Virtual rehearsal environment for maxillofacial fracture repair with haptic feedback
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Repair of maxillofacial fractures involves aligning fragments of bone with accuracy so that aesthetics and function are restored, as well as selecting and adjusting implant plates intraoperatively.

We are presenting conceptual and functional prototypes of a haptics-enabled maxillofacial surgery rehearsal environment that aims at providing a direct high-fidelity immersive experience for the operator with little training.

The ability to shift important surgical decisions to a pre-operative planning stage would decrease the length of surgery and improve confidence in the accuracy of repair.

With novel computational algorithms and interaction design of 6-DOF haptic technology, we aim to establish a level of user confidence in the interaction equivalent to the use of conventional plaster models.

Left: The user can move bone segments in free space using a 3D haptic feedback device and feel contact forces when the segments collide.

Below: A typical scenario for fracture repair involves repositioning bone fragments, choice of appropriate plate, and bending it to fit the specific patient.

Example of conventional surgery planning software (Simplant OMS, Materialise Dental, Leuven, Belgium). The user is restricted to positioning the jaw segments along one translational or rotational axis at a time using the mouse. In addition, no real-time collision detection is provided.

Plaster-based planning, which is very common for certain procedures, provides a bi-manual tactile experience for the surgeon. Results of very small movements can be felt concurrently with visual inspection from arbitrary angles.

Real-time collision detection combined with a novel 6-DOF haptic rendering algorithm developed in our lab enables surgeons to move bone segments in space and feel resistance when colliding.