Primary Resection of the Posterior Cruciate Ligament Does Not Produce a Gap Mismatch in the Navigated Gap Technique

GEORG MATZIOLIS, MD; CARSTEN PERKA, MD

abstract

Treatment of the posterior cruciate ligament (PCL) is a matter of continued controversy in total knee arthroplasty. By using so-called cruciate ligament–substituting implant designs, retention and resection of the PCL produce equivalent clinical results. However, it remains unclear whether primary resection of the PCL leads to relevant instabilities of the flexion gap. Especially when the increasingly popular navigated gap technique is used, this would result in a nonanatomic size selection and positioning of the femoral component and thus compromise the clinical outcome. The objective of this retrospective study was therefore to determine whether the navigated gap technique leads to a mismatch of the flexion and extension gap in primary routine resection of the PCL. In 92 patients consecutively enrolled in this study (92 knees), the flexion and extension gap were determined and documented after tibial resection, using the navigated gap technique navigation system (OrthoPilot 4.0; B. Braun Aesculap, Tuttingen, Germany). The flexion gap was 10.4±2.6 (2.5–19.5) mm; the extension gap was 10.4±2.4 (5.5–17.5) mm. The individual difference was normally distributed around 0.0±2.9 (−7 to 7) mm. In the navigated gap technique, primary routine resection of the PCL does not lead to a mismatch of the flexion and extension gap, so that a systematic nonanatomic resection of the femur can be ruled out.

It has been unclear in total knee arthroplasty (TKA) whether the posterior cruciate ligament (PCL) should be retained at all costs, whether it should be resected, or whether the procedure chosen should depend on the pathology. The short- and long-term clinical results of PCL retention and resection are comparable. In PCL resection, the sagittal stabilizing function is taken over by the implants, resulting in a high femorotibial congruency, or a post-cam mechanism. In contrast, unconstrained implants do not support a stabilization of the flexion and extension gap that might be necessary after PCL resection.

Whereas the majority of studies demonstrate a stabilizing function of the PCL, especially on the flexion gap, few authors report stabilization of the flexion and extension gap by the PCL. These data contradict the clinical experience of surgeons who routinely remove the PCL without observing any relevant instability of the flexion gap.
release, through the size and position of the femoral component. Because this technique largely ignores the femoral osseous anatomy, there is a danger of oversizing or undersizing the femoral component with a mismatch of the flexion and extension gap. Whereas undersizing limits active flexion capacity by reducing posterior offset, oversizing leads to overhanging with painful soft tissue impingement. Increased or reduced distal femoral resection leads to displacement of the joint line, possibly influencing stability in midflexion and patellofemoral contact pressure.

This study aimed to determine the extent to which routine resection of the PCL using the navigated gap technique leads to a mismatch of the flexion and extension gap, which has to be addressed by changing the size and position of the femoral component.

**Materials and Methods**

All patients who had received a navigated surface replacement due to primary gonarthrosis were consecutively enrolled in this retrospective case-control study. Exclusion criteria were the presence of any kind of instability, which would not have allowed treatment with an unconstrained implant, and secondary arthroses.

Age at the time of surgery and gender were documented from each patient’s file.

After surgical incision, the rigid bodies were fixed and the anatomic and functional landmarks were read into the navigation system (OrthoPilot 4.0; B. Braun Aesculap, Tuttlingen, Germany). The tibia was resected perpendicularly to the mechanical axis and both cruciate ligaments were resected, regardless of the pathology present. The extension and flexion gaps were then measured and documented. If there was any relevant asymmetry or inequality, appropriate soft tissue release was performed and the gaps were measured again. After virtual planning of the size and position of the femoral components, the femoral resections were performed.

**Results**

Thirty-seven men and 55 women of an average age of 68.0±7.5 years (53.7-81.8 years) were enrolled.

The documented flexion gap was 10.4±2.6 mm (2.5-19.5 mm), and the extension gap was 10.4±2.4 mm (5.5-17.5 mm). The connection between the flexion and extension gap produced a zero point line with a gradient of 0.96 (P<.001) (Figure 1), so that a systematic instability of the flexion or extension gap that would produce a gradient different from 1 could be ruled out. In 32 cases, the flexion gap was >1 mm wider than the extension gap, in 31 cases the gap was narrower, and in 29 cases the difference was ±1 mm. The individual difference between the flexion and extension gap was normally distributed around 0.0±2.9 mm (−7 to 7 mm) (Figure 2).

**Discussion**

The routine resection of the PCL regardless of the pathology present leads to approximately anatomic resections in the navigated gap technique. In contrast to the results of in vitro release studies, a preferred stabilization of the flexion gap by the PCL cannot be confirmed. This seems to be linked to the time of PCL resection. Luring et al, Park et al, and Kadoya et al only removed the PCL after extensive medial capsule ligament release, so that an unphysiologic displacement of the stabilizing function from the medial collateral ligament and capsule to the PCL has to be assumed. In contrast, the resection of the PCL performed in this study before any other soft tissue release reveals the true role of the PCL in the stabilization of the knee joint.

The function of the PCL can be mimicked in the sagittal plane by using appropriate implant designs. Whereas the post-cam mechanism causes femoral rollback at greater than 50° to 70° flexion, an ultracongruent inlay prevents femoral translation. Although no advantage in primary resection of the PCL has been demonstrated using cruciate ligament–substituting designs compared with sufficient cruciate ligament retention, PCL insufficiency should not be tolerated. Apart from sagittal instability, this leads to a reduction in the effectiveness of the extensor apparatus and in an elevation of the patellofemoral contact pressure.
pressure, which can result in therapy-resistant peripatellar pain.\textsuperscript{15-17}

**CONCLUSION**

Because there has been a lack of objective criteria for intraoperative assessment of the sufficiency of the PCL, primary resection represents the safer alternative to retention of the PCL for many surgeons. Also in the navigated gap technique, this leads to anatomic resections, without relevant displacement of the joint line or alteration of the posterior femoral offset.

**REFERENCES**