

Intraoperative Bildgebung des Gesichtsschädels mithilfe eines mobilen CBCT-Systems

Intraoperative imaging of the facial skeleton using a mobile CBCT system

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Purpose

Cone beam computed tomography (CBCT) has been introduced with the NewTom 9000 (NIM s.r.l., Verona, Italy) in preoperative dental imaging and gained increasingly acceptance. The Siremobil Iso-C3D (Siemens Medical Solutions, Erlangen, Germany), a mobile C-arm image amplifier for 3D imaging, is also based on CBCT. It was primarily developed for intraoperative application involving the axial and appendicular skeleton and has not been clinically used in the facial skeleton. After having demonstrated radiation exposures of several imaging modalities and performed preclinical studies, the application of the Siremobil Iso-C3D was extended to intraoperative imaging of the facial skeleton. Therefore, we want now to show the results of intraoperative three dimensional imaging of the facial skeleton using this mobile CBCT system.

Methods

20 patients were included in this study. Intraoperative imaging was performed in 14 patients after surgical treatment of zygomaticomaxillary complex (ZMC) fractures, in three patients after open reduction of mandibular angle fractures, in two cases from the neurological intensive care unit before dental surgery in whom sufficient preoperative dental X-ray diagnostics were not possible, and in one case after bimaxillary osteotomies. For imaging before dental surgery data sets based on 50 projections proved to be suitable, in the other indications data sets based on 100 projections were preferred. In trauma

patients whose reduction result was intraoperatively imaged, the otherwise performed postoperative radiography were omitted. After DICOM-import in eFilm WorkstationTM 1.8.3 (Merge Technologies Inc., Milwaukee, USA) axial, coronal and sagittal reconstructions of the 14 data sets of ZMC fracture treatment were evaluated by five examiners with the help of defined criteria.

Results

In this study, secondary reconstructions of the Siremobil Iso-C3D were intraoperatively available after 6 min, with time for evaluation of images to be added. Especially the positioning of the isocentre of the Siremobil Iso-C3D with the help of laser devices and 2D fluoroscopy proved to be uncomplicated. Because of the size of the data volume, assessment of postoperative symmetry of the malar projection generally proved difficult. In most cases both zygomatic arches could not be captured using one data set. Best scoring results were found regarding the visualization of fragment position, bony anchorage of screws and fitting of plates. Remarkable was the low level of metal artefacts in primary and secondary reconstructions, even in close proximity of the material.

In cases of complex mandibular fractures, especially involving the mandibular angle region, intraoperative reconstructions of Siremobil Iso-C3D data sets proved to be very useful. Especially the clear visualization of the lingual cortical border was beneficial to the otherwise performed conventional imaging. In one patient with open reduction of a mandibular angle fracture a screw projected in the mandibular canal and, therefore, immediate revision surgery was performed.

Conclusion

Our results demonstrate intraoperative CBCT using the Siremobil Iso-C3D suitable for imaging of the facial skeleton. Regarding high-contrast structures an easy to use alternative to intraoperative CT is available opening new avenues for intraoperative data acquisition during navigated procedures.