Virtual Reality in Microsurgery Training

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BACKGROUND

Microsurgery is a well-established medical field, and involves repair of approximately 1mm vessels and nerves under an operating microscope in order to reattach severed fingers or transfer tissues for reconstruction. Initial skills in microvascular surgery are usually developed in the animal lab and subsequently in the operating room. Development of these skills typically requires about 6 months of animal based training before additional learning takes place in the operating room. The experience level of the microsurgeon was shown to be significant in the outcome of these procedures. We have developed a virtual reality computer system that allows the user to realistically simulate vessel anastomosis and is able to monitor the progress of the trainee as well as compare the performance to an experienced microsurgeon.

PURPOSE

To provide an additional teaching tool for the beginning microsurgeon that is more convenient, faster and in the long term more cost effective than the animal lab. The progress of the trainee can be monitored and the performance compared to that of an experienced microsurgeon.

MATERIALS & METHODS

The system consists of a fully configured Sun Ultra 60/Elite 3D Graphics workstation connected to and a stereoscopic display by Fakespace Technologies (the BOOM). Real microsurgery instruments were adapted and were used as input devices so that the surgeon's experience would be as realistic as possible. An electromagnetic tracking device was mounted on these instruments to provide 3D localization and orientation. Using a physically based model, two vessels were simulated in the virtual environment. Through the tracked instruments the user is able to perform microsurgical anastomoses. The system evaluates the surgeon's performance based on a number of heuristics.

RESULTS
Because of the lack of force-feedback in actual microsurgery, the virtual environment is extremely realistic. The virtual instruments are responsive and their interaction with the virtual vessels is very close to reality. The vessel images deform like living tissues and anastomoses can be performed over and over again at any magnification or vessel orientation. The computer is able to calculate the redundant motions of the users in their attempts to perform the repair and is able to keep track of the performance of a user over time as well as compare the performance of different users.