THE RISK OF NOTCHING OF ANTERIOR FEMORAL CORTEX UNDER NAVIGATION SYSTEM IN TOTAL KNEE ARTHROPLASTY

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INTRODUCTION:
Navigation system in total knee arthroplasty (TKA) has recently been developed and coming in to wide use. The aim of navigation system is to achieve optimal prosthetic alignment. Notching of anterior femoral cortex is a contributing factor to postoperative femoral fracture. When we use navigation system, there are two important requirements on sagittal plane; (1) femoral bone cut should be perpendicular to the mechanical axis (MA) and (2) notching of anterior femoral cortex should be avoided. These two requirements, however, may conflict.

Under navigation system, sagittal alignment of femoral prosthesis depends on the reference point on distal femoral condyle. The purpose of this study is to investigate the relationship between the risk of femoral notching and the various reference points on distal femoral condyle, using the radiographs of whole lower extremity in weight-bearing with the knee extension of healthy Japanese volunteers.

METHODS:
Sagittal radiographs were made of the twenty lower extremities of ten healthy male Japanese volunteers (mean age of 27 years, mean height of 172 cm, and mean body weight of 68 kg) with standing. Sagittal radiograph of the lower extremity in one-legged stance was made under the method of our previous report (Figure 1).

Following lines were defined.

AC: The line of anterior cortex of distal femur at 7 cm proximal from the joint line (Figure 2).

FN1: The insertion point of intra-medullary guide rod through the center of femoral head (CFH) (* IM guide rod direction was define as the line through the center of the cannal at 10cm & 20cm distal femur.)

FN2: The center of distal femoral condyle - CFH

FN3: The most distal point of femoral condyle – CFH

SMA: The line through CFH and the center of the ankle (Figure 1&3)

The angle between AC and 4 reference lines was measured using an image analyzer (NIH image; Version 1.59) and calculated to one decimal place. If the implant alignment was extension potion to AC (notching of anterior femoral cortex), the degree was expressed in positive value. If the implant alignment was flexion potion to AC, the degree was expressed in negative value (Figure 4).

RESULTS:
Alignment of femoral prosthesis to anterior cortex was showed in Table 1.

<table>
<thead>
<tr>
<th>Alignment to AC (degree)</th>
<th>No. of Notching Cases</th>
<th>No. of Notching Cases*</th>
</tr>
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<tbody>
<tr>
<td>FN1 1.7 ± 0.4 -2.6</td>
<td>17 / 20</td>
<td>5 / 20</td>
</tr>
<tr>
<td>FN2 -0.1 ± 0.4 -3.7</td>
<td>8 / 20</td>
<td>1 / 20</td>
</tr>
<tr>
<td>FN3 -0.7 ± 0.4 -4.6</td>
<td>8 / 20</td>
<td>0 / 20</td>
</tr>
<tr>
<td>SMA 1.0 ± 0.4 -2.2</td>
<td>14 / 20</td>
<td>3 / 20</td>
</tr>
</tbody>
</table>

* 3 degree tilt of anterior chamfer is considered

DISCUSSION:
The current study showed that the risk of the notching of anterior femoral cortex was high under navigation system, especially when the insertion point of intra-medullary guide rod (FN1) was chosen as the reference point of distal femur. Even if femur cut is perpendicular to sagittal mechanical axis, notching was made in 70 % of cases.

The subjects of the current study were healthy young male volunteers. However, most candidates for total knee arthroplasty are elderly female who have shorter and more anterior bowed femur. In such patient the risk of notching could be higher.

When we use navigation system in TKA, we should take care not to make femoral notching and ensure the cutting slot of anterior femoral cortex carefully before anterior chamfer cut is performed.

References

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