curac2004
3. Jahrestagung der Deutschen Gesellschaft für Computer- und Roboterassistierte Chirurgie e.V.

Qualitätsverbesserung anatomischer Modelle durch 16-Zeilen CT

Improvements of the quality of anatomical modelling by using 16 row multislice CT

Florian Dammann[1], Schwaderer E[2], Maassen M M[3], Hoffmann J[4], Stallkamp J[5], Claussen C[2]

[1]Radiologische Klinik
Universitätsklinik Tübingen
[2]Radiologische Klinik Universitätsklinik Tübingen
[3]Hals-, Nasen- und Ohrenklinik, Universitätsklinikum Tübingen
[4]Klinik und Poliklinik für MKG-Chirurgie, Universitätsklinikum Tübingen
[5]Fraunhofer-Institut für Produktionstechnik und Automatisierung IPA, Stuttgart

Purpose

To assess qualitative and quantitative differences between anatomical models derived from a 16 row multislice CT (MSCT) vs. a single slice spiral CT (SSCT).

Materials and Methods

A series of human skull (Fig. 1) and mandible specimen were subsequently scanned on a SSCT and a MSCT. Scan parameters included a standard (2/3/0.5mm; collimation/ table feed/ increment) and a high resolution protocol (1/1/0.3mm) on the SSCT (Tomoscan, Philips) and 16x0.75/12/0.3mm on the MSCT (Sensation 16, Siemens). 125 mAs were applied in all cases. Bony structures were extracted out of all datasets using a threshold based segmentation algorithm. A triangulated mesh was generated to represent the surfaces with a resolution identical to that of stereolithographical anatomical modelling. Qualitative image evaluation was performed by visual inspection of clinically relevant anatomical details, including the relief of the dental surface, the mandible's condyle, the orbital rim, the zygomatic arch and the orbital floor. Quantitative analysis was performed by software based three dimensional surface comparison.

Results

The quality of the surfaces derived from the SSCT standard protocol (Fig. 2) was markedly inferior compared to those derived from both high resolution scans. The best quality was provided by the 16 row MSCT (Fig. 3). All anatomical structures were depicted much more detailed. The relief of the dental enamel appeared more precisely. The resulting quality is promising to deliver sufficient detail for orthognatic surgery. Stairstep artifacts were markedly less pronounced (Fig. 2,3: arrows). This allows to reduce the amount of smoothing necessary for the manufacture of stereolithographical models.
The 3D surfaces as derived from the MSCT scans provided a much more complete representation of thin osseous lamellae (Fig. 2,3: arrowheads). Size and number of pseudo lesions of the orbital floor were significantly reduced.

Conclusions

The quality of anatomical surface models derived from a 16 row MSCT is markedly superior compared to those based on SSCT technique. Highly detailed surface models as provided by a 16 row MSCT scan, promise to provide relevant additional information for surgery planning, navigation and robot control systems when compared with conventional SSCT based modelling.