Technical Note
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Manipulation of Tibial Component to Ensure Avoidance of Bearing Separation from the Vertical Wall of Tibial Component in Oxford Unicompartmental Arthroplasty

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In Oxford unicompartmental knee arthroplasty, the relationship between the mobile bearing and the vertical wall of the tibial tray is important in preventing bearing dislocation. Separation of the bearing from the vertical wall can cause spinning of the bearing with an increased risk of subsequent dislocation. We report on intraoperative adjustment of the tibial tray performed to prevent the bearing from spinning. After tibial and femoral bone cutting and adjustment of the flexion and extension gap, the trial bearing is inserted and the bearing-vertical wall distance is evaluated before the preparation using the tibial template and bearing trial. In the case of separation, it can be resolved by medialization with or without rotational adjustment. The technique is useful and can be easily performed, it is therefore recommendable for all cases of Oxford mobile-bearing unicompartmental arthroplasty.
Keywords: *Arthroplasty, Replacement, Knee, Dislocation, Unicomparmental, Bearing*

Unicompartmental knee arthroplasty (UKA) enables fewer systemic complications, quicker recovery, better patient satisfaction, and deeper postoperative knee flexion than total knee arthroplasty.[1] Mobile-bearing UKA (MB-UKA) is recommended because of notably rare polyethene wear[2] and long-term survival.[3] Dislocation of the bearing, however, is a serious complication after MB-UKA.[4] Several causes of dislocation have been theorized, such as improper gap balance, overstretch of the medial collateral ligament, and impingement of the posterior osteophyte.[5] Another possible cause of the complication is the separation of the bearing from the vertical wall of the tibial tray.

The mobile bearing is concave and the medial and lateral sides are thinner than the anterior and posterior sides (Fig. 1A). If the bearing were to rotate, the thickness of the medial and lateral sides may be insufficient to hold the femoral component. Ideally, a 1-mm space is maintained throughout the range of motion (Fig. 1B). Currently available bearings have an anatomical shape, which has projections at the lateral corners to prevent rotation by contact with the corners (Fig. 1A). Maintaining the correct space between the bearing and walls is very important. If a bearing is too medial, it may cause separation and subsequent rotation, causing dislocation. Conversely, if the bearing is too lateral, the bearing may contact the vertical wall, which could also be the cause of dislocation.

The relationship between the tibial and femoral positions in the coronal plane decides the space between the bearing and the vertical wall. Regarding the femoral component, it is placed at the center of the medial femoral condyle. The tibial tray, meanwhile, is implanted along with the tibial vertical cutting plane, just medial to the apex of the medial tibial spine. Koh et al.[6] reported that

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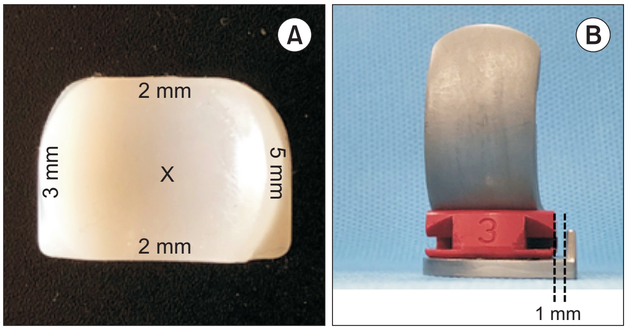

Fig. 1. Characteristics of the Oxford mobile bearing. (A) The features of the mobile bearing. The difference in thickness (so-called jumping height) of the anterior, posterior, medial, and lateral edges against the thickness at the center (the thinnest point) of the bearing is 5 mm, 3 mm, 2 mm, and 2 mm, respectively. If the bearing rotates 90° from the right position (i.e., spinning), the bearing can dislocate easily because of the smaller jumping height. (B) The ideal relationship between the mobile bearing and the vertical wall of the tibial tray in the Oxford unicompartmental knee arthroplasty, where a 1-mm space is kept throughout the full range of motion.

