Reducing Radiation Dose During Plate Fixation Using Depth Camera Augmented Fluoroscopy (DeCAF)

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Purpose: In orthopaedic trauma surgeries, C-arm fluoroscopy is commonly used to guide safe drill and screw placement, often resulting in repeated x-ray exposure. To reduce x-ray usage, we developed depth camera augmented fluoroscopy (DeCAF), overlaying fluoroscopic images onto live patient anatomy video to enable the surgeon to monitor changes in tool position without reacquiring x-ray images.

Methods: We assessed DeCAF accuracy with reference objects visible in x-ray and video, and its performance in a simulated minimally invasive proximal tibial plate fixation by 2 experienced orthopaedic surgeons, using Sawbones and a latex covering to simulate soft tissues.

Results: DeCAF showed clinically acceptable overlay accuracies (1.6 ± 0.4 mm) and significantly reduced x-ray dependency from 39.2 images ± 5.1 and 21.5 images ± 8.3 down to 0 for both surgeons (eliminating the need in most cases). Time for procedures remained similar between DeCAF and conventional methods (P = 0.47). DeCAF-inserted screws were marginally deeper (average ~3 mm), yet within safe depths.

Conclusion: These results could support DeCAF's integration into live surgeries for clinical assessment, as it enabled safe and proper screw placement with minimal to no radiation, and minimal to no difference in time and breach rates compared to conventional methods. Thus, further deployment and testing of DeCAF in live surgical settings can be considered.

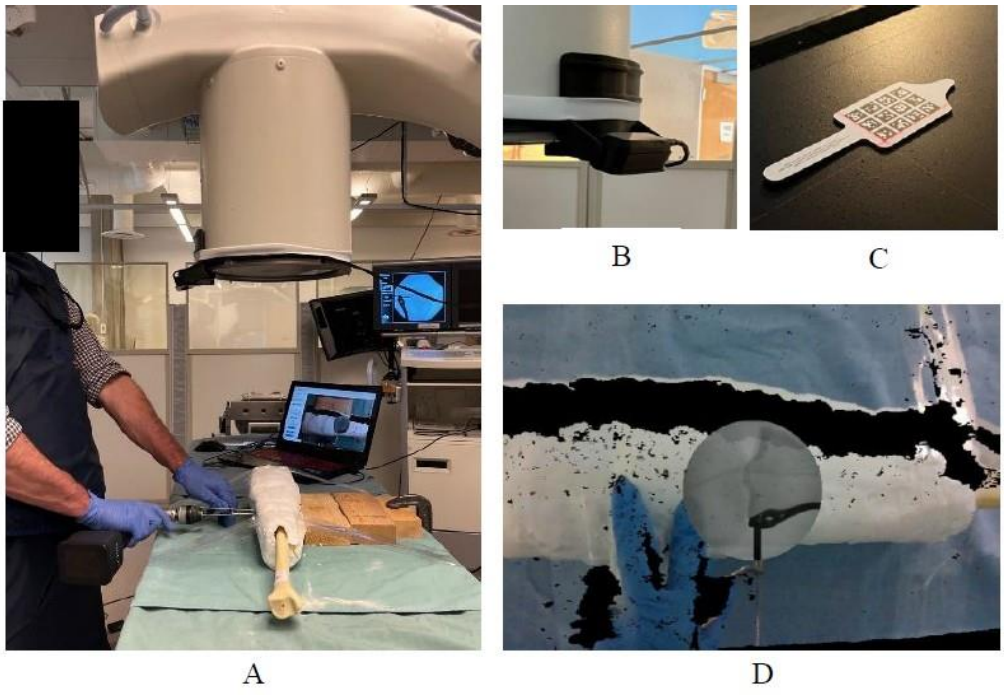

Figure 2. (A) Surgical setup for testing DeCAF in proximal tibia plate fixation while using the overlay for drilling, B) Camera Assembly, C) Calibration Tool, and (D) x-ray overlay view while the surgeon holds a surgical drill