

Surgical simulation makes it possible to objectively evaluate surgical skills. Access to detailed position, velocity, and force information makes it possible to measure tool accuracy, tissue damage, and surgical technique. Trainees are able to review their performance and compare it to that of experts. By using “gold standards” derived from the performances of expert surgeons, simulators amplify the teaching capacity of experts beyond the one-on-one apprenticeship that has been the standard. By insuring that trainees are prepared to make the best possible use of valuable time in the operating room, surgical simulation enhances traditional training techniques to improve the quality and reduce the cost of surgical education.

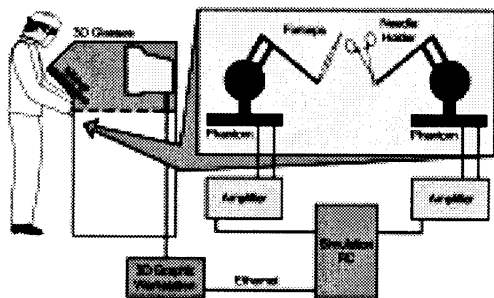


Figure 2. Hardware Diagram for the BDI Surgical Anastomosis Simulator. The simulator is an integrated system that uses standard computers for simulation, 3D graphics, and force feedback devices.

The simulator is an integrated system that allows users to practice end-to-end anastomosis, a common surgical procedure. The user holds real surgical tools, which are connected to force-feedback devices. Holding an instrumented needle holder in one hand and forceps in the other, the user can grasp and stabilize a tube using the forceps while puncturing the tube with a needle held in the jaws of the needle holder. The user sutures the vessels using standard curved needle technique. The forces of interaction between the tools and the simulated vessels are displayed to the user through the force-feedback devices, while the visual images of the interaction are displayed through 3D computer graphics.

A key feature of the simulator is its ability to measure surgical skill. The simulator measures damage to the tissues, curved needle suturing technique, time, accuracy, and several other parameters. In a preliminary test we have compared the performance of experienced vascular surgeons and medical students on a simulated surgical task. We found that the surgeons performed significantly better than the medical students.

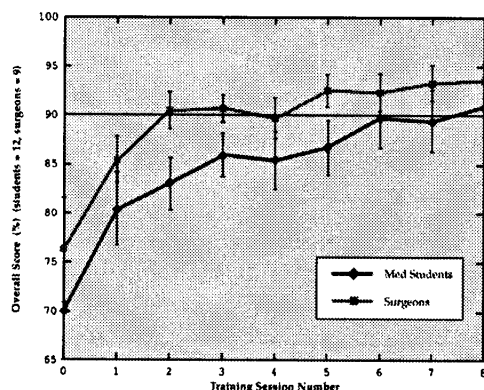


Figure 3. The overall scores of experienced surgeons exceeded those of medical trainees on the skill assessment test.

Knee Arthroscopy Simulator

Working with the American Board of Orthopaedic Surgeons, Boston Dynamics developed the BDI Knee Arthroscopy Simulator, a virtual reality simulator for teaching arthroscopy of the knee. The simulator is an integrated training system that uses an arthroscopy mounted on a force feedback device, 3D computer graphics, a mechanized lower leg, and physics-based simulation of interactions between the arthroscope and tissues of the knee joint. The system will be used for training and accreditation within arthroscopy.

