



Review article

Dimensions of distal femur in terms of total knee arthroplasty among different origins – A systematic review



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ABSTRACT

Background: The achievement of optimal results out of total knee arthroplasty surgery depends on fit and sizing of the implant over the bone. Mismatch between resected bone and implant alters the outcome of the surgery. Identifying the medial-lateral and anterior–posterior measurement in the resected femur lays the foundation for identifying the implant size. The ratio of medial-lateral and anterior–posterior measurement figures out the match between implant and bone. The bony architecture is influenced by ethnicity. Therefore it becomes essential to study distal bone notability from different indigenous origin groups.

Questions/purposes: This study incorporates a systematic review analysis of the English literature published on the anthropometric dimensions of the distal femur. The anterior–posterior and medial-lateral width values are assessed to determine the inherent ethnic differences in bony parameters.

Methods: An extensive search in seven search engines was performed to produce 9820 responses. This collection was imported in endnote library to finally obtain 6320 publications after duplication. Further detailed examination produced only 65 papers to undergo full-text inspection. After a thorough review of the full text, only 20 papers were found to be relevant for a systematic review.

Results: There were 8 different racial populations assessed in the various studies. Caucasians were studied by most of the authors. All papers imply the need of alterations in the current implant sizing to improve fitment in Asian population.

Conclusions: Most of the studies were performed with patients of Caucasian origin. The Asian sub-populations studies demonstrated the incongruence in implant sizing and anthropometric measures and therefore recommending that these ethnic differences need to be addressed in future implant design.

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1. Introduction

The accuracy in placing the appropriate fit femoral implant is an essential factor in achieving the optimum results in total knee arthroplasty including normal range of motion. Mismatch between the bone and prosthetic size implies severe longevity related complications. Undersized component leads to loosening of the implant and oversized causes soft tissue impingement. All these discussion leads to the need of the increased accuracy in the implant sizes with proper fit. Various evidences are available to support the fact that Asian sub-populations are smaller in size than the Western population. Therefore it becomes essential to design implants suitable for Asian population considering this variation to obtain the optimum results. Various authors studied distal femoral morphometry using different tools and techniques to determine different parameters in the proposed subgroup. The important measurement in the distal femur is femoral medio-lateral and antero-posterior dimensions. Their ratio defines the geometrical shape of the femur. This systematic review involves the collection and result concluded from such papers, involving the normal bone anatomical samples form a variety of ethnic groups.

2. Material and methods

A standard search was run through Ovid MEDLINE(R) and other Non-Indexed Citations and Ovid MEDLINE(R) 1946 to 27th October 2014 and PubMed, CINAHL, Scopus, Cochrane and Web of Sciences. A total number of 9820 results were obtained, limiting to humans, English language and samples with intact bone anatomy only. The following Prisma chart shows the further selection criteria (Fig. 1).

3. Results

Table 1 summarizes the relevant values of fAP and fML.

20 relevant papers were extracted from the above strategy. The samples of results were from seven different ethnic groups.

3.1. Asians

Mahfouz et al.,²⁰ collected knee CT (cadaveric or skeletal) of 80 East-Asians (40 males and 40 females) to generate 3D model and measure. The values obtained in males are fAP – 54.9 ± 4.4 mm, fML – 85.4 ± 4.3 mm and fML/fAP – 1.56 ± 0.11. Corresponding

values in females are fAP – 50.0 ± 4.0 mm, fML – 74.8 ± 3.3 mm and fML/fAP – 1.5 ± 0.1.

3.2. Chinese

Yue et al.,⁵ involved CT scans of 20 male and 20 female knee joints of Chinese descent. Using a 3D modeling software, these CT images were segmented to construct a 3D model of the sample to be measured. The values obtained are as follows: In males – fAP is 65.0 ± 2.8 mm and fML is 82.6 ± 3.6 mm. In females – fAP is 58.8 ± 2.5 mm and fML is 72.8 ± 2.6 mm. The aspect ratio is 1.27 ± 0.03 in males and 1.24 ± 0.04 in females. (The dimensions of Chinese knees were generally smaller than white knees. In addition, Chinese females had a significantly narrower distal femur than white females, whereas Chinese males had a wider proximal tibia than their white counterparts.)

Yue et al.,¹⁰ created 3D anatomical model of the femur from CT of all 40 Chinese subjects (20 males and 20 females). They measured fML, fLAP and fMAP to calculate aspect ratio as fML/fLAP. The values in male are fML 82.6 ± 3.6 mm, fLAP 65.0 ± 2.8 mm, fMAP 62.2 ± 3.9 mm and fML/fLAP 1.27 ± 0.03. The corresponding values in females are fML 72.8 ± 2.6 mm, fLAP 58.8 ± 2.5 mm, fMAP 55.3 ± 2.7 mm and fML/fLAP 1.24 ± 0.04.

Yan et al.,¹³ included 100 subjects (50 males and 50 females) of Chinese descent in their study. The collection of CT of these subjects produced 3D model to be measured. The values obtained are; in males fML is 69.62 ± 3.10 mm, fAP is 65.61 ± 2.49 mm and aspect ratio (fML/fAP) 1.06 ± 0.04. In females fML is 61.14 ± 3.07 mm, fAP 59.41 ± 2.53 mm and aspect ratio (fML/fAP) 1.03 ± 0.05.

Yue et al.,¹⁴ recruited 50 males and 50 females to get their knee scanned by CT. These CT created 3D femur model of these samples to be further analyzed to measure fAP and fML. The author does not directly provide the fML and fAP.

Li et al.,¹⁷ reconstructed 3D models from CT images of 148 Chinese samples (61 males and 87 females). The values found in males are fML 72.7 ± 3.8 mm, fAP 56.5 ± 2.5 mm and aspect ratio (fML/fAP) 1.29 ± 0.04. The corresponding values in females are fML 64.4 ± 2.6 mm, fAP 52.8 ± 2.6 mm and aspect ratio (fML/fAP) 1.22 ± 0.05.

Cheng et al.,¹⁹ included 94 males and 78 females of Chinese ethnicity. Computer Tomographic Angiography (CTA) images constructed 3D model to be studied for morphological features.

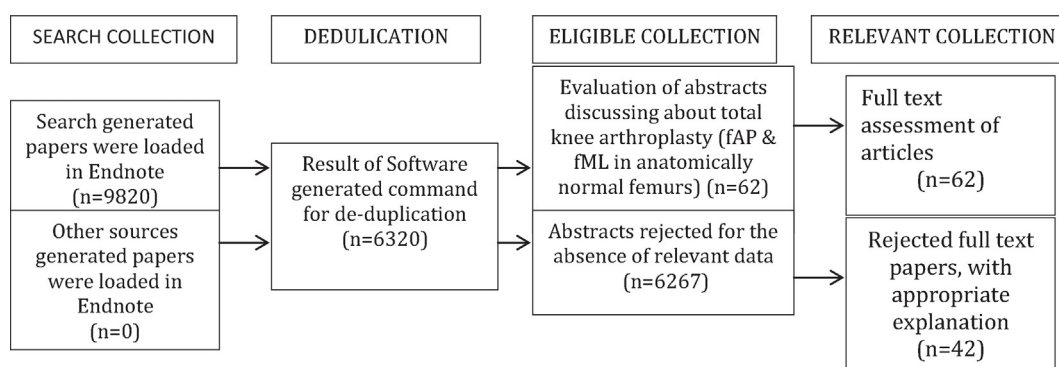


Fig. 1. Prisma flowchart.

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