

Effect of Preoperative Medial Proximal Tibial Angle on Medial-Lateral Ligament Imbalance in Flexion after Mechanically Aligned Total Knee Arthroplasty

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INTRODUCTION:

After total knee arthroplasty (TKA), a considerable number of patients experience dissatisfaction due to postoperative knee instability, especially medial-lateral (ML) ligament imbalance during knee flexion. A difference in the extent of tibial osteotomy on the ML plateaus might cause postoperative mismatch of ML ligament tension. In addition, excessive medial tibial bone resection might damage the medial collateral ligament (MCL). Medial proximal tibial angle (MPTA) has been used to describe the degree of coronal inclination of the proximal articular surface of the tibia, including the Coronal Plane Alignment of the Knee (CPAK) classification. A previous study reported large interindividual differences in tibial plateau geometry, with a MPTA range of over 12°. However, when aiming for neutral mechanical alignment (MA), surgeons perform bone resection of the proximal tibia perpendicular to the coronal tibial axis, regardless of MPTA. The purpose of this study was to evaluate the relationship between preoperative MPTA and ML joint laxity in knee flexion after TKA.

METHODS:

We examined 130 knees in 111 patients (mean age, 76 years) with severe medial osteoarthritis (OA) who underwent neutral MA posterior cruciate-substituting TKA and had follow up for more than 2 years. Mean preoperative hip-knee-ankle angle was 11.9° varus (1.7°–23.4° varus). Femoral rotational alignment was set relative to the surgical epicondylar axis and the superficial layer of the MCL was not released. Preoperative MPTA, defined as the angle between the tibial plateau and tibial mechanical axis, was measured on anteroposterior tibial full-leg radiographs (Fig. 1). We also obtained stress radiographs before and 1 year after surgery to evaluate medial and lateral joint laxity at 90° of knee flexion with a 1.5-kg weight attached at the level of the ankle (Fig. 1). We evaluated correlations between preoperative MPTA and preoperative and postoperative joint line convergence angle (JLCA) and lateral and medial joint space widths (LJSW and MJSW, respectively) in knee flexion, as well as knee flexion angle. A positive JLCA indicates that the lateral gap is wider than the medial gap. Correlation coefficient was characterized as moderate (0.41–0.70).

RESULTS:

Mean preoperative MPTA, JLCA, LJSW, MJSW, and knee flexion angle were shown in Table 1. There was moderate correlation between preoperative MPTA and preoperative JLCA ($r=0.51$; $p<0.01$) and MJSW ($r=-0.41$; $p<0.01$), but not with preoperative LJSW ($r=0.02$; $p=0.79$) and knee flexion angle ($r=0.20$; $p=0.02$), respectively (Fig. 2). Mean postoperative MPTA, JLCA, LJSW, and MJSW, and knee flexion angle were also shown in Table 1. Correlation coefficients between preoperative MPTA and postoperative JLCA, LJSW, MJSW, and knee flexion angle were $r=-0.08$ ($p=0.35$), $r=-0.16$ ($p=0.08$), $r=-0.16$ ($p=0.08$), and $r=-0.08$ ($p=0.38$), respectively (Fig. 2).

DISCUSSION AND CONCLUSION:

The most important finding of this study was that preoperative MPTA does not lead to postoperative ML ligament imbalance in knee flexion after mechanically aligned TKA. Recently, kinematically aligned TKA using the CPAK classification, in which the components are set according to the knee joint surface and intended to recreate pre-OA alignment, has been attempted to adjust ML ligament balance and achieve balanced ML tibial plateau resection. However, this study found that preoperative MPTA is negatively correlated with preoperative MJSW, indicating that a large inclination of the tibial proximal articular surface is accompanied by a wide medial flexion gap. In contrast, there was no correlation between preoperative MPTA and preoperative LJSW. Our results demonstrate that a large MPTA reflects a large bony defect in the medial tibial plateau while the preoperative lateral tibial plateau is almost preserved. In addition, this study showed that MCL damage does not occur during TKA. Therefore, we believe that mechanically aligned TKA, usually with thick lateral and thin medial plateau resections, can achieve proper ML ligament balance in knee flexion after TKA without excessive MCL release and changes in component alignment.

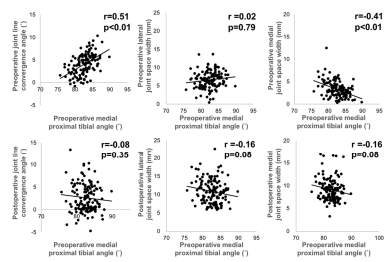
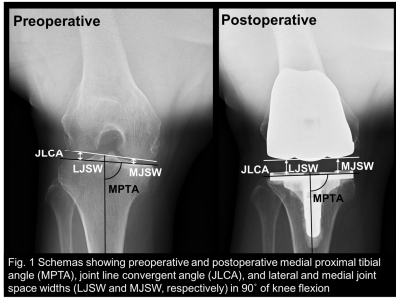


Table 1 Preoperative and postoperative medial proximal tibial angle (MPTA), joint line convergence angle (JLCA), and lateral and medial joint space widths (LJSW and MJSW, respectively) in knee flexion, as well as knee flexion angle

| | | Mean | SD | Range |
|---------------|------------------------|-------|------|--------------|
| Preoperative | MPTA (°) | 82.6 | 2.6 | 75.7 to 89.8 |
| | JLCA (°) | 4.1 | 2.3 | -0.8 to 10.4 |
| | LJSW (mm) | 6.6 | 2.3 | 0.5 to 13.7 |
| | MJSW (mm) | 3.3 | 1.8 | 0.4 to 12.5 |
| | Knee flexion angle (°) | 118.3 | 14.4 | 75 to 155 |
| Postoperative | MPTA (°) | 89.7 | 1.7 | 85.7 to 94.3 |
| | JLCA (°) | 2.6 | 3.1 | -4.7 to 13.5 |
| | LJSW (mm) | 10.9 | 3.3 | 5.9 to 22.7 |
| | MJSW (mm) | 9.1 | 2.5 | 3.3 to 16.9 |
| | Knee flexion angle (°) | 118.2 | 13.0 | 80 to 140 |