Design a Tourniquet, Double Time!

The Project: Design a tourniquet in a little over two weeks that needs to offer exceptional strength and durability, while also enabling ease of use.
The Solution: Use a rapid prototyping process and eliminate any possible fat in the design routine, while also maintaining very close communication with the client and mold maker.

By Gary Bordenkircher

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Product Design Labs LLC provided the engineering expertise for the Cybertech MAT (Mechanical Advantage Tourniquet).

The Cybertech MAT, a Mechanical Advantage Tourniquet produced by Bio Cybernetics International (BCI), proved to be a challenging design project that required a partner that could easily adapt to the specific needs of the medical device company. BCI contracted Ewing Design Group who then subcontracted Product Design Labs to perform the engineering. BCI had created a prototype of the concept but it did not work well and the company had no plan on how to design for manufacturing. In addition, the manufactured product needed to be to the Army for testing by July 1, 2004. Deducting the time for making the injection molding die and testing it out gave Product Design Labs a little over two weeks to get all the files to the mold maker.From the beginning, the tourniquet had to meet several specific design criteria, as well as, functional requirements.

- Device needed to be able to stop blood flow in limbs sized from small forearms to large thighs.
- Device had to endure all environments from arctic winters to steamy jungles to hot deserts.

- Device had to be very lightweight so that the soldier would not be burdened any more than necessary.
- Material had to have low friction and inherent lubricity for ease of movement of internal parts.
- Tourniquet had to be able to be put on by one hand in case soldier had to apply it himself.

Additionally, there were several non-written specifications that were required for the tourniquet. “You know what these soldiers are going to do with it, don’t you? They are going to be using it to pull their HumVees out of the mud.” This meant it had to be made of some high-strength material. The first step was to investigate what type of plastic was needed.

As an avid snorkeler and free diver, a trip was made to the dive shop. This visit yielded a diving fin made of a plastic that was very flexible, yet strong, abrasion resistant, and had a good degree of natural lubricity. A quick call to the manufacturer led to the name of the plastic and, after checking data sheets, a very similar polymer was chosen (a nylon derivative).

During this time, the industrial designer drew up a few ideas on how the tourniquet should look. Computer models were created in ProEngineer from the desired concept. From this point forward, the routine was to create a prototype using FDM (fused deposition modeling), assemble and test the prototype, meet with the client to discuss the prototype and how to modify it, modify the computer models, create a new FDM, and repeat this process several times. FDM is a rapid prototyping process that builds a part one layer at a time by heating a filament of thermoplastic and squeezing it out of a nozzle. FDM was used because it provided a very fast turnaround time and yielded a working prototype so that the performance could be checked quickly.

When a prototype was found that met all performance criteria, including ease of use, strength, and flexibility, and all the little details that can distinguish a great product from a mediocre one, the files were transferred to a local injection-mold manufacturing house. Details that were provided much attention included the exact shape of the engage and disengage levers, the size and curvature of the molded spring arm (so that the winder would have the correct feel), and what the end of the plastic would look like so that the tourniquet would not dig into the victim’s limb while being tightened. Although these details don’t contribute to the main point of the tourniquet, they do go a long way in lessening the discomfort for the user.

Finally, long meetings with the mold maker were substituted for all the usual part drawings as there was no time beforehand to make the necessary documentations. The molds were made, the plastic was shot, and the pieces were assembled and overnighted to the Army to arrive on July 1. There they achieved a 100% success rate compared with previous tourniquets’ 80% success.

As to the little details, Tor Alden, principle of HS Design, said “. . . brings simplicity and elegance to a very traumatic event. Very appropriate aesthetics give a soft comforting feeling without losing the perception that this is a very serious piece of equipment.” This was stated after the tourniquet won a Gold IDEA award in 2006, sponsored by IDSA and Businessweek. The article goes on to state that “the design has been successfully used in combat conditions, in the dark, underwater and in extreme weather conditions.” Although this was not a typical project with a more typical design cycle, it does illustrate how a small team of dedicated individuals can

produce a high quality medical device in a very short amount of time, streamlining the entire process.

Online

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