The Flexion Contracture Of The Knee Correlates With Posterior Offset Ratio After Total Knee Arthroplasty

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Introduction: Improving the postoperative knee motion in total knee arthroplasty (TKA) has become a major goal for orthopaedic surgeons and joint prostheses. The effect of the implant posterior condylar offset has recently generated much enthusiasm among researchers. [1]

Some reports were concerned about the relationship between the posterior condylar offset and an extension gap. However, the posterior condylar offset was measured in a flexed knee position or in reference to femoral anatomy alone.[2-4] We have previously reported that posterior femoral condylar offset relative to the posterior wall of the tibia (posterior offset ratio; POR) is possibly the risk of knee flexion contracture associated with posterior femoral condylar offset after TKA. [5] However, there are no reports concerning the relationship between POR and flexion contracture of the knee in vivo. The aim of this study is to evaluate the relationship between the measurement of POR and flexion contracture of the knee in vivo.

Methods: Twenty-seven patients (4 males and 23 females) who underwent a primary posterior stabilized total knee arthroplasty (PFC Sigma RP-F; Depuy, Warsaw, IN, USA) were participated in the study. The lateral femoro-tibial angle (lateral FTA) was measured using lateral radiographs obtained by two procedures. Two procedures are applied to obtain true lateral radiographs of the lower extremities. (1) Full-length true lateral radiographs on standing, (2) True lateral radiographs in the prone position (Fig. 1A). ‘Posterior offset ratio’ was defined as follows (Fig. 1B). The maximal protrusion of the posterior condyle, posterior to the extension line parallel to the tibial shaft from the edge of the posterior tibial plateau was measured on true lateral radiographs (a). Antero-posterior diameter of the tibia was also measured orthogonally to the tibial shaft (b). ‘Posterior offset ratio’ was obtained by dividing ‘a’ by ‘b’. Posterior offset ratio was evaluated on standing true lateral radiographs of all patients. Significant differences among groups were assessed using two-tailed Student’s t-tests. Spearman’s correlation analysis was performed to evaluate the relationship between lateral FTA and posterior offset ratio of patients. All differences were considered significant at a probability level of 95% (P < 0.05).

Results: The mean value of the POR on standing was 14.94 ± 7.53% (0.00% to 27.91%) (Table 1). The mean value of flexion contracture of the knee on standing was 11.67 ± 9.21 degree (0 to 35 degree) and that in the prone position was 4.22 ± 6.17 degree (-5 to 17 degree) (P = 0.001). The POR was negatively correlated with flexion contracture of the knee in all procedures with statistical significance (standing: r = 0.62, P = 0.0039; prone: r = 0.66, P = 0.0001) (Fig. 2).

Discussion: The precise evaluation of flexion contracture after TKA is difficult because muscle tension around the knee influenced by postoperative pain, hence having large variation among the patients. Therefore, we have evaluated flexion contracture by two procedures. The mean value of flexion contracture of the knee on standing was 11.67 ± 9.21 degree, whereas that in the prone position was 4.22 ± 6.17 degree. We surmised that this discrepancy occurred due to the flexor muscle tension on standing. In terms of the evaluation of posterior soft tissue tightness of the knee, muscle relaxation can be achieved in prone position is rather than standing position.

Our study investigated the relationship between the posterior protrusions of the posterior condyle of the femur relative to the tibia (POR) and flexion contracture after TKA evaluated by two measurement procedures. POR is strongly correlated with flexion contracture evaluated by both measurement procedures. The value of POR of this implant in vitro was about 25% in previous study [5], whereas the mean value of POR in vivo was 14.94 %, suggesting that POR in the flexion contracture knee relatively reduced because posterior soft tissue pushed femoral component anteriorly. Our result clearly showed that if posterior clearance is insufficient, flexion contracture occur due to posterior soft tissue tightness.

In conclusion, POR after TKA in vivo negatively correlate with flexion contracture presumably because posterior soft tissue pushed femoral component anteriorly. POR is a useful indicator of the posterior soft tissue tightness after TKA.

Significance: The flexion contracture of the knee strongly correlates with posterior offset ratio after total knee replacement.
Acknowledgments:

Figure 1. A. The radiographic procedure of true lateral radiographs in the prone position. The X-ray cassette was placed in the patient's inner thighs. B. The measurement of posterior offset ratio. The maximal protrusion of the posterior condyle, posteriorly to the extension line parallel to the tibial shaft from the edge of the posterior tibial plateau was measured on true lateral radiographs (a). Antero-posterior diameter of the tibia was also measured orthogonally to the tibial shaft (b). ‘Posterior offset ratio’ was obtained by dividing ‘a’ by ‘b’.
Figure 2. A. Correlation between posterior offset ratio and flexion contracture on standing. B. Correlation between posterior offset ratio and flexion contracture in prone position. Dot plot represents an individual value. FTA, femoro-tibial angle.
Table 1 Radiographic findings

<table>
<thead>
<tr>
<th>Variable</th>
<th>Result</th>
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<tbody>
<tr>
<td>POR (%)</td>
<td>$14.94 \pm 7.53$ (range 0.00 to 27.91)</td>
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<tr>
<td>Lateral FTA(^\d) (degree) standing</td>
<td>$11.67 \pm 9.21$ (range 0 to 35)</td>
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<tr>
<td></td>
<td>prune position $4.22 \pm 6.17$ (range -5 to 17)</td>
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\(^\d\)FTA, femoro-tibial angle