Intraoperative measurement of Femoral anterior tangent (FAT) line for determining rotational alignment of the femoral component in Total knee arthroplasty

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INTRODUCTION

Several reference axes have been proposed to establish the appropriate rotational alignment of the femoral component, including the posterior condylar axis (PCA), the antero-posterior (AP) axis (Whiteside’s line), and the transepicondylar axis (TEA).

Previously, we reported using computed tomographic (CT) images that the anterior surface of the femur immediately proximal to the tricbhea and its tangent line (Femoral anterior tangent line; FAT line) could be used as a good index of the femoral rotation\(^1\). The analysis of the CT images of 150 knees with osteoarthritis indicated that FAT line was consistently determined to be 12 degrees internally rotated to the clinical TEA.

The purpose of this study was to measure the angle of the FAT line against the reference TEA during TKA surgery and to examine whether the intraoperative measurement value reflected the preoperative value using CT images and could become an index of the appropriate rotational alignment of femoral component.

METHODS

The patient population included 43 patients (47 knees) who had TKA operation because of osteoarthritis of the knee. There were 6 men and 37 women, and average age was 75.1 ± 5.7 years old (average± standard deviation; range, 62- 83 y.o.). In these patients, both preoperative and postoperative CT images were available.

A CT scan of the lower extremity was performed in full extension at 1 mm intervals. The scan direction was aligned perpendicularly to the longitudinal axis of the femur.

The anterior femoral surface around the upper pole level of patella was examined on the serial CT slices. Next, a CT slice immediately proximal to the femoral trichlea, which showed widest anterior width without trochlea prominence, was selected. The configuration of the anterior femoral surface was examined and a line tangential to the anterior femoral surface (FAT line) was determined. CT slices on which the medial or lateral epicondyles were most prominently detectable were also selected to measure the clinical and surgical TEA (Fig. 1). Preoperatively, the angles between the FAT line and these TEAs were calculated.

For intraoperative measurement of the FAT line, we developed a jig that would allow us to measure the angle of FAT line against the arbitrary rotational alignment of the femoral component (Fig. 2). The target rotational alignment of the femoral component was determined to be internally rotated from the clinical TEA with reference to the surgical TEA in consideration of soft tissue balance in flexion.

From postoperative CT images, the rotational angle of the femoral component relative to the clinical TEA was measured (Fig. 3). The Pearson correlation test was used to analyze the correlation between preoperative clinical TEA/ FAT line angle and intraoperative FAT line angle. The level of significance was set at a value of 0.05.

RESULTS

On measurement of the preoperative CT, FAT line was 12.2 ± 3.9 degrees internally rotated to the clinical TEA. In 20 knees (20/47 knees; 43%) in which the surgical TEA was able to be determined, the FAT line was 7.3 ± 4.0 degrees internally rotated to the surgical TEA. These measurement values were largely similar to those of the preceding study involving 150 knees\(^1\).

The average intraoperative measurement value of the FAT line was 9.8 ± 3.2 degrees. This value significantly correlated to preoperative FAT line/ clinical TEA angle (Fig. 4; r=0.72, p<0.01).

The postoperative CT revealed that the femoral component was aligned at 2.8 ± 1.9 degrees internally rotated to the clinical TEA.

DISCUSSION

There was significant correlation between intraoperative angle of the FAT line and preoperative FAT/clinical TEA angle using CT images.

The intraoperative measurement value of the FAT line was 9.8 ± 3.2 degrees. This was smaller by an average of 2.3 degrees than the preoperative value of the angle composed of the FAT line and clinical TEA (12.2 ± 3.9 degrees). Moreover, the intraoperative measurement value was larger by an average of 2.5 degrees than the preoperative value of the angle to the surgical TEA. In other words, the femoral component was expected to be rotated approximately 2.3 degrees internally from the clinical TEA and approximately 2.5 degrees externally from the surgical TEA, respectively. According to postoperative CT images, the component was internally rotated 2.8 ± 1.9 degrees to the clinical TEA, well reflecting the preoperative and intraoperative measurement values.

These findings demonstrated that the FAT line is a useful index for appropriate rotational alignment of femoral component, both before and during TKA surgery.

SIGNIFICANCE

The use of a new landmark of the anterior femoral surface and its tangent line (FAT line) would help to properly determine the femoral rotational alignment both before and during surgery.

REFERENCE