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Anthropometric Analysis of Human Knee Joint in Indian Population

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Study Protocol

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ABSTRACT

Background: It is well understood that distal femoral and proximal tibia scale is lower in case of the Asian than that of their western counterparts. Because of the Asian population's comparatively smaller structure and stature, many surgeons claim that imported implants may not be well fitted for Asian origin patients, mainly based on Western morphometry. It is very likely that an overweight section will be used in many Asian centres in most operations, resulting in low results of the procedure of the implant. For joint substitution of distal femur, careful positioning of fitted implants as well as balancing of underlying soft tissues is important. It is also important to use incredibly complex surgical procedures. To retain its usual functional motion spectrum, use of a suitable femoral part dimension is necessary. Furthermore, owing to a discrepancy between the size of the prosthesis and the bone, there could be a host of serious issues.
Objectives: To calculate the anthropometric distal femur parameter and determine the distal femur variations on the right and left side of the morph metric measurement and to evaluate dimension of current TKA as related to Indian population.
Methodology: This study included visiting the out patients Department of Orthopedics, at AVBRH in the age group 30-50 year during the period of June-2020 to April-2023 with sample size of 50 patients.

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Detailed history and clinical review will be taken, including age, sex, socio-economic background, type of employment. In all patients involved in the study in Orthopedic OPD, thorough radiological assessment of all the knee joints will be performed. The radiological test and various anthropometrics will include knee joint Simple X-ray and CT-Scan.
Expected Results: We expect that from our results, anthropometric measurements of Indian population may differ from other literatures.

Keywords: Anthropometry; knee joint; TKA.

1. BACKGROUND

It is well understood that distal femoral and proximal tibia scale is lower in case of the Asian than that of their western counterparts. Because of the Asian population's comparatively smaller structure and stature, many surgeons claim that imported implants may not be well fitted for Asian origin patients, mainly based on Western morphometry [1-3]. It is very likely that an overweight section will be used in many Asian centres in most operations, resulting in low results of the procedure of the implant. Therefore, using a sufficient femoral scale for the multiple demographic and ethnic groups is of utmost importance for the required individuals. This will guarantee that the implants used during their lifespan had optimal efficiency.

To get back the knee to its usual physiological function, most knee arthroplasty is usually done on the diseased knees. Many of them also jointly influenced the pathological conditions of individuals aged 45 and over. However with the prevention of rheumatoid arthritis and osteoarthritis, there were instances when complete knee replacements were carried out for the relatively young people aged 45 years or below. Cases of post traumatic arthritis, AVN, hemochromatosis, lupus, dislocation, sepsis, and unstable components have been identified in follow-up trials. Use of extremely complicated operation procedures is important to replace distal femur together, as this ensures that well-fitting implants are placed and soft tissue around them are balanced [1-3]. To retain the usual functional range for the motion of the leg, the use of a sufficient femoral part size is important. Furthermore, a difference between the scale of the prosthesis and the bone may contribute to a variety of serious problems Use of a small portion is already found to induce implantation loosening, while an overweight aspect will induce impression of underlying soft tissues. Therefore after complete knee arthroplasty, the use of the required part size is important for long-term performance. Currently, several Asian countries like China, Japan, Korea, Taiwan and Thailand made available the anthropometric knee joint measurements [1, 2]. Analyses of most of India's population are compared with separate anthropometric ethnic data reported in those other literatures [1].

