INTRODUCTION:
The assumption that symmetric flexion-extension gaps improve the femoral condylar lift-off phenomenon and the proprioception in Total Knee Arthroplasty (TKA) is now widely accepted. Although the expensive navigation system allows a significant improvement in the accuracy of implantations in relation to the mechanical axis, the management of soft tissue balance during surgery remains difficult and much is left to the surgeon’s feel and experience. Furthermore, little is known about the differences of the soft-tissue stiffness (STS) of medial and lateral compartment in extension and flexion in the cruciate ligaments sacrificed knee. It has a deep connection with the achievement of appropriate gaps operated according to the dependent cut technique. Therefore, the purpose of this study was to analyze the STS of individual compartment in vivo. In addition, we examined in the patient factors which influenced on the STS.

MATERIALS AND METHODS:
Patients: This study included 31 knees suffering from consecutive medial osteoarthritis (OA) underwent primary posterior-stabilized TKA (NexGen LPS-Flex, Zimmer, Warsaw, USA). All provided their informed consent. The patient population comprised 5 men and 26 women with a mean age of 74.9 ± 5.73 years. The average height, weight, BMI, weight-bearing FTA, non-weight-bearing FTA, flexion contracture (70-140 N [20-40 lb]) were loaded in the knee at full extension and 90° flexion position. The results demonstrated that our new tensor device worked effectively as a parallel cut guide for making a flexion gap (the difference in gap between Flex-Lat and Flex-Med was 0.613 ± 2.25 mm). In other words, it suggests the importance of patello-femoral joint reduction in the dependent cut technique for TKA. Furthermore, we first demonstrated that individual compartment soft-tissue stiffness in PS-TKA when the femoral trial prosthesis was fitted with patello-femoral joint reduction even for MIS-TKA. In this study, a prototype of the new tensor device (Fig. 1) was used, after that we finished improving the handy new tensor device which is also available for severely deformed knees which needs metal augmentations.

Surgical procedure according to the modified gap technique:
1. 4-6 inches anterior straight midline skin incision and medial para-patellar arthroscopy.
2. Sacrificing ACL and PCL, and medial release according to Clayton’s staged release method. (No pes anserinus was released in this study.)
4. Proximal tibia osteotomy perpendicular to the tibial axis using I.M. guide referred to Ex. M. alignment rod.
5. Femoral postero-medial capsular release if necessary.
6. Tibial tray sizing and finishing cut. All soft tissue clearance, release and osteophyte resection should be completed, and appropriate extension gap and balance should be obtained in this step.
7. Extension and flexion gap measurement (30lb), and decision on the rotational alignment and the component size of the femur using a new tensor device.
9. Component gap measurement fitting with femoral trial prosthesis.
Component gap measurement and STS calculation: First, a femoral trial prosthesis was fitted with patello-femoral joint reduction. Then, the medial and lateral gaps were measured when various distraction forces (70-140 N [20-40 lb]) were loaded in the knee at full extension and 90° flexion positions respectively. The STS (N/mm) was calculated from a load displacement curve generated by the intra-operative component gap data and joint distraction force of a prototypal new tensor device. (Fig. 2) Statistical Analysis: Data were expressed as mean ± SD and analyzed with Stat View version 5.0 (SAS Institute Inc.,). Relations between the component gaps and poly-insert thickness were analyzed with simple regression. Comparisons were made by one-way ANOVA post hoc analysis with Fisher’s PLSD test. Correlations between patient’s factor and the STS were analyzed with Pearson’s correlation coefficient and Fisher’s z transformation of r. A value of P<0.05 was considered significant.

RESULTS:
Intra-operative component gaps when 30 lb (105 N) of joint distraction force was loaded were the following extension medial (Ex-Med) was 11.8 ± 2.4 mm, extension lateral (Ex-Lat) was 13.5 ± 2.9 mm, flexion medial (Flex-Med) was 15.3 ± 3.2 mm and flexion lateral (Flex-Lat) was 15.9 ± 3.8 mm. And poly-insert thickness was significantly strongly correlated with Ex-Lat gap (r=0.818, P<0.0001). Calculated STS was demonstrated in Figure 3 where medial compartment indicates significantly higher stiffness both in the knee at extension (P<0.0001) and 90° flexion position (P=0.0177). Moreover, inflating air tourniquet did not significantly influence the STS (P>0.05). In addition, patient’s height and BMI correlated significantly with the STS of Ex-Lat (r=0.391 and 0.388, P=0.0321 and 0.0226). And non-weight-bearing FTA significantly correlated negatively with the STS of Flex-Lat (r=-0.402 and 0.0269).

DISCUSSION:
The results demonstrated that our new tensor device worked effectively as a parallel cut guide for making a flexion gap (the difference in gap between Flex-Lat and Flex-Med was 0.613 ± 2.25 mm). In other words, it suggests the importance of patello-femoral joint reduction in the dependent cut technique for TKA. Furthermore, we first demonstrated that individual compartment soft-tissue stiffness in PS-TKA when the femoral trial prosthesis was fitted with patello-femoral joint reduction. We should notice the significant difference of the STS between medial and lateral compartments both in the knee at extension and 90° flexion position. Also, a higher angle of non-weight-bearing FTA indicates lower accurate of implantations in relation to the mechanical axis, the management of soft tissue balance during surgery remains difficult and much is left to the surgeon’s feel and experience. Furthermore, little is known about the differences of the soft-tissue stiffness (STS) of medial and lateral compartment in extension and flexion in the cruciate ligaments sacrificed knee. It has a deep connection with the achievement of appropriate gaps operated according to the dependent cut technique. Therefore, the purpose of this study was to analyze the STS of individual compartment in vivo. In addition, we examined in the patient factors which influenced on the STS.

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