TECHNOLOGY

Click and Cut in the Virtual OR

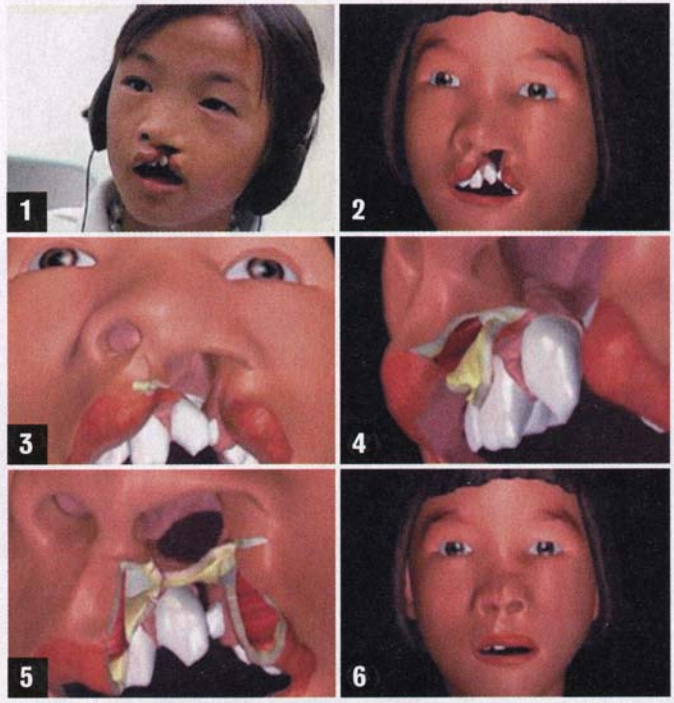
A TRACHEOTOMY TO PUT a breathing tube in the throat of an infant can be a risky procedure, says Dr. Court Cutting, a leading plastic surgeon at New York University Medical Center; it runs the danger of cutting the superior thyroid artery, which can cause blood to spurt out as fast as it can be sucked up. The surgeon probably won't make that mistake again, but it can be tough luck for the baby. Talking with a pilot friend one day, Cutting realized that the way we teach surgeons is like training pilots by sending them up in loaded 747s—loaded mostly with poor people, since the affluent seek out experienced doctors as private patients. But pilots learn to fly on simulators. Why can't surgeons practice on machines, instead of bodies?

They already do, but existing devices all have shortcomings. Cutting himself has developed a videogame-based system for teaching cleft-lip and -palate repair, and there are programs for cardiac surgeons to practice threading catheters up the femoral artery to the heart. But those are based on generic anatomical models. Cutting wanted the ability to rehearse an operation on a virtual model of a real patient's actual anatomy, based on CT or MRI scans. And he wanted to be able to do it in real time, interactively, on a model incorporating skin, muscle, nerves, organs, bones—and blood.

How hard can that be? Well, equations exist to calculate how tissues will stretch or tear when a surgeon manipulates them, and how they will respond when they're sutured up again. But on existing desktop computers they can take days to solve, says Joseph Teran, a UCLA mathematician who is organizing a conference on "virtual surgery" at the university next month. To show the effects in real time on a screen, you have to do the calculations in one thirtieth of a second. To create the illusion of actually wielding a scalpel or hook—using a device that simulates actual motion and resistance, analogous to the joystick on a flight simulator—requires reducing the lag time to one thousandth of a second. Essentially, you'd need to put the power of a supercomputer into a desktop. Cutting thinks this will be achievable, using multiple parallel processors and new algorithms Teran is developing, within a couple of years. "You could have a patient in a small town scanned while a surgeon in the city practices the surgery," Teran says. "The patient then flies out for the operation."

And none too soon to help Iraq War veterans who, thanks to improved body armor, are now surviving attacks that would have been fatal in earlier wars, but are left with severe wounds to their extremities and faces. Many other specialties could benefit as well, including cardiac, cancer and orthopedic surgery, and Cutting's own field of cleft-lip and -palate repair; there are 40,000 cleft babies born every year in China alone. "No two traumas or birth defects are the same," says Teran. "The surgeon makes a plan to repair the damage, only nothing goes according to plan." Better, in that case, for the virtual patient to bleed on the screen—than the real one in the operating room.

—JERRY ADLER



VIRTUALLY SMILING: *Soon surgeons will practice correcting a cleft lip and palate in real-time simulation—the way pilots learn to fly*

TOP TO BOTTOM, LEFT TO RIGHT: JOSEPH TERAN—AARON OLIKER-COURT CUTTING-BIODIGITAL SIMULATION, LLC (6); TOM GANNAM—AP; CHARLIE NEIBERGALL—AP; SHAUN HEASLEY—GETTY IMAGES