Background: The Synthes 4.5mm LCP Condylar Plate is used regularly for fixation of fractures of the distal femur. Based on the manufacturer’s technique guide\(^1\) the uses of this plate include, but are not limited to, buttressing of multifragmentary distal femur fractures, supracondylar fractures, intra-articular and extra-articular condylar fractures, periprosthetic fractures, and osteotomies of the femur. The use of locking plate technology has increased steadily since its introduction, including the use of the 4.5mm LCP Condylar Plate from Synthes. The distal most portion of the LCP Condylar Plate features a central screw hole for a 7.3mm cannulated conical or locking screw, and five surrounding screw holes which accept 5.0mm cannulated conical or locking screws for fixation in the distal femoral condyle fracture fragments. The product manufacturer’s technique guide suggests not using a full length 5.0mm screw in the most posterior distal screw hole as it could enter the intracondylar notch and violate the knee ligamentous structures, specifically the posterior cruciate (PCL) and the anterior cruciate (ACL) ligaments. Although the morphology of the intracondylar notch has been well described\(^2\) there has been no prior study showing that a full length screw violates the intracondylar notch and if it does, what ligamentous or soft tissue structures are damaged by screw placement. The topography of the PCL was recently well described by Forsythe, Hamer, et al.\(^3\) and our hypothesis is that placement of a bicondylar 5.0mm locking screw into the most distal and posterior hole of the Synthes 4.5mm LCP Condylar Plate for the distal femur extending to the medial cortex of the medial femoral condyle would consistently enter the intracondylar notch and violate the PCL and other knee soft tissue structures within the notch.

Methods: Six fresh frozen cadaver knees, based on availability, (3 left and 3 right, 4 male and 2 female, average age 78.8) were harvested and prepared for use in this study leaving all soft tissue structures intact. Using a standard lateral approach to the distal femur, the 4.5mm LCP Condylar Plate was placed on each intact distal femur in the position suggested in the manufacturer’s technique guide\(^1\). The plate was reduced to bone using a 4.5mm cortical screw along the shaft portion of the plate, followed by placement of the 7.3mm center conical or locking screw. The positioning of the plate was verified with C-arm fluoroscopy. With the plate in place a 5.0mm locking screw was placed in the most posterior distal screw hole spanning the lateral and medial condyles to the medial cortex of the medial condyle (fig 1). Each knee was then dissected and ligamentous structure violation was recorded by direct visualization. The above procedure was then repeated in the dissected specimens with the plate translated distally 5mm and then proximally 5mm, to account for variability of plate placement. Ligamentous structure violation was again recorded at the distal and proximal plate positions (fig 2). Lateral femoral condyle width at the postero medial screw hole position was measured with a standard Synthes depth gauge at each plate position.

Results: A total of 18 positions were recorded, 6 standard, 6 translated 5mm distal to standard position, and 6 translated 5mm proximal to standard position. The 5.0mm screw violated the intracondylar notch in 94.4% (17/18) of all tested plate positions. The PCL was the ligamentous structure most often affected with the screw entering the PCL and/or violating the PCL footprint in 88.9% (16/18) of tests. The ACL was less often involved with the screw either violating the ligament or footprint only 22.2% (4/18) of tests. The average lateral condyle width was 43.0mm ± 1.7, 40.3mm ± 1.5, and 45.2mm ± 3.4 for the standard, distal, and proximal plate positions respectively for an average width of 42.8mm.

Conclusion: Based on our anatomical study we accept our hypothesis that the intracondylar notch is violated and soft tissue structures within the notch are at risk of significant injury with use of a bicondylar screw in the most distal posterior hole of the Synthes 4.5mm LCP Condylar Plate for the distal femur. The PCL is consistently damaged, in 88.9% of tests, while the ACL is damaged in 22.2% of tests. This study is limited by the use of a cadaveric model with intact femurs, not ideally recreating a trauma situation. We attempted to limit this by keeping the soft tissue envelope intact for initial plate placement and using c-arm for position verification. Based on measurements of lateral condyle width through the postero medial hole, and overwhelming evidence to support not using a bicondylar screw, we recommend using a unicondylar 5.0mm screw no longer than 35mm in the most posterior distal screw hole of the Synthes 4.5mm LCP Condylar Plate for the distal femur. Although violation of the PCL and ACL were consistently seen in this study, the clinical relevance of bicondylar screw placement remains unknown and was beyond the scope of this study. Further biomechanical and clinical investigation is warranted to evaluate its significance.