J Anat Res. 2017; 5(4.2): 4595-4599.
26. Shweta, J., Renu, C. Morphometric analysis of Condyles and Intercondylar notch of femur in North Indian population and its Clinical significance. J Evolution Med Dent Sci. 2017; 6(32): 2605-2608.
27. Kalpana Ramachandran,MahalakshmiRajan.Morphometric analysis of lower end of adult dry femur in south indian population-Across-sectional observational satudy and its clinical significance.Biomedicine:2020;40(2):128-133.