Soft Tissue Balance in Cruciate-retaining and Posterior-stabilized Total Knee Arthroplasty

*Takayama, K; *Kurosaka, M; *Kuroda, R
# Department of Orthopaedic Surgery, Kobe University Graduate School of Medicine, Kobe, Japan.
† Department of Orthopaedic Surgery, Hyogo Rehabilitation Center Hospital, Kobe, Japan
Corresponding author matsun@m4.dion.ne.jp

Introduction:
A common difficulty with manually-performed total knee arthroplasty (TKA) is obtaining accurate intra-operative soft tissue balancing, an aspect of this procedure that surgeons traditionally address through their “subjective feel” and experience with an everted patella. We have developed a new tensor for TKAs that enables us to assess for soft tissue balancing throughout the range of motion about the knee with a reduced patella-femoral (PF) joint. This tensor permits us to intra-operatively reproduce the post-operative alignment of the PF and tibio-femoral joints. [1] Using this new tensor for TKAs, we have described the design of this tensor, our initial intra-operative joint center gap measurement, its clinical relevance, and its accuracy of measurement. [2-5]

The long term results of both cruciate-retaining (CR) and posterior cruciate (PS) TKAs have shown ability to relieve pain and improve function. Nevertheless, the controversial continues regarding the superiority of CR or PS type over the other. In the present study, accordingly, we extend our previous study and report on our experience with this device for the intra-operative soft tissue balance measurements of CR and PS TKAs performed with both a reduced and everted patella.

Materials and Methods:
Patient selection; From a group of 40 consecutive females blinded to the type of implant received, we prospectively randomized 20 patients (20 osteoarthritic knees) to receive a CR TKA (NexGen CR Flex, Zimmer, Inc., Warsaw, IN) and the other 20 patients (20 osteoarthritic knees) a PS TKA (NexGen LPS Flex, Zimmer, Inc., Warsaw, IN). The CR TKA group had a mean age of 73.7 ± 1.3 years while the PS TKA group had a mean age of 73.8 ± 1.7 years. After excluding patients with valgus deformity and severe bony defects, each remaining patient had a varus deformity, with an average pre-operative coronal plane alignment of 6.2 ± 1.3° in varus CR TKA and 7.5 ± 2.2° in varus PS TKA. Offset type tensor; Our TKA tensor consists of three parts: an upper seesaw plate, a lower platform plate with a spike and an extra-articular main body (Fig. 1A) [1-5]. Both plates are placed at the center of the knee, and we apply one of two tensioning devices that are catered to appropriately fit either a PS (Fig. 1B) or a CR (Fig. 1C) TKA. Intra-operative measurement; We performed all TKAs using a conventional resection block with measured resection technique. Using the tensor under 40 lb. distraction force (Fig. 1D), we intra-operatively measured the ligament balance (!, positive value in varus imbalance) and joint component gap (nm) of CR and PS TKAs performed with both a reduced and everted patella.

Results:
Kinematics of ligament balance; In assessing the kinematics of the CR TKA, knees slowly increased in the varus angle after 45° of knee flexion when the patella was everted (p<0.05), whereas this balance maintained constant slight varus balance when the patella was reduced. After 90° of flexion, the varus angle was significantly lower with a reduced compared to everted PF joint (p<0.05) (Fig. 2). In assessing the kinematics of the PS TKA, there were slow increases in the varus angle from extension to 45° of knee flexion with the patella both everted and reduced (p<0.05). During flexion beyond 45°, the size of the varus angle kept constant values with both everted and reduced patella. At 135° flexion, however, the varus angle was significantly lower with a reduced compared to everted PF joint (p<0.05) (Fig. 3). Finally, upon comparing both types of TKA, there was a significantly lower varus angle value for the CR TKA at 45, 90, and 135 degrees of flexion (Fig. 4B).

Conclusion:
In the present study, we elucidate the intra-operative ligament balance kinematic pattern observed for CR as well as PS TKAs when they are performed while preserving a more physiological condition of the knee. We believe that this pattern is more reflective of the true post-operative kinematics, and thus by maintaining a reduced patella for each intra-operative measurement, the surgeon will be able to adjust the soft tissue balance more accurately and thereby expect a better post-operative outcome.

References: