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Artificial Intelligence to Identify Arthroplasty Implants from Plain Radiographs of the Hip

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Introduction: The surgical management of complications surrounding patients who have undergone hip arthroplasty necessitates accurate identification of the femoral implant manufacturer and models. Failure to do so risks delays in care, increased morbidity, and further economic burden. Since few arthroplasty experts can confidently classify implants using plain radiographs, automated image processing using deep learning for implant identification may offer an opportunity to improve clinical patient care.

Methods: We trained, validated, and externally tested a deep-learning system to classify total hip arthroplasty (THA) and hip resurfacing arthroplasty (HRA) femoral implants as one of 18 different manufacturer models from 1,972 retrospectively collected anterior-posterior (AP) plain radiographs from 4 sites in one quaternary referral health system. From these radiographs, 1,559 were used for training, 207 for validation, and 206 for external testing. Performance was evaluated by calculating the area under the receiver-operating characteristic curve (AUC), sensitivity, specificity, and accuracy, as compared with a reference standard of implant model from operative reports with implant serial numbers.

Results: The training and validation data sets from 1,715 patients and 1,766 AP radiographs included 18 different femoral components across four leading implant manufacturers and 10 fellowship-trained arthroplasty surgeons. After 1,000 training epochs by the deep-learning system, the system discriminated 18 implant models with an AUC of 0.999, accuracy of 99.6%, sensitivity of 94.3%, and specificity of 99.8% in the external-testing data set of 206 AP radiographs.

Conclusions: A deep-learning system using AP plain radiographs accurately differentiated among 18 hip arthroplasty models from the four industry leading manufacturers.

Notes