3D Printer for Orthotic and Prosthetic Devices

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INTRODUCTION

3D printing has the potential to change the way we manufacture orthotic and prosthetic devices. This technology utilizes additive, rather than reductive techniques, such as CNC, carving, milling, etc. to fabricate parts. The latter all start with a mass of material and "reduce" it down to the desired part. Additive manufacturing, however, starts with a clean slate and builds the part from scratch, synthesizing material in the process and constructing in layers. This allows the designer to have more control over the outcome, including the interior, which saves materials and results in a more efficient process.

While 3D printing uses an unconventional process, additive and reductive manufacturing are not that different. Both utilize a computer aided design (CAD) process, where a digital rendering is planned, controlled, and executed using a computer. The computer generates a series of commands, which it provides to machines that fabricate the part. This allows the user to remotely monitor fabrication, which ultimately saves time, money and resources. Computer aided design and manufacturing (CAD/CAM) has been shown to be effective in orthotics and prosthetics for years now, since the advent of scanning and carving for prostheses and orthoeses. Where CAD/CAM carving reduces the number of steps and materials required to produce patient devices, 3D printing inherently takes this one step further, resulting in a final product. CAD/CAM carving has eased production and increased patient care, and 3D printing is poised to become the next wave of technology in orthotic and prosthetic fabrication.

METHODS

This project consisted of creating a dedicated orthotic and prosthetic prototype printer that employs additive technology. Designed from the ground up to create devices for patients, this project helps lay the groundwork for others to follow.

The planning stage involved formulating a design and parts list for the printer. This meant utilizing information collected from others in the community to limit the pitfalls after construction. Then, assembling a parts list to order parts and procure funding. Once everything is collected, detailed building notes will be presented.

One of the greatest challenges of this project will be getting the various pieces of the puzzle to communicate with one another effectively—the physical printer, to the firmware, to the software, to the computer, and vice-versa. Once this is solved, the printer will be ready to start building orthoses and prostheses.

The final step in the process is to tune the hardware and software so that it can be most effective in construction of devices. Temperature, heating, cooling, layer height, infill, speed, etc. all play into how a printed part appears, functions and lasts, so optimizing these are crucial to producing an effective patient device.

RESULTS

Upon successful completion of this project, there will be a low-budget "guide" for other practitioners to employ 3D printing in their offices. The technology exists to change the way we treat our patients, decreasing costs and increasing care at the same time.

Furthermore, physically demonstrating the products of 3D printing will increase the possibilities and acceptability in the minds of practitioners. The availability of this technology is ever-increasing, but allowing practitioners and students to hold devices in their hands, and visualize how they will work on patients, helps them to formulize how the technology may fit into practice.

DISCUSSION

Inherently, there are pros and cons to 3D printing. These will be discussed over the course of the presentation. Most of the limitations currently lie in the setup and cost, two components that this project aims to significantly address. Conversely, 3D printing provides qualities that will appeal to clinicians. It produces a replicable, quality product, fast turn-around, decreased production costs, and the ability to provide cutting edge care to patients.

CONCLUSION

I believe in the technology of 3D printing and I also believe that it isn't going anywhere. It is on this faith that I set out on this project, to build a low-budget socket printer that could be used in an average sized. This project will help to integrate 3D printing technology into the field and allow other students, practitioners, and patients to see the applicability, which will snowball new ideas. As a field, we are in constant transition, and 3D printing is the next major stepping stone in how we provide our services to patients.

CLINICAL APPLICATIONS

Clinical applications of 3D printing are unlimited. The custom nature of the field of orthotics and prosthetics lends itself to one-off manufacturing and the advent of new materials used in printing increases the applicability.

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