

Section: Intraoperative Bildgebung

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Abstract-Title:

MAXILLARY REGISTRATION SPLINTS FOR CRANIOFACIAL IMAGE GUIDED SURGERY.

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Abstract-Text:

Purpose

Fiducial marker registration using bone screws is an established method for patient to image data for image guided surgery in the head. It is the gold standard for registration accuracy in image guided surgery. Today, as a less invasive alternative, intraoral fiducial markers mounted on a template for the maxillary dentition are in use for intraoral image guided surgery. In this study we wanted to verify if this registration method is also sufficiently accurate to be used for navigation in extraoral regions.

Materials and Methods

In a phantom study, registration experiments were performed. Since maxillary splints are individually fabricated, in this study 243 different configurations of fiducial markers mounted on a maxillary template were investigated: Using a plastic skull, bone screws were attached as target markers to various regions of this skull. Redundant registration markers were attached to a maxillary splint and this splint was attached to the dentition of the phantom. After CT imaging of this assembly, the further measurements were made using a standard infrared tracking system (Polaris, NDI, Waterloo, Ontario, Canada). Navigation accuracy was measured as the Target Registration Error (TRE) of each target marker on the skull. It was defined as the euclidean distance between the position in image data and the measured position using the tracking system, after registration. The average TRE was calculated for each target marker from 243 registrations with different marker configurations. Hence, the accuracy of the identification of artificial skull mounted targets located in surgically relevant locations was determined. Results

Targeting accuracy varied dependent on the location of the target markers. It was sufficient for image guided surgery of the facial regions closer to the registration splint: the orbit, the midface, the maxilla, and the pterygopalatine fossa. In these regions, the average target registration error was 1.5 mm or lower. However, in regions of the calvarium, the average target registration errors were in excess of 3 mm. Conclusion Fiducial marker registration based on a maxillary template is a safe and non-invasive alternative to bone mounted fiducial markers for image guided surgery in the regions of orbit, face, maxilla, and pterygopalatine fossa. Although the registration splints are individually fabricated and the configuration of the registration markers may always differ slightly, the method is reliable. Furthermore, with the use of a registration splint, there is also the possibility to attach the dynamic reference frame of the tracking system to the splint to achieve fully non-invasive image guided surgery.