Effects of Posteromedial Vertical Capsulotomy on the Medial Extension Gap in Cruciate-retaining Total Knee Arthroplasty

Ryutaku Kaneyama, M.D., Hideaki Shiratsuchi, Kazuhiro Oinuma, MD, Yoko Miura, MD, Hidetaka Higashi, MD, Tatsuya Tamaki, MD.
Funabashi Orthopedic Hospital, Chiba, Japan.

Disclosures:

Introduction: Equality between the extension gap (EG) and the flexion gap (FG) is one of the most important factors for good clinical results in total knee arthroplasty (TKA). The gap situation during surgery has a wide variation. The EG needs to be widened in patients with varus knees that have a small EG. For this purpose, posterior soft tissue release is necessary to avoid additional resection of the distal femur, which would cause undesirable joint line elevation. However, the detail methodology and efficacy of the posterior release is unknown. The usual method for widening the EG is by posterior capsular release from the femur or tibia or by posterior transverse capsulotomy. However, the effect of these procedures on the EG is not always sufficient because the EG is influenced by the posterior capsule and by the medial collateral ligament (MCL). Based on our experiences, we believe the MCL and posterior capsule complex would have some influence on the EG and we hypothesize that contracture of the posterior capsule pulls the MCL backward and prevents full extension of the knee because full elongation of the MCL is limited. We believe that it is necessary to separate the MCL from the contracted posterior capsule to widen the EG sufficiently. We also performed posteromedial vertical capsulotomy to divide the connection between the MCL and the posterior capsule in TKA.

Methods: Ninety consecutive knees were operated on. Posteromedial vertical capsulotomy was performed on 55 knees (12 males, 43 females), which included 52 knees with osteoarthritis and three knees with rheumatoid arthritis. The EG was initially created with a standard femoral distal cut and tibial cut. To estimate the gaps more precisely and to restore the femoral posterior condylar bone as much as possible before FG adjustment at the final step of the surgery, we performed a 4 mm precut of the femoral posterior condyle and measured the gaps with a 1 mm increment offset spacer system with the patella reduced after setting a precut trial component that had a usual distal part and 4 mm thick posterior part of the femoral component. After setting the precut trial, the situation was the same as after setting the usual femoral trial component by using the measured resection technique with preservation of the posterior cruciate ligament (PCL) (Fig 1). Based on the EG and FG measurements, a posteromedial vertical capsulotomy was performed in patients for whom the medial extension gap was considered too small (Fig 2). After this procedure, if the EG remained narrow with respect to the medial FG, either a transverse posterior capsulotomy or additional resection of the distal femur, which would cause undesirable joint line elevation. However, the detail methodology and efficacy of the posterior release is unknown. The usual method for widening the EG is by posterior capsulotomy. We also performed posteromedial vertical capsulotomy to divide the connection between the MCL and the posterior capsule in TKA.

Results: After the precut trial was set to the femur, the average EG and FG were 5.7 ± 2.3 mm and 10.2 ± 2.2 mm, respectively (expressed by the mean ± the standard deviation). After performing the posteromedial vertical capsulotomy, the average EG and FG were 8.2 ± 2.1 mm and 10.4 ± 2.0 mm, respectively. The average increase of the EG and FG were 2.5 ± 1.8 (0-12) mm and 0.1 ± 0.4 (0-2) mm, respectively. The EG increase was significantly larger than the FG increase (p < 0.001) and there was no significant difference between males and females. As the result of the vertical capsulotomy, the FG showed little change, but the EG increased. Only two knees showed no change in the EG and five knees showed only a 1 mm increase in the EG; however, 41 (85 %) patients had a 2 mm or greater increase in the EG with little increase in the FG. Most patients who had a 7 mm or less gap difference (i.e., FG - EG) had a 2 mm or 3 mm increase in the EG after the posteromedial vertical capsulotomy. Patients with a gap difference greater than 7 mm (only 3 patients) had an increase in the EG greater than 5 mm. Patients with a small EG seemed to achieve a much greater EG increase after the vertical capsulotomy procedure. Subsequent transverse capsulotomy and MCL release after the vertical capsulotomy were performed in 6 knees and 7 knees, respectively. An additional increase in the EG and FG was 1.6 ± 0.9 mm and 0 ± 0 mm, respectively, after the transverse capsulotomy, and 0.8 ± 0.4 mm and 1.0 ± 1.0 mm, respectively, after the MCL release. The effects of the additional soft tissue management were not substantial but certainly present.

Discussion: The TKA surgical procedure is a precise gap-making process performed in a three-dimensional geometry. After bone resection by using a measured resection technique and soft tissue management for good ligament balancing, if an undesirable gap unbalance remains, an additional bone resection has to be performed. This may cause an undesirable joint line elevation or may decrease the posterior condylar offset to make an equal EG and FG. To avoid undesirable bone resections, it is important to
understand which soft tissue management is effective to increase the FG without changing the EG or to increase the EG without changing the FG. If it is necessary to increase the FG without changing the EG, resection of the PCL is useful for this purpose. On the other hand, posterior capsule release may be necessary to increase the EG without changing the FG. However, the effective methodology of widening the EG is unknown. The EG of the varus knee is influenced by several factors such as tightness of the MCL and the posterior capsule or protrusion of the posterior femoral component. In this study, a precut trial component was used to take into account the effect of posterior protrusion of the femoral component of the EG. Based on our experiences, we believe that contracture between the MCL and the posterior capsule has undesirable effects on the medial EG. Therefore, we performed a posteromedial vertical capsulotomy to separate the MCL from the posterior capsule. After this separation, the MCL can freely move to the anterior and stretch sufficiently to allow full knee extension. The medial EG is restricted by tightness of the MCL and the posterior capsule. Separating the MCL and the posterior capsule allows these structures to act freely from each other (Fig 3). With the technique we present in this paper, we demonstrate the effect of the posteromedial vertical capsulotomy and we achieve a constant increase in the EG without changing the FG.

Significance: The posteromedial vertical capsulotomy is a simple and effective method that maintains a constant widening of the EG but without changing the FG. We revealed that the mechanism of a narrow EG is caused by contracture of the MCL and the posteromedial capsule complex.

Acknowledgments:

References:
Precut Trial Component

Usual Femoral Component

Preserved Bone

Fig 1
A Section of The Femur

Posterior Capsule

MCL

A Section of The Tibia

Posteromedial vertical capsulotomy

Fig 2
Fig 3

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