For differing quantities of prostheses, various types of prostheses are essential. Bone degradation, deformity, laxity and arthritic involvement. The used prostheses range from single-service versions to reinforced prostheses for severe deformities and ligament defects and healing procedures for minimally deformed single-service disease. Most surgeons recommend using PCL prostheses for moderate deformities and PCL-replacements for serious deformities. Choice of surgeons is dependent on expertise and practice. Manufacturers of knee prostheses have designed prosthetics which either requires retention of PCL or PCL substitution with modular polyethylene tibial implants, as well as replacement of PCL and PCL femoral components involving identical bone cuts [3]. In general, such prostheses are being used to promote an intraoperative shift from PCL conservation to PCL replacement or a selective candidate arrangement. In most situations, the arthroplasty may be converted with relative ease to a PCL-substituting configuration if it is difficult to balance the PCL. Tibial polyethylene section with a substantial dissipation (or improved AP congruence or constraint in sagittal plant) for alternative usage is mostly included in several prosthesis designs, rather than the post-stabilized structure with PCL incompetence [3]. Usually, interchangeable stems, metal augmentations and restricted condylar modules are available in most appliances. Several other variables influencing the prosthesis design and selection, includes prosthesis fixation, modularity, patellofemoral articulation, handling, and polyethylene issues [3]. It is the expected of the surgeon to consider the signs, contraindications, predicted functional outcome and survival for each type of prosthesis and

particular prosthesis [3]. These are covered in corresponding sections of this chapter. For any form of prosthesis and individual prosthesis, it is the responsibility of the surgeon to consider the symptoms, contraindications, possible functional outcome and survival. Each surgeon should be familiar with his or her choice of choices and instrumentation and assure that all the bases in the operating room are covered. Long-term follow-up research may further extend our understanding of appropriate spectrum signals of knee prosthesis available.

1.1 Aim and Objectives

i. To measure distal femur anthropometric parameter
ii. To calculate the anthropometric distal femur parameter and determine the distal femur variations on the right and left side of the morphometric measurement
iii. To evaluate dimension of current total knee arthroplasty system as related to Indian population

2. MATERIALS AND METHODOLOGY

This prospective study will be carried out in Department of Orthopedics, at JLN Medical College and AVBRH, Sawangi, Wardha during the period from **June 2020 to April 2023**.

Sample Size: 50

Study type: Prospective Observational Study

2.1 Method OF Collection of Data

All the patient visiting the out patients Department of Orthopedics, at JLN Medical College and AVBRH, Sawangi, Wardha in **the age group 30-50 year** during the period of **June 2020 to April 2023.** Detailed history and clinical review will be taken, including age, ethnicity, social status, personal activities, and type of work. In all patients involved in the study in the Orthopedic Patient Department, comprehensive radiological analysis of all the knee joints will be performed. A basic X-ray and CT-Scan of the knee joint will be used in the radiological evaluation. On X-ray and CT scans, various anthropometric parameters will be analyzed as follows:

- Femoral torsion distally (dft)
- Anatomic axis
- Blumensaat's line length (bll)
- Posterior femoral angle distally (pdfa)
- Blumensaat's line angle
- Inter-epicondylar distance (ied)
- Posterior tibial slope (pts)
- Metaphyseo-diaphyseal angle (mda)
- Angle of tibial plateau
- Length of tibial plateau
- Width of tibial plateau
- Anterior to posterior diameter
- Medial to lateral diameter
- Insall-Salvati Index
- Modified Insall–Salvati Index
- Black burnepell Index
- Caton – Deschamps Index

2.2 Exclusion Criteria

- Patients with infection, fractures, and bone tumors will be excluded from the study.
- Individuals who underwent prior distal femur surgery
- Individuals with congenital deformity of distal femur

STATISTICAL ANALYSIS- Appropriate statistical test would be applied to analyze data.

EXPECTED RESULT- Result will be formulated on basis of observations. Also the conclusion will be drawn on the basis of observations and result.

3. DISCUSSION

CT instruments often aren't easily obtainable even as standard throughout most of the various parameters restricts their use in this study, processing time are typically longer than ordinary radiographs as well as the technical standard is not more than five times. Radiation is considerably higher (knee position, settings) (5 to20 mSv). Horizontal areas should be used with all landmarks at the same time to provide greater clarity in the measurement of bony landmarks. Involvement of metal artifacts and osteoarthritis with significant ostesphytes is obstacles to fulfillment of these requirements through complications of coordination of that same knee [1, 4]. In the majority of tests, regardless of the tool used, difficulties in distinguishing bony landmarks were identified. The reliability of measurements can be compromised by these difficulties. 3D CT requires additional period for rebuilding but no definition or measurement

precision appears to be enhanced [4]. Thus, this analysis makes an honest effort to quantify all the parameters utilize digital x-rays that have the advantage of being readily usable, inexpensive and much less sensitivity to radiation compared to CT.