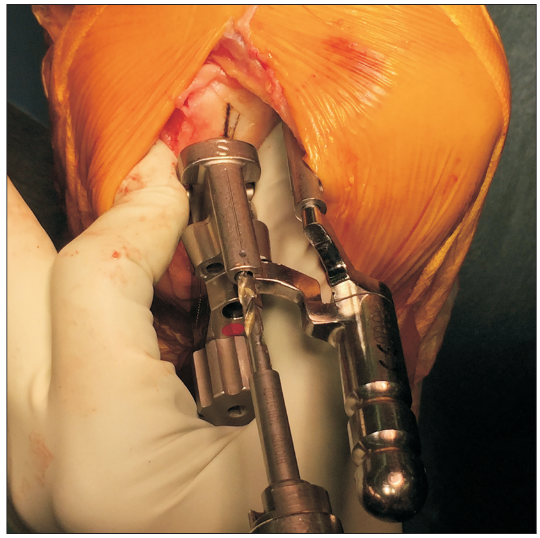

Fig. 2. The pinch technique to place the femoral drill guide at the center of the medial femoral condyle. Both sides of the medial femoral condyle are pinched with the femoral drill guide in place, using the thumb and the index finger. The operator can check with fingers if the drill guide is placed at the center of the condyle. If the guide is not located at the center of the condyle, the guide's position can be adjusted with the fingers.

the Microplasty instrument set reduced bearing dislocation because it enables the contiguous and convergent placement of both components. However, the relationship between the femoral and tibial condyles varies in different knees.[7] Knees with a lateral thrust or subluxation of the tibia could be a cause of separation. Therefore, it is recommendable to confirm the relationship before final implantation. The current study aims to demonstrate how to evaluate and correct bearing separation during Oxford UKA.

TECHNIQUE

All operations were done in the leg-hanging position using a leg holder provided by Zimmer Biomet (Warsaw, IN, USA). The Microplasty instrument set was used in all cases in accordance with the manufacturer's instructions.[8] The tibial vertical cut is always made after the horizontal cut following the tibial cutting slot, the level of which is decided by the connection with the spoon gauge using the G-clamp. The sagittal saw is placed just medial to the medial tibial spine, aimed at the anterior superior iliac spine. Regarding the femoral side, the center line of the medial femoral condyle is drawn, and the femoral drill guide is placed at the center of the femoral condyle. This central placement is verified by looking at the center line through the drill hole. We also use the pinch technique, where the operator's thumb and index finger are placed on both sides of the medial femoral condyles, pinching the body of the femoral drill guide between the fingers (Fig. 2). This technique enables the operator to feel whether or not the drill guide is placed at the center of the femoral condyle. The drill guide can be medially or laterally manipulated by the operator using the fingers.

Before the keel slot preparation, the tibial template and the twin peg femoral trial component are inserted and the operator checks whether the bearing does not contact or is separated from the vertical wall of the tibial template. If contact is observed, a vertical recut should be done, as described in the manufacturer's surgical technique manual.[8] If the bearing is separated from the vertical wall (Fig. 3A), the template is shifted medially until the space between the bearing and the vertical wall is approximately 1 mm (Fig. 3B). The space is again checked from full extension to full flexion. If the space changes according to the flexion angle, the rotation of the tibial tray requires adjustment. Typically, the bearing is separated from the vertical wall in full extension. The template should be rotated internally to avoid the bearing spinning in the extension position. The adaptability of the template should be ensured because the medial shift of the template can cause the plate to overhang and downsizing may be necessary. At this time, if the tibial tray is placed far medial and the size needs to be reduced, implying an increased risk of the fracture, use of fix bearing without tibial plate ma-

