The effect of the remaining cartilage of the posterior condyle for femoral component rotational alignment in total knee arthroplasty.

Hamada, D; Mikami, H; Goto, H; Takasago, T; Goto, T; Oba, K; Miyoshi, H; Egawa, H; Yasui, N

The University of Tokushima Graduate School, Tokushima, Japan; Oe-Kyodo Hospital, Tokushima, Japan

hamaj@clin.med.tokushima-u.ac.jp

Introduction
The clinical outcome following total knee arthroplasty (TKA) depends on accurate positioning of the components and proper soft tissue balancing. The frontal and sagittal alignment can be achieved easily using intramedullary guide or navigation system following the information obtained from long-leg radiographs. In contrast the rotational alignment of the femoral component is one of the most difficult factors for successful results.

The epicondylar axis is one of the most reliable landmarks to consistently recreate a balanced flexion gap. However, intraoperative identification of the transepicondylar axis is difficult. In measured resection technique, we always refer to the condylar twist angle (CTA), which is calculated from the difference in posterior condylar axis (PCA) and clinical epicondylar axis (CEA) measured by computed tomography (CT) and/or plain X-ray epicondylar view. However, the PCA obtained from preoperative CT or radiograph is deferent from the PCA that we refer intraoperatively because remaining cartilage of posterior condyle is not shown in CT and radiograph. Remaining cartilage may affect considerable error for the femoral component rotational alignment.

In this paper we examined the effect of the remaining cartilage of the posterior condyle for femoral component rotational alignment using navigation system and intraoperative multi-planar reconstruction (MPR) images acquired with a mobile C-arm system.

Methods
This study involved 322 consecutive TKAs secondary to osteoarthritis performed from January 2007 to March 2010 (43 male 57 knees and 193 female 265 knees) with a mean age of 76.5 (±5.0) years. This study approved of an institutional review board and informed consent. All cases underwent standard cruciate retaining or posterior stabilized TKA [Scorpio NR (Stryker), NexGen (Zimmer)] using navigation system. The navigation system used for the measurements was the image-free Stryker knee navigation system (Stryker). Before bone resection, navigation trackers were rigidly attached through bicortical bone screws to the distal femoral shaft and proximal tibial shaft. At this time suture anchor [STATAK (Zimmer)] were inserted into the most prominent points of the medial and lateral epicondyle. Clinical epicondylar axis was input into the navigation system by pointing the suture anchors using instrumented pointer. Then the AP sizer with instrumented tracker was put the distal femur cut and calculated the difference between inputted CEA and PCA including remaining cartilage. This CTA is named as navi. CTA.

On the other hand, after the distal femoral cut, the Arcadis Orbic 3D (Siemens Medical Solutions) was used to receive multi-planar reconstructions of the distal femur. The Arcadis Orbic 3D is a motorized mobile C-arm which provides fluoroscopic images during a 190° orbital rotation. On multi-planar reconstructions, line between the STATAKs was drawn as the CEA. Two slices including most posterior margin of the medial and lateral condyle were synthesized and line between the posterior margins was drawn as the PCA erasing the cartilage. This CTA is named as MPR CTA.

Results
The average condylar twist angle calculated by navigation system (navi. CTA) is 4.63±2.45 degree (Fig. 1). Meanwhile the average CTA measured from MPR images (MPR CTA) is 6.85±2.82 degree (Fig. 2). The difference between these two CTA is 2.22±2.58 degree which corresponds to the effect of the remaining cartilage of the posterior condyle.

No association between the deference of CTAs and Femoral rotational angle (FTA) was observed. The average deference of CTAs of varus knees (FTA>180 degree) was 2.23±2.59 degree. Valgus knees (FTA<173) showed less influenced difference of 0.56±2.92 degree (p<0.05 Mann-Whitney U test).

Discussion
Intraoperative identification of prominences of the medial and lateral epicondyles is hard to achieve it in a reproducible fashion. The advantage of this study is that CEAs in navigation system can be reproduced in that of MPR images. For this reason the difference between navi. CTA and MPR CTA is correspond to the difference of PCAs that are resulting from remaining cartilage of posterior condyle. In arthritic knees with varus deformity, the articular cartilage of medial posterior condyle is usually worn away and sclerotic subchondral bone was exposed to the surface. On the contrary, full thickness or slight degenerated cartilage was remained in the lateral posterior condyle. Because images from CT or radiograph are not able to present these remaining cartilages, the PCA is internally rotated than that of intraoperative evaluation.

In this study, we presented that the CTA measured from MPR is larger than intraoperative measurement calculated by navigation system. Indicating that CTA measured from preoperative image is larger than intraoperative measurement. If the cutting block is set along the posterior condyle and rotational alignment is determined by preoperative measurement, the external rotation of the femoral component become larger than expected by the effect of remaining cartilage of posterior condyle. In determining the rotational alignment of the femoral component, we should consider the remaining cartilage of the posterior condyle.

Significance
Although the rotational alignment of the femoral component is always measured from preoperative CT or radiograph, there is a pitfall that remaining cartilage affect to make the bone cut larger than expected. This study will contribute to make accurate femoral rotational alignment of TKA.