In turn, efficiency of inter-observer (98%) and intra observer (95%) must be enhanced due to specification done in the calculations. Both x-rays are taken by our institution's professional radiographers. The AP, short knee X-ray, weight-bearing, was attained while the patient was seated in line with the longitudinal cassette with the back of his knees. Central beam was concentrated roughly 2.5 cm under edge of patella with a 100 cm film. The posture of the patient was to stand slightly outwardly with their heads rotated in order to maintain the angle between the two feet about 15°. [5] In the current research, radiographs are obtained with a film focal length of 130 cm, 60 kV, 200 mA and 50 ms. Weight bearing time [1, 6]. AP knee is radiographed by stretching and rotating a knee full with the patella in middle of femoral condoyle [6]. From AP knee radiographs, anatomical orientation is determined. A marker is positioned at the middle of the spine of the tibia. Anatomical axis is located at a core of tibia spines, line drawn 10 cm above tibia spines, midway between cortical surfaces of the bones' lateral and media femoral surfaces. tibial anatomic axis is defined by connecting the dots between medium and lateral cortical surfaces of bone from middle of tibial spines to 10 cm well below tibial spines [2-7]. The medial angle for the axis intersection is then calculated, with measurements stated as either > 180 °or <180° based on the misalignments of the valgus or varus.

- Towards knee-related surgery, DFT (Distal Femur Torsion) is a crucial component, since it influences kinetic kinematics, in specific monitoring of satellite and bending ligaments. [7] Anatomy of knee X-rays from the AP are defined. In center of tibia spine, an indicator is located in femoral portion. These bony landmarks were used to identify two angles in DFT determination [1, 7]:

i. APCA (Anatomic Posterior Condylar Angle) between posterior condyle tangent line and the trans epicondylar axis angle
ii. A sPCA between the tangent angle (Surgical Posterior Condylar Angle)

- The line to the posterior condyles and the relation to the Medial sulcus epicondyle of the medial epicondyle lateral condyles [7]. The PCA was internally distorted and reported arbitrarily as negative (anti-clockwise direction for the left knee). When angle tip was medium, distal femur was externally bending and angle was favorable (clockwise direction for the left knee).
- Then link the sagittal plane and distal femoral joint orientation line followed by identification of location of metaphysis entering the condyle for pointing out the anterior and posterior points.
- The distal femoral angle posterior is the angle subtended between the femoral angle between mid-diaphysial line of the distal femur (distal femoral anatomic axis) and lateral distal femoral angle of the femur (PDFA) [6, 8].
- The blumensaat line angle (BLA) of the Blumensaat is determined between the line of the Blumensaat and the distal anatomical femoral axis.
- Intercondylar notch roof is shown by Blumensaat line in lateral x-ray vision. Blumensaat line length (BLL) and tibial plateau length (lateral tibial distance [LTW]) were determined on the lateral radiograph [7].
- Tibial plateau scale has been estimated at the subchondral bone level. The antero posterior radiograph is used to assess the distance between the medial and lateral femoral epicondyles (interepicondyl distance [IED]) and the width of the tibial plateau (coronal tibial range [CTW].
- Metaphysis Diaphysis Angle (MDA) is cross-sectional angle between tibia and metaphysis axis [9-11].
- Proximal anatomical axis of tibia is first drawn in a lateral visual radiograph, linking the middle points of external cortical diameter of a tibia at intervals of 5 and 15 cm to knee articulation [5, 11].
- Then, second line was drawn, that is, metaphysic, by bringing in a lateral film and linking middle points of two points on both proximal and distal cortices of the tibial metaphysic [11, 12].
- MDA was eventually calculated. The angle was defined as Preoperative Posterior Tibial Slope (PTS), the first line was produced by two lines in the lateral radiography [6, 11].

