Artificial Intelligence Templating for Total Knee Arthroplasty: Using Standard Preoperative Knee Radiographs

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Introduction. This study investigated the accuracy and learning capabilities of an artificial intelligence (AI) templating algorithm that converts two-dimensional (2D) knee radiographs to three-dimensional (3D) bone models to facilitate preoperative planning in total knee arthroplasty (TKA).

Methods. 108 consecutive patients who underwent primary TKA by a single surgeon during a seven-month period were identified retrospectively. De-identified preoperative anteroposterior and lateral radiographs were uploaded to a novel AI algorithm (PeekMed, Braga, Portugal). The accuracy of the AI algorithm was evaluated by comparing implanted tibial and femoral sizes to the AI-predicted implant sizes. Novel machine learning with improved accuracy over time was evaluated by comparing the percentage of implanted components that were within one size (±1) of the predicted size between the initial 50 patients, and last 51 patients.

Results. The AI algorithm accurately predicted the exact femoral and tibial implant sizes in 40% and 41.5% of cases, respectively. When allowing for (±1) size difference, the accuracy of the predicted femoral and tibial sizes improved to 90% and 87%, respectively. The AI algorithm significantly increased in accuracy over time for the tibial component (80% vs 94%, $p = 0.0342$) and trended towards significantly improved accuracy for the femoral component (87% vs 94%, $p = 0.1719$).

Conclusions. 2D radiographs converted to 3D models by this AI-based algorithm demonstrated high levels of accuracy when predicted TKA implant sizes were compared with the component sizes actually implanted during Department of Surgery. Moreover, prediction accuracy improved over time suggesting the algorithm may be a valuable preoperative planning tool for TKA.