PAPERS

Preoperative Planning of a Craniofacial Defect Using a Virtual Environment

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BACKGROUND

This case involves a 17 year-old hispanic boy who lost his left eye and left upper jaw from a tumor at age 9. Because this is a particularly unusual and difficult case, we sought to use advanced visualization to aid in the preparation of this surgery. Reconstructing the patient's face from his own body parts was a challenge without our visualization software because of the three dimensional complexity of the defect.

METHODS

Reconstruction

A computed tomography (CT) scan was performed, DICOM images were segmented, and meshes of the bone and soft tissues were generated. The meshes were reduced from 2.5 million polygons to 500K for interactive visualization. This was the minimum size that was judged by the surgeons that still provided sufficient detail.

Virtual Environment for Reconstructive Surgery

The Virtual Environment for Reconstructive Surgery (VERS) consists of a Silicon Graphics Onyx InfiniteReality workstation, a FakeSpace Immersive Workbench display system, a Polhemus FasTrak stylus, StereoGraphics CrystalEyes stereo glasses, and uses WorldToolKit from Sense8.

The application reads in the given mesh files and allows the user to visualize, measure, interact, and manipulate the data of their patient. A number of virtual tools exist for selection/moving, marking locations, and adjusting physical parameters/lighting of an object. In addition, the user can perform operations for performance characterization and scene graph display, measuring distances (surface and linear) and angles, cutting the mesh, reflecting a submesh, manipulating object attributes, turning on/off objects, setting standard viewpoints, rendering modes, saving the scenegraph in VRML, dumping a screen image, deleting markers, and a help subsystem.

RESULTS

In the case of this patient, the intact side of the face was reflected over the affected side and a template to fix the defect was produced. Then a CT model of the boy's hip was generated and, within the environment, the pieces of the template could be moved within the model of the hip to find the location of the best curvature match. Then a paper template was produced and taken into the operating room to allow the surgeon to harvest the bone directly from the hip. Since they had planned it out ahead of time, they could harvest the bone, wire it together, and repair the defect correctly the first time, in significantly less time than would otherwise be required. In addition, these benefits also decrease the risk to the patient due to long-term exposure to anesthesia and risk of infection.

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