

## A Plastic Surgery Application in Evolution: Three-Dimensional Printing

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**Background:** Three-dimensional printing represents an evolving technology still in its infancy. Currently, individuals and small business entities have the ability to manufacture physical objects from digital renderings, computer-aided design, and open source files. Design modifications and improvements in extrusion methods have made this technology much more affordable. This article explores the potential uses of three-dimensional printing in plastic surgery.

**Methods:** A review was performed detailing the known uses of three-dimensional printing in medicine. The potential applications of three-dimensional printing in plastic surgery are discussed.

**Results:** Various applications for three-dimensional printing technology have emerged in medicine, including printing organs, printing body parts, bio-printing, and computer-aided tissue engineering. In plastic surgery, these tools offer various prospective applications for surgical planning, resident education, and the development of custom prosthetics.

**Conclusions:** Numerous applications exist in medicine, including the printing of devices, implants, tissue replacements, and even whole organs. Plastic surgeons may likely find this technology indispensable in surgical planning, education, and prosthetic device design and development in the near future. (*Plast. Reconstr. Surg.* 133: 446, 2014.)

Three-dimensional printing, otherwise known as “additive manufacturing” or “rapid prototyping,” allows construction of physical models from computer-aided design.<sup>1-3</sup> Developed more than 30 years ago, this technique has only recently become available and affordable to the general public; the ability to print three-dimensional models is revolutionizing the business world.<sup>2</sup>

Computer-aided drafting is a means of using computer technology to create a design referred to as a draft. Computer-aided manufacturing is the process by which computer software is used to guide a machine into manufacturing goods. These technologies can be applied to create a three-dimensional model on a computer that can then be produced using a three-dimensional printer.

In addition, repositories for downloading and sharing designs have made many designs that

were only available at brick-and-mortar or online vendors available to individuals in their homes and offices.<sup>2</sup> In comparison to the prior accepted standard of stereolithography, three-dimensional printing is less costly and can be more accurate.<sup>1</sup>

In medicine, three-dimensional printing technology has emerged in applications such as organ printing, body part printing, bio-printing, and computer-aided tissue engineering. Inkjet techniques have also been introduced by several groups to build organs and functional body parts. Furthermore, a three-dimensional model can be assembled with a high degree of accuracy in personalized prosthetics with printing resolution (100  $\mu$ m).<sup>4-8</sup>

Combining three-dimensional printing with three-dimensional scanning technology adds a dimension in which real objects can be imaged with devices as ubiquitous as smart phones to generate three-dimensional files that can then be printed. Recently Sculpteo, a French company specializing in three-dimensional printing, revealed a mobile

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