INTRODUCTION
Injuries to the medial knee structures, collectively called the medial collateral ligament, are the most common knee ligament injuries [1, 2]. A review of the literature provides numerous qualitative [3, 4] and quantitative [5] gross anatomical descriptions of these medial knee structures. There is no established and validated method for the radiographic identification of medial knee anatomy. The purpose of this study was twofold. First, we qualitatively and quantitatively defined radiographic landmarks for the locations of the femoral and tibial attachments of the superficial medial collateral ligament (sMCL) and the femoral attachment sites of the medial patellofemoral ligament (MPFL) and posterior oblique ligament (POL). Second, we devised a validation study using examiners with differing experience levels.

METHODS
Eleven fresh-frozen cadaveric knee specimens had radioopaque markers implanted into the femoral and tibial attachments of the sMCL, and the femoral attachments of the POL and MPFL. Two millimeter stainless steel spheres (Small Parts Inc., Miami Lakes, FL, USA) were embedded into the center of these attachment sites. The sharp ends of one mm diameter T-Pins (Advantus Corp, Jacksonville, FL), cut to approximately five mm in length, were embedded flush with the cortical bone surface at the centers of the medial epicondyle, the adductor tubercle, and the gastrocnemius tubercle (Figure 1). Both AP and lateral radiographs were obtained. Structures were assessed within quadrants formed by the intersection of reference lines projected on the lateral radiographs (Figure 2). Quantitative measurements were performed by three independent examiners (a board certified sports medicine orthopaedic surgeon, a research fellow, and a medical student). Intraobserver reproducibility and interobserver reliability were determined using intraclass correlation coefficients.

RESULTS
Overall intraclass correlation coefficients for intraobserver reproducibility and interobserver reliability were 0.996 and 0.994, respectively. All measurements were to the centers of the structure’s attachment sites and are reported as averages (+/- standard deviations). On the AP radiographs, the sMCL, POL, and MPFL were 30.5 (± 2.4 mm), 34.8 (± 2.7 mm), and 42.3 mm (± 2.1 mm) from the femoral joint line, respectively. On the lateral femoral radiographs, the sMCL attachment was 6.0 mm (± 0.8 mm) from the medial epicondyle and located in the anterodistal quadrant. The POL attachment was 7.7 mm (± 1.9 mm) from the gastrocnemius tubercle and located in the posteroendistal quadrant (4). The MPFL attachment was 8.9 mm (± 8.9 mm) from the adductor tubercle and located in the anteproximal quadrant (1). On the lateral tibial radiographs, the proximal and distal tibial sMCL attachments were 15.9 mm (± 5.2 mm) and 66.1 mm (± 3.6 mm) distal from the tibial inclination, respectively (Figure 2).

DISCUSSION
Reconstructions of chronic medial knee injuries have varying success rates, and one reason for this inconsistency might be imprecise reattachment of repaired or reconstructed structures. We were able to consistently assess both qualitatively and quantitatively the anatomic attachment sites of the sMCL, POL, and femoral insertion of the MPFL on radiographs. These attachment sites were correlated to known radiographic locations on the distal femur and proximal tibia and to standard radiographic reference lines. All examiners were able to reproducibly and accurately measure the distances between attachment sites and projected reference lines despite the variability in experience level, as evidenced by the high inter- and intraobserver intraclass correlation coefficients.

In conclusion, we believe that the attachment locations of the main medial knee structures can be qualitatively and quantitatively correlated to bony landmarks and projected radiographic lines, which will allow for more consistent radiographic assessments of anatomic repairs and reconstructions. These landmarks should be clinically useful and allow for accurate identification of medial knee structure attachment sites and allow for preoperative, intraoperative, and postoperative assessments of surgical repairs and reconstructions of the main medial knee structures.

REFERENCES

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