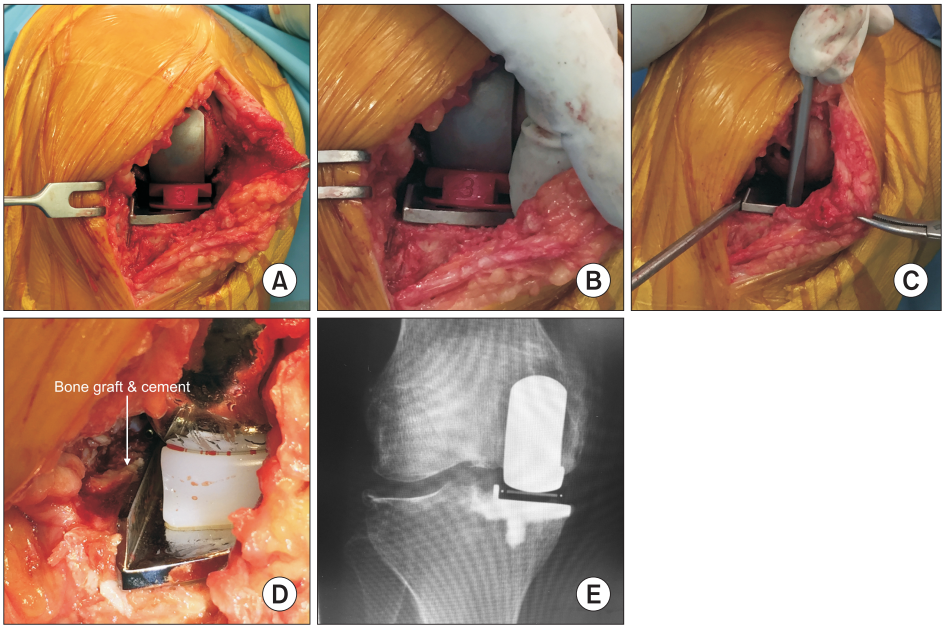

Fig. 3. Intraoperative procedure. (A) Approximately 3-mm space is shown between the mobile bearing (MB) and the vertical wall of the tibial component (VW), showing the bearing separation. (B) The tibial template is shifted laterally to make a 1-mm space between the MB and the VW. (C) The intramedullary rod is inserted to maintain the distance between the vertical cutting surface (VC) and the VW. (D) Bone chips are inserted between the VC and the VW, followed by cement filling. (E) A postoperative radiograph showing the space between the VC and the VW filled with the cement.

nipulation should be considered. A spacer can be inserted between the vertical cutting plane and the template to stabilize the template. The intramedullary rod, a chisel, a saw blade, or a bone fixation plate can be used as a spacer (Fig. 3C). Once the keel slot is made, the position of the tibial tray is stabilized. A medialized tibial tray creates a space between the vertical wall of the tibial tray and tibial cutting surface and can lose the mechanical support from the medial side. The space needs to be securely filled with cement and bone chips to stabilize the tibial tray (Fig. 3D). The position of the component is confirmed in postoperative radiography (Fig. 3E).

DISCUSSION

The most important point of this technique is that the ideal positioning of the tibial tray is enabled by the evaluation and adjustment of the tibial component position concerning the bearing position. Although the contact of the bearing with the vertical wall has been described in the surgical technique manual,[8] separation of the bearing, the opposite movement, has not been discussed.

The tibia rotates externally during the terminal extension of the knee (so-called screw home movement),[9] so the bearing can be separated from the vertical wall even if the bearing position is correct in the flexion position. Kawaguchi et al.[10] reported bearing dislocation in the extension position, although they explained the cause of dislocation as the contact between the bearing and the vertical wall. Kamenaga et al.[11] showed the bearing tended to move laterally by knee extension. The mediolateral relationship between the bearing and the vertical wall in complete knee motion is difficult to predict, so our technique can provide rotational adjustment.

A limitation of this report is the lack of clinical data. It can be challenging to accurately evaluate the interrelationship between the vertical wall and the bearing. Further study using a special technique such as 3-dimensional motion analysis is warranted and the efficacy of this technique on the prevention of dislocation should be studied. The mid- to long-term safety also should be proved by a prospective study. However, we have experienced no adverse events such as tibial component loosening and tibial fracture with this technique until now. Therefore, we recommend checking the relationship between the tibial cutting surface and the tray and manipulating the position of the tray if required.

In conclusion, evaluation of the bearing position throughout the motion before the keel slot preparation is strongly recommended. If bearing separation is found, the position and the rotation of the bearing can be adjusted before the final keel slot preparation. Mid- to long-term study would be needed to prove the effectiveness and safety of the technique.

CONFLICT OF INTEREST

Takafumi Hiranaka received honorarium for instruction and presantation from Zimmer Biomet. No other potential conflict of interest relevant to this article was reported.

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