Three-Dimensional Photography for Calculating Pre- and Post operative Volume in Breast Surgery

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Introduction

Every year thousands of women worldwide undergo breast reconstruction, augmentation with implants, or reduction surgery. Without a practical protocol for breast measurement, it is difficult to assess postoperative results objectively. Recent advancements in three-dimensional (3-D) imaging technology may help doctors accurately assess breast morphology. Imaging products on the market employ 3-D imaging software for use in breast surgery. The purpose of this study was to quantify and compare the actual morphological change in breast shape to that simulated by the 3-D imaging software. We investigated the validity of using three-dimensional breast photography by comparing several measurement techniques. These included the traditional water displacement method, the casting technique, and the Grossman-Poudner device.

Methods

To determine the 3-D surface data of the patient's breast(s), we used a Genex Technologies Rainbow 3-D camera. The Rainbow 3-D camera operates on a structured-light process projecting random colors on the anatomical surface and captures over 440,000 data points of information. The patient’s anatomy is photographed with a multilens camera to capture any topology changes, while information from the reflected structured light grid is collected and focused onto a CCD. The position of an illuminated surface point relative to the viewpoint is obtained by triangulation. The measurement accuracy is submillimeter since it is possible to achieve an imaging resolution of 25 microns.

Volume and topology measurements were done using existing Genex software. The software used for this study incorporates a two-plane technique that includes in its assessment of breast volume the medial and lateral aspect of the breast but excludes the chest wall. The two-plane algorithm consequently detects as much as 90 cubic centimeters of breast volume, which is more than the one-plane software is capable of detecting.

Results

The volume assessment using the 3-D camera correlated closely (<5% error) with the

measurements obtained from traditional methods. It was useful for the surgeon to determine the immediate volume of the implant needed or the weight of the free tissue to transfer. One of the obvious limitations of the camera is that it cannot capture non-projecting breast volume. This shortcoming is not unique to the camera, however, as water displacement, casting, and the Grossman-Poudner technique do not measure this additional breast volume either. Imaging also proved clinically useful in the assessment of volume asymmetry, determining the implant volume needed to achieve symmetry. Lastly, 3-D data was used to determine implant distribution in augmentation mammoplasty, and correlated closely (<5% error) with the volume of the implant used.

Conclusions

3-D digital photography is a useful clinical tool for preoperatively assessing breast volume, presence and degree of asymmetry, and shape. It provides objective data that guides and improves breast surgery outcomes. In addition, it may play an important role in the evaluation of the implant shape on overall breast appearance and the distribution of implant volume in the tissues.