

## THE USE OF MIXED REALITY IN ORTHOPEDIC PREOPERATIVE PLANNING

**Magrini G.<sup>1,2</sup>, Stanuch M.<sup>1</sup>, Skalski A.<sup>1,3</sup>**

<sup>1</sup>MedApp S.A., Poland

<sup>2</sup>Politecnico di Milano, Italy

<sup>3</sup>AGH University of Krakow, Poland

This work investigates the application of mixed reality for orthopedic preoperative planning, with a particular focus on bone-substitute implantation procedures using CarnaLife Holo software on the Microsoft HoloLens 2 headset. Mixed reality enables the display of virtual elements and their interaction with physical objects in a real-world environment. In healthcare, mixed reality can be a powerful resource for preprocedural and surgical planning, as well as a supplementary tool for several treatments. In contrast to conventional 2D displays, mixed reality provides real-scale three-dimensional representations of the computed tomography or magnetic resonance imaging data, improving depth perception, spatial understanding, and anatomical orientation while reducing the cognitive effort required to mentally reconstruct 3D anatomy from 2D slices. These advantages are particularly relevant in bone-substitute implantation, where accurate assessment of critical-size defect (>2–3 cm) and volumetric bone loss is essential for determining when regenerative capacity is insufficient and scaffold-based reconstruction is required. The system supports sterile interactions through hand gestures and voice commands, allowing dynamic view adjustments, arbitrary slicing planes, and the visualization of images at different depths according to the surgeon's needs in orthopedic procedures, where the planning phase is particularly relevant, such as tumor resection or fracture reduction. Additional functionalities include the ability to manually or automatically add anatomical landmarks (e.g., to compute main bone axes for planning a realignment) and to measure relevant anatomical distances (e.g., shaft length or epicondylar distance). Moreover, mixed reality can display osteotomy planes directly on the holographic model of the target bone, so that the surgeon can visualize where to cut, reducing the size of the skin incision. Overlaying patient-specific 3D anatomy and additional masks directly into the surgeon's field of view reduces head-down time and cognitive load while improving understanding of the overall 3D environment during surgical tasks. The integration of the system into clinical workflows facilitates procedure rehearsal, navigation support, and remote collaboration through the sharing of holographic views, thereby confirming the role of mixed reality as a support in diagnostic assessment, both in preoperative and intraoperative procedures.

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