Section: **Visualisierung**

ID: 102

Abstract-Title:
AN APPLICATION FOR 3D-PLANNING OF MANDIBULAR DISTRACTION OSTEOGENESIS UTILIZING POINT-BASED VISUALIZATIONEINE APPLIKATION ZUR 3D-PLANUNG MANDIBULÄRER DISTRAKTIONS-OSTEOGENESE UNTERVERWENDUNG PUNKTBASIERTER VISUALISIERUNGSTECHNIKEN

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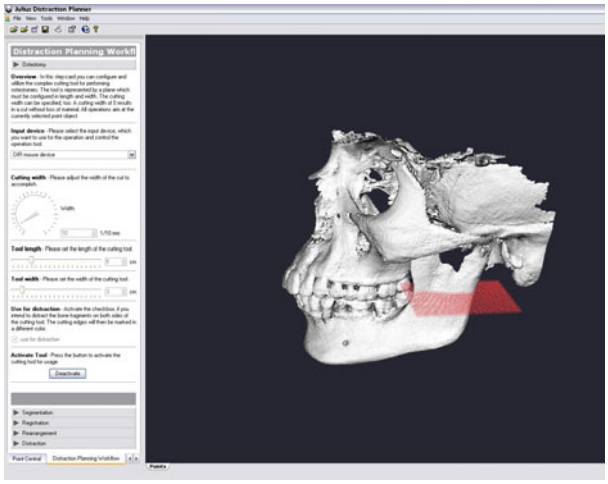
Abstract-Text:
Purpose:
Rehabilitating patients suffering from athrophic or resected bony structures in the maxillofacial skeleton frequently require the regeneration or transplantation of bone. Distraction osteogenesis is a well known procedure for the stepwise generation of bone that has been successfully applied to the maxillofacial skeleton. However, for buried or partly buried distractors detailed planning of the osteotomy-placement and the distraction vector is required.3D techniques for planning such interventions based on surface models generated from segmented medical slice data are described in the literature. Several disadvantages using polygonal surface-based techniques, like iterative segmentation steps after time consuming calculation of the surfaces led to the investigation of point-based techniques for 3D distraction planning.Methods:
Existing planning systems for distraction osteogenesis processes use common polygonal mesh data structures for the visualization of the planning scene and the internal representation of the involved virtual objects. Our application is founded on point data structures, which have several advantages over polygonal meshes, especially when complex datasets are involved. The lack of connectivity information effects in a compact and flexible representation, allowing efficient modelling of geometric and topological changes, e.g. virtual interactive bone cutting. Point data structures are described as clouds of 3D points that are visualized via geometric primitives like spheres or planes. Rendering is accomplished via hardware-accelerated “splatting”.All methods have been implemented as a component-based software system, enabling the surgeon to virtually perform the required operation and to simulate the distraction process stepwise by providing an integrated distraction-planning-workflow. The major buildings blocks of this workflow are plug-ins for accomplishing virtual osteotomies, segmentation of bone fragments that have to be distracted, their rearrangement to the optimal final positions, computation of an appropriate distraction plan, and simulation of the distraction process with the capability of collision detection. Thereby the software’s focus lies on planning distraction of the mandibula. The whole application is based on the Julius Software Framework, which allows a rapid application development per supply of numerous essential base

components like the in- and export of medical data formats and automatic slice-view-visualization. Rendering facilities, data structures and software tools for the handling of point data are encapsulated in an extendable add-on library for the Julius Software Framework - the PointPack - that provides interfaces for rapid development of medical applications. Results:
As result of the distraction simulation process the application shows a detailed protocol that describes the translations and rotations which are required to reach each distraction step. The final simulation of the distraction process and the computed distraction protocol serve as valuable resources for the surgeon when planning mandibular distraction processes. The visualized distraction vector and the distraction protocol can be used as basis for the selection of the right distraction device that has the capability to accomplish the pre-surgically planned translocation of the osteotomized bone segment .Conclusion:
The achieved performance in model-manipulation, segmentation and visualization indicates that point-data structures can be usefully applied for medical planning systems that have to manage large 3D-datasets. In future, we plan a clinical evaluation of intra-operative guidance techniques in conjunction with our planning system.

Bild 1/JPG



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