Otolaryngology–Head and Neck Surgery (2008) 139, 313-315

CLINICAL TECHNIQUES AND TECHNOLOGY

A new three-dimensional imaging device in facial aesthetic and reconstructive surgery

Samuel J. Lin, MD, Neel Patel, MD, Kristina O'Shaughnessy, MD, and **Neil Fine, MD,** Boston, MA; and Chicago, IL

The conventional methods used for assessment of facial aesthetic outcomes are largely based on subjective observation instead of objectively measured data. It is not possible to quantify three-dimensional change on a two-dimensional surface such as a photograph. Although attempting to make measurements based on photographs has been the state of art for many years, this method is inherently inaccurate, because the facial structure and other body structures are naturally three-dimensional. Previous authors have attempted to visualize the face in three dimensions.[1-4] One of the most challenging issues of imaging in three dimensions is producing a reliable and consistent method of obtaining three-dimensional images both preoperatively and postoperatively over time.

We have begun using a three-dimensional imaging device, the Minolta Vivid 300, which has a high degree of precision for studying the surface topography in facial reconstructive and aesthetic patients. Previously, three-dimensional imaging devices have been traditionally used in industry for quality control during manufacturing, and surface topography and engineering surveys. In the current application, this three-dimensional device can accurately capture the fine details of a human face over different time points. Collating each time point, we may study these images to quantify topographic changes of the face over time.

Continually improving the means of imaging technology is crucial for more accurately assessing the outcomes of patients in the long term. In essence, three-dimensional imaging can serve as an improved objective guide, over conventional photography, with which changes in surface topography can be studied in the immediate and long-term postoperative period.

MATERIALS AND METHODS

This preliminary study was approved by the institutional review board at the Northwestern Feinberg School of Medicine. Each patient undergoing facial reconstruction or rejuvenation can be imaged preoperatively with the Minolta Vivid 300 three-dimensional camera. The images are captured by using a standardized protocol that controls for variance between images; for instance, there is a standard distance from the camera that is used. Imaging software is used to construct the three-dimensional images for comparison (Inspection Technologies Inc, Madison Heights, MI). The "raw" image obtained by the three-dimensional camera is shown on the left panel in Figure 1.

Three individual positions on the three-dimensional topography of the patients' faces may be selected for study throughout the postoperative course for comparison with preoperative images (right panel, Fig 1). These measured data points may be selected on the basis of quantifiable change as measured by computer and seen by the observer during facial rejuvenation or reconstructive techniques; the data points were standardized distances from the midpupillary line. For example, nasolabial fold positions were one area of study during facial rejuvenation. The other points included the temporal region and malar area.

These three-dimensional images of the patients are taken periodically over time. The images of each time point may be superimposed onto the original image to construct a "color map." Three-dimensional color maps can be constructed to compare postoperative to preoperative topography (Fig 2). The red and orange hues represent positive change, or swelling and soft tissue projection over time. The blue hues represent negative change, or flattening and tightening of the respective areas over time. Vector change in fractions of millimeters can be determined in comparisons of patient images before and after procedures.

DISCUSSION

This is one of the first attempts to design a means of objectively quantifying facial contour change using three-dimensional imaging in patients undergoing procedures for facial rejuvenation and reconstruction. Numerous applications exist for this technology. For instance, in contour

Received March 18, 2008; revised May 15, 2008; accepted May 15, 2008.

doi:10.1016/j.otohns.2008.05.025