- Then second line was formed by connecting the lateral radiograph with the most proximal points on tibia plateau, avoiding osteophytes [6, 10-13].
- Since no prior consensus on the ideal anatomical axis for PTS measurement was noted, the connecting line between the midpoints of the outer cortical diameter at a distance of 5 and 15 cm to the knee joint is suggested as being the most parallel to mechanical sagittal axis. [11]
- The anatomical axis of our research was also considered to be this axis. Angle between plateau's angles, proximal articular tibial axis and horizontal line determines an angle of the Tibial Plateau (TPA) [3, 11, 14].

Few of the related studies on anthropometric analysis [15], knee joint in different conditions [16,17]. and MRI of knee joint [18,19,20] were reviewed. Evidences of musculoskeletal morbidities are available in studies by Khanam et. al. [21] and Global Injury studies [22-27].

4. CONCLUSION

The conclusion will be drawn on the basis of observations and result.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Hussain F, Kadir MR, Zulkifly AH, Sa'at A, Ad A, Hossain MG, Kamarul T and Syahrom A. "Anthropometric measurements of the human distal femur: A study of the adult malay population. BioMed Research International; 2013.
Available:https://doi.org/10.1155/2013/175056
2. Buran T, SanemGökçeMerveKılınç, ElmasKasap. Prevalence of extraintestinal manifestations of ulcerative colitis patients in turkey: community-based monocentric observational study. Clinical Medicine and Medical Research. 2020;1(2):39-46.
Available:https://doi.org/10.52845/CMMR/2020v1i2a8
3. Cheng FB, Ji XF, Lai Y, Feng JC, Zheng WX. Three dimensional morphometry of the knee to design the total knee arthroplasty for Chinese population; 2009.
4. Colebatch AN, Hart DJ, Zhai G, Williams FM, Spector TD, Arden NK. Effective measurement of knee alignment using AP knee radiographs. 2009;16(1):42-45.
5. Mihalko WM. Arthroplasty of the knee, Campbell operative orthopedics 12th edition, Philadelphia; Elsevier Mosby. 2013;7(1):391.
6. Daniel V, Daniel K. Perception of nurses' work in psychiatric clinic. Clinical Medicine Insights. 2020;1(1):27-33.
Available:https://doi.org/10.52845/CMI/2020v1i1a5
7. Viel T, Casin C, Ducellier F, Steiger V, Bigorre N, Bizot P. "Is radiographic measurement of distal femoral torsion reliable?" 1877-0568– see front matter © 2013 Published by Elsevier Masson SAS.
Available:http://dx.doi.org/10.1016/j.otsr.2013.02.009
8. Chiba D, Tsuda E, Sasak S, Li X, and Ishibash Y. Anthropometric and Skeletal Parameters Predict 2-Strand Semitendinosus Tendon Size in Double Bundle Anterior Cruciate Ligament." The Orthopaedic Journal of Sports Medicine. 2017;5(8):2325967117720148.
DOI: 10.1177/2325967117720148
9. Campbell TM, Trdel G, Laneuville O. Knee flexion contractures in patients with osteoarthritis: clinical features and histologic characterization of the posterior capsule. PM&R; 2015.
10. Daniel V, Daniel K. Exercises training program: It's Effect on muscle strength and activity of daily living among elderly

people. Nursing and Midwifery. 2020;1(01): 19-23.
Available:https://doi.org/10.52845/NM/2020v1i1a5

