MORPHOMETRICAL MEASUREMENTS OF RESECTED SURFACE OF FEMUR IN CHINESE KNEES - CORRELATION TO THE SIZING OF CURRENT FEMORAL IMPLANTS

*Ho, WP; *Liu, JY
+Institute of Rehabilitation Science and Technology, National Yang Ming University, Taipei, Taiwan
jjliau@ortho.ym.edu.tw

INTRODUCTION

In total knee arthroplasty (TKA), one important factor in achieving a successful TKA is a good shape match between the prosthesis and the resected surfaces of knee [1]. In femoral implants, two major parameters, namely the anterior-posterior (AP) dimension and medial-lateral (ML) dimension are used to identify the possible size for the patient’s knee. The AP dimension is widely used as the main parameter in selecting the size of implant because it is strongly associated with the normal gait motion and accurate ligamentous balancing in flexion and extension, while the ML dimension deals with contact areas and the distributions of loads [2]. Therefore, the relationship between the AP dimension and ML dimension of knee joint is very important for implant design.

Many researchers had studied knee morphology from cadavers or X-ray films of normal knees. However, most osteoarthritic knees that require TKA are deformed and those anatomical dimensions would differ from normal knees [3]. The morphometrical data in resected surfaces is more useful in determining appropriate implant size [1]. The objective of this study was to measure the resected surfaces of the femur in Chinese osteoarthritic knees and compared the measurements with the dimensions of current femoral implants.

METHODS

From January 2002 to December 2002, 70 patients with osteoarthritic knee underwent total knee replacement were involved. All subjects signed an informed consent document approval by authors’ institute. There are 57 females and 13 males, the mean age was 68.8 years old, the mean body weight was 67.8 Kg, the mean body height was 154.0 cm, and the mean body index was 28.6 Kg/m².

The knee surgery was performed and the morphometrical data in the distal part of the resected femur was measured by a single surgeon to eliminate the inter-operation error in measurement. During the surgery, the distal femur cutting was performed firstly. The cutting thickness was 8 or 10 mm from the lateral condyle depending on the wear of medial condyle. Then the anterior-posterior length of lateral condyle was measured. In addition, the widths of the medial and lateral femoral condyles and intercondylar notch were also measured. The total width of resected femur was defined as the sum of medial condyle, lateral condyle and intercondylar notch (Figure 1). The measured point in the resected femur was defined as the sum of medial condyle, lateral condyles and intercondylar notch were also measured. The total width of resected femoral surfaces of knee [1]. In femoral implant designs, the size of implant because it is strongly associated with the normal gait motion and accurate ligamentous balancing in flexion and extension, while the ML dimension deals with contact areas and the distributions of loads [2]. Therefore, the relationship between the AP dimension and ML dimension of knee joint is very important for implant design.

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A suitable relationship between the medial-lateral width and the anterior-posterior length of resected femoral surface can be useful for proper size distribution for implant design. The Nexgen, Duracon and UKnee systems tend to overhang the medial and lateral condyle at a given anterior-posterior length. The size distributions for PFC Sigma and Scorpio are closer to the regression line than that of Nexgen, Duracon and UKnee. This finding is similar with Urabe et al’s [4] study that Nexgen and Duracon systems tend to overhang the medial and lateral femoral condyles while the PFC system showed a better design for Japanese patients. However, in Hitt’s study [5], the size distributions of Duracon system were closer to the regression line than that of the Scorpio and PFC Sigma systems for American patients. This finding demonstrated that one system suitable for European patients would not be suitable for Chinese patients. For Chinese patients, other prosthetic sizes for better fitting are required.

In conclusion, some femoral implants in current design are not suitable for Chinese patients. The morphometrical data for the length of lateral femoral condyle and the total width of distal femur of resected femur may be used as a guideline to determine the size distributions of femoral implant for Chinese patients.

RESULTS

The mean anterior-posterior (AP) length of the lateral femoral condyle was 63.7 (SD 5.1) mm and the mean medial-lateral (ML) width of resected femur was 70.2 (SD 5.4) mm. The widths of the medial condyle, intercondylar notch and lateral condyle were 26.7 (SD 2.7) mm, 18.2 (SD 2.3) mm and 25.3 (SD 2.6) mm, respectively. The resected femoral ML dimension versus the AP dimension and the implant’s AP and ML sizes is shown in Figure 2. The Duracon, Nexgen and UKnee systems showed a larger ML dimension than the morphometrical data for a given AP dimension. Those implants tend to overhang in the ML width of resected femur of Chinese patients. The mean femoral aspect ratio for the morphometrical data was 109% (SD 6%). The femoral aspect ratio for the morphometrical data showed a higher ratio for smaller knees and a proportionally lower ratio for larger knees. The five implant systems showed little changes in the aspect ratio with AP dimension.

DISCUSSIONS

The range of two major parameters measured in this study is widely distributed (Figure 2). This finding is similar with Hitt et al. [5] and Urabe et al.’s [4] studies. Although the anterior-posterior length in some patients are approximately equal, the medial-lateral width of those patients are not always equivalent. By contrast, most implant systems provide only one medial-lateral width for one anterior-posterior length. The implant component should be designed with several medial-lateral widths for one anterior-posterior length to obtain a better anatomical fit.

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REFERENCE


Figure 1 Dimensions of resected distal femur. AP is the anterior-posterior length of lateral condyle, WL, WI and WM are the width of lateral condyle, intercondylar notch and medial condyle respectively.

Figure 2 The femoral anterior-posterior (AP) versus the medial-lateral (ML) measurement.