Editorial Commentary: Fluoroscopy Is Seldom Required During Knee Posterolateral Reconstruction

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Abstract: Identifying the structures of the lateral knee is critical during knee posterolateral corner reconstruction. Several methods exist that can help estimate the femoral insertions of these structures on lateral radiographs. However, it is important to recognize the limitations of these methods and that anatomic visualization is often more practical and more accurate. Until percutaneous or more minimally invasive techniques become standardized, intraoperative fluoroscopy is seldom needed or used for posterolateral corner reconstruction, whereas radiographic analysis of lateral knee structures could be of benefit in cases of failed reconstruction to assess tunnel placement.

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When considering surgical management of posterolateral corner (PLC) injuries of the knee, a detailed understanding of normal anatomy is critical to maximize function and limit complications. Unfortunately, such injuries typically are associated with high-energy trauma and revision scenarios that can complicate normal anatomy. Defining the radiographic locations of the key ligamentous structures is not a novel endeavor. To date, several articles aiming to describe the fluoroscopic locations of the described knee ligaments can easily be found,[1-5] including those performed by the authors of this commentary. However, in terms of true clinical relevance and application, we should ask ourselves if this effort is related to primary surgical technique. Fluoroscopy during knee PLC reconstruction is rarely required during open reconstruction. That said, it could be of benefit in cases of failed PLC reconstruction to assess tunnel placement.

The article titled "Comparative Analysis of Sagittal Plane Radiographic Landmarks Used to Identify the Femoral Attachments of Lateral Knee Structures" by Kremen, Haggerty, Chahla, Eberlein, Nelson, Schroeder, and Metzger[6] uses cadaveric knee specimens to evaluate previously described methods for identifying the radiographic femoral origin of 3 well-studied lateral knee structures: the lateral collateral ligament, the popliteus tendon, and the anterolateral ligament (ALL). After placing a radiographic bead at the true insertion point determined during dissection, lateral radiographs were used to compare 2 methods for each structure to the actual location. Inter- and intra-observer reliability also was assessed.

The authors should be commended for a well-designed study that has several important implications. By dissecting a large sample of knee specimens, the authors were able to plot the true locations of each insertion as a function of its "length percentage" on both the x- and y-axes. Figure 5 in Kremen et al.[6] shows that there is a surprisingly wide range of actual insertion sites, with several of the ALL insertions actually lying anterior to some of the popliteus insertions. By averaging the mean x- and y-axis coordinates for each structure, the authors created a third radiographic estimation method that was in fact more accurate than both of the previously described methods for all 3 structures. Some may claim that this is not surprising, as "Method C" is both derived and evaluated from the same sample of knees. However, this finding does, in our opinion, further the important takeaway point from this study: Radiographic methods for estimating the location of lateral knee structures are truly just estimates. As the present study shows, this variability is not unique to radiographic estimation methods. Even in the setting of dissecting specimens in the laboratory, a certain degree of inconsistency persists.

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Perhaps more so than other aspects of the joint, the anatomy of the knee's PLC has been extensively studied in the 21st century. After the landmark study by Terry and LaPrade in 2003,[7] further research by LaPrade and Arciero carefully defined the location of each structure and outlined surgical techniques that have produced good results, both clinically and biomechanically.[8-13] A recent study actually compared the LaPrade technique (2 free Achilles allograft tendons that are both tibia and fibula-based) with the Arciero technique (single fibular-based soft-tissue graft), and no biomechanical difference was seen.[14] Clinically, LaPrade's technique has shown significant improvements in objective scores, varus and rotational stability, and single-leg hop.[11] It follows that an anatomic approach to PLC reconstruction will rarely lead one astray.

In our experience, fluoroscopy and radiographic landmarks seldom have a role in the operative treatment of posterolateral knee injuries. The primary method of PLC reconstruction at our institution is either the LaPrade or Arciero technique—typically decided based on the extent of posterior cruciate injury and posterolateral (dial) laxity. For more severe injuries, we will typically favor the LaPrade reconstructive technique due to the more anatomic reconstruction of the popliteal limb, but in the anterior cruciate ligament/PLC injury pattern, we have anecdotally experienced good results with the Arciero oblique-fibular tunnel technique.

Considering the typical extensile hockey-stick exposure and a knowledge of the anatomic descriptions and relationships that LaPrade et al. and Arciero et al. have so adeptly described, we have not had to rely on intraoperative fluoroscopy. The lateral epicondyle typically can be palpated after the first window in the iliotibial band is created, and remnants of both the lateral collateral ligament and the popliteus tendon typically can be found. Furthermore, when identification of surgical anatomy is questionable, our standard backup method follows the principle of graft isometry and adjusting tunnel positions until the desired isometric positioning is made. Ultimately, the purpose of PLC or any other reconstruction is a stable graft, and any graft that does not display appropriate isometry properties intraoperatively will function no better after the patient leaves the operating room.

Radiographic assessment of the lateral knee structures is, however, important for the purposes of quality improvement. In the setting of failed surgery or revisions, a critical assessment of tunnel positioning and technique is important to avoid and correct initial mistakes. This is where the recent work really matters—Kremen et al. have emphasized that there is a larger range through which the lateral structures of the knee may exist in comparison with previous published works. As the authors have correctly noted, obtaining a true perfect lateral radiograph is challenging and likely contributes to this variability. Only through unabashed critical assessment of our techniques can we really improve.

Information on radiographic positioning really improves our technical expertise when it allows us to transition from more extensile to minimally invasive approaches to surgery. Since the work of Schöttle et al.[15] and verified by others, we have transitioned to a percutaneous technique for femoral socket creation in medial patellofemoral ligament reconstruction, which has reduced patient morbidity. Unfortunately, with the proximity of the peroneal nerve, and the need to typically reconstruct several structures, we do not foresee a similar transition with PLC reconstruction. Kremen et al. do present an interesting juxtaposition, given that the ALL has become highlighted while treating anterior cruciate ligament injuries.[16] "Method C," as mentioned by the authors, produced the closest distance to the true ALL insertion and may potentially allow for a more percutaneous technique, not dissimilar from the Schöttle technique for medial patellofemoral ligament reconstruction, although in our hands we have typically favored a Lemaire tenodesis for lateral augmentation as opposed to a free ALL graft.

In summary, the authors have emphasized that there is wider range than often emphasized in the location of the critical lateral knee structures. This is an important development in our own quality improvement, and further efforts will need to be directed toward outcomes and improvements in surgical technique.

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