11. Takai S, Yoshino N. A new roentgenographic technique to assess rotational deformity and alignment of the distal femur. Journal of Arthroplasty. 2003;18(4):478-483.
12. Lonner JH, Jasko JG, Thomas BS. Anthropomorphic differences between the distal femora of men and women. Clin Orthop Relat Res. 2008;466:2724–2729.
13. Mohanty SS, Rao NN, Dash KK, Bhosale SK. Correlation of posterior tibial slope with metaphysio-diaphyseal angle in total knee arthroplasty: A radiological study. 2013;47(1):67-71.
14. Daniel V, Daniel K. Diabetic neuropathy: New perspectives on early diagnosis and treatments. Journal of Current Diabetes Reports. 2020;1(1):12–14.
Available:https://doi.org/10.52845/JCDR/2020v1i1a3
15. Thirunarayanan V, Ramprasath DR, Amarnath R, Arun V. An observation of posterior tibial slope and metaphysio-diaphysealangle in indian population. Journal of Orthopedics and Joint Surgery; 2020
16. Sung-Mok Oh, Seong-Il Bin, Bum-Sik Lee, Jong-Min Kim. The entry point of intramedullary tibia cutting guide should vary according to the individual tibia morphology in TKA. Archives of Orthopaedic and Trauma Surgery; 2019.
17. Available:www.ncbi.nlm.nih.gov
18. Wang X, Jing L, Wang X, Li Z, Li Z, Zhang Z AND Yang J. Effects of medial posterior tibial slope on the locations of meniscal tears. Medicine; 2020.
19. Nagrale N, Patond S, Jain K. Estimation of Cephalic Index of Chhattisgarhi Population: An Anthropometric Study from Central India. Journal of Forensic Medicine and Toxicology. 2019; 36(1):9–12.
Available:https://doi.org/10.5958/0974-4568.2019.00003.6.
20. Mohabey A, Gupta S, Gawande V, Saoji K. A study on correlation of magnetic resonance imaging and arthroscopy in evaluation of anterior cruciate ligament injury in cases of acute traumatic haemarthrosis of knee: A prospective study. International Journal of Current Research and Review. 2020;12(14)Special Issue:14–17.
Available:https://doi.org/10.31782/IJCRR.2020.1417.
21. Nikose SS, Nikose D, Kekatpure AL, Jain S, Saoji K, Reddy SM. Impact of medial open-wedge high tibial osteotomy for medial compartment osteoarthritis of the knee. World Journal of Orthopaedics. 2020;11(12):534–626.
Available:https://doi.org/10.5312/wjo.v11.i12.606.
22. Phatak S, Deshpande S, Mishra G, Madurwar K, Marfani G, Lohchab B. Sonographic evaluation of knee pain: A prospective observational study. Journal of DattaMeghe Institute of Medical Sciences University. 2019;14(3):192–95.
Available:https://doi.org/10.4103/jdmimsu.jdmimsu_81_19.
23. Vaidya SV, Aneesh MK, Mahajan SM, Dhongade HS. Radiological assessment of meniscal injuries of the knee on magnetic resonance imaging. International Journal of Current Research and Review. 2020;12(15):98–102.
Available:https://doi.org/10.31782/IJCRR.2020.121511.
24. Vaidya SV, Dhongade HS, Mahajan SM, Aneesh MK. Evaluation of anterior and posterior cruciate ligament injuries of the knee on magnetic resonance imaging: A cross-sectional study. International Journal of Current Research and Review. 2020;12(14):105–8.
Available:https://doi.org/10.31782/IJCRR.2020.121422.
25. Khanam N, Wagh V, Gaidhane AM, Quazi SZ. Assessment of work-related musculoskeletal morbidity, perceived causes and preventive activities practiced to reduce morbidity among brick field workers. Indian Journal of Community Health. 2019;31(2):213–19.
26. James SL, Castle CD, Dingels ZV, Fox JT, Hamilton EB, Liu Z, Roberts NLS, et al. Global injury morbidity and mortality from 1990 to 2017: Results from the global burden of disease study 2017. Injury Prevention. 2020;26(1):196–114.
Available:https://doi.org/10.1136/injuryprev-2019-043494.

27. Abbafati C, Machado DB, Cislaghi B, Salman OM, Karanikolos M, McKee M, Abbas KM, et al. Five insights from the global burden of disease study 2019. The Lancet. 2020;396(10258):1135–59.
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