Accuracy and Precision of a Photographic System for the Three-Dimensional Study of Facial Morphology

A thesis

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Abstract

Facial analysis is vital for orthodontic treatment planning but traditional methods of facial analysis are incapable of fully capturing the three-dimensional (3D) complexity of the human face. The purpose of this study was to determine the precision and accuracy of facial anthropometric measurements obtained through low-cost digital three-dimensional (3D) photogrammetry system.

Eighteen standard craniofacial measurements were obtained from faces of thirty healthy young adults (twenty males and ten females) using two methods: calipers and 3D photos (obtained with a Photomodeler system). After marking anthropometric landmarks on the faces of the sample direct measurements were taken using calipers then five photographs were taken at different angles and 3D model constructed and the same measurement were taken using Photomodeler. Differences between two methods were calculated. To test the precision of the new photogrammetric system, measurements were repeated on the same photographs by the researcher and then by another examiner and also a new set of photographs were taken for each individual and measurements were done on them. Three different precision estimates were calculated to measure random error for the new method.

Systematic errors between the two methods were found for seven measurements but most mean differences were clinically insignificant (below two mm). In terms of measurement precision, no systematic biases were found between repeated measurements on the same photographs or on different photographs and our precision estimates showed a clinically acceptable level of repeatability for the Photomodeler system.

It can be concluded that Photomodeler 3D photogrammetry system can provide accurate and reliable facial measurements. Although the method requires some attention to technical details, it is relatively fast and requires only inexpensive equipment. It can be used for private practice, research, or other practice.