

... Exhibition Spotlight N°2: Ellis Developments

Embroidered surgical implants allow the body to mend beautifully.

BY JUDE STEWART

"We're famous in Nottingham for selling fresh air, with little bits of thread holding the puffs together," Julian Ellis jokes of the English textile city in which his company, Ellis Developments, is based. The textile technologist and his partner, Peter Butcher, have adapted Nottingham's venerable industry to modern-day medicine: tweaking standard commercial embroidery machines to create surprisingly strong artificial ligaments. Beautiful, too, as visitors to "Extreme Textiles" will soon discover.

Educated first as a chemist and then as a textile technologist (he wrote his master's thesis about woven bra-strap elastics), Ellis, 58, began his career making stretch fabrics. In the 1980s he expanded into automotive and aerospace textiles, which still represent a good chunk of his business. For instance, his company designed fiberglass swatches to reinforce the floor pads surrounding seat-belt anchors in cars. "In an accident, you have very heavy pullout forces," he notes.

Ellis's artificial ligaments are a kind of reinforcement, too. Surgeons use them most frequently to treat abdominal aortic aneurysms, a condition in which the walls of this major artery weaken, causing swelling and, if the vessel bursts, death. Often this operation requires temporary removal of the intestines (so surgeons can reach and repair the artery using hand-stitching), and then a five-day stay in intensive care. By contrast, a surgeon can insert one of Ellis's embroidered, collapsible stents through a 7-millimeter-wide hole in the patient's groin. The stent is pushed up through the femoral artery to the swollen portion of the aorta, where it expands to form a new arterial wall. The procedure takes place under local anesthetic and requires less healing time.

Ellis designed his first surgical implant, an artificial ligament, in 1981 with woven polyester suture thread but later learned that embroidery machines can compose stitches to match the pattern of natural muscle fibers precisely and with a minimum amount of material. "Because an embroidery machine can place the fibers exactly where we want them, we can optimize the architecture so we don't put in more fibers than needed," he says. Embroidered implants are less porous and more durable than woven ones, and embroidered patterns are easily reproducible at low cost.

The firm now leads the industry in computerized embroidery techniques. Ellis's software translates a CT scan of a healthy ligament into stitches graphed on an X/Y axis. Suture thread is embroidered into soluble base cloth in the pattern of the ligament fibers; the material is then dissolved, leaving only the implant to be sterilized and grafted by the surgeon to muscle or bone. The new polyester ligament moves and stretches the way the patient's muscle would, with similar strength, and it lasts inside the body indefinitely. Ellis's software also includes algorithms for resizing a ligament, so that a design can fit any body type.

Ellis holds future designs close to the vest, but he does offer one promising development: tissue-engineered implants, in which, for example, living tissues are grown to replace a damaged host tissue. In this case, embroidery might be used as a lattice, training cells into the right shape. The embroidery technique yields artificial fibers that are "strong in the directions they need to be strong in," and offers "mass production in units of one," he notes. Right now, the only designs that are cheaper or more durable are stitched by Mother Nature herself.

Jude Stewart's "Rant" column on umbrella design appeared in the June 2004 I.D.

An embroidered ligament implant for reconstructive shoulder surgery, designed by Peter Butcher of Ellis Developments

