

A Validated Method for Restoring Leg Length After Hip Arthroplasty Independent of X-Ray Magnification: The Lesser Trochanter to Center of Femoral Head Distance to Femoral Head Diameter Ratio

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Purpose: Lack of pre-injury radiographs, fracture displacement, and uncalibrated imaging create barriers to restoring leg length after hip arthroplasty in the setting of femoral neck fracture. This study determines the accuracy of 2 templating methods for restoring proper leg length: (1) a method (independent of x-ray magnification) that utilized the contralateral lesser trochanter to center of femoral head distance (LTC) to femoral head diameter (FHD) ratio to predict actual LTC, and (2) a method utilizing calibrated x-rays.

Methods: 63 patients undergoing primary total hip arthroplasty (THA) between 2021 and 2022 with recorded intraoperative measurements of LTC and FHD were retrospectively utilized to evaluate the accuracy of the templating methods. Patients with fractured femoral necks could not be utilized as normal neck length could not be determined in this group. Measurements were repeated at 1 month to assess intraobserver reliability.

In the LTC/FHD ratio method, radiographic measurements of LTC and FHD were performed in a blinded manner on uncalibrated preoperative x-rays. FHD accounted for articular cartilage by measuring from the midpoint between the femoral head and acetabulum. LTC was measured from the proximal axilla of the lesser trochanter to the center of the femoral head. Prediction of the actual LTC (measured during THA) was calculated by multiplying intraoperative FHD by LTC:FHD. The LTC and FHD were measured directly using calibrated PACS images. Correlation coefficients and paired t-tests ($\alpha = 0.05$) were used for comparison of the intraoperative and radiographic measurements.

Results: The LTC/FH ratio showed no significant difference from intraoperative measurements of LTC ($P = 0.12$). Calibrated x-ray measurements of FH and LTC were significantly different from respective intraoperative measurements (FHD: $P < 0.001$; LTC: $P < 0.001$). Repeat measurement of LTC/FHD ratio showed no significant difference in intraobserver reliability ($P = 0.22$).

Conclusion: This study supports the use of LTC/FHD ratio as an accurate method for templating femoral head height in hip arthroplasty in the setting of hip fracture where pre-injury radiographs are unavailable. This method is independent of x-ray magnification and more accurate than calibrated measurements.