Letter to the Editor

The iPad/iPhone 3D photography app—a promising device, but how about its accuracy?

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With great interest, we read the article entitled "*Three-dimensional facial scanner in the hands of patients*: *validation of a novel application on iPad/iPhone for three-dimensional imaging*" by our highly appreciated colleagues Yuming Chong, Xinyu Liu, Mai Shi, Jiuzuo Huang, Nanze Yu, and Xiao Long (1).

This study assessed the validity and reproducibility of a novel imaging system by comparing 21 anthropometric parameters measured using calipers (direct measurement) and three-dimensional photographs (3D photogrammetry). Furthermore, the 3D virtual model obtained by the new imaging system was compared and analyzed with the 3D virtual model obtained by the VECTRA H1 camera using a heat map. The authors found most anthropometric parameters did not show statistically significant differences between their novel iPad/iPhone 3D photography app and calipers (direct measurement). At the same time, intra- and interobserver reliability were high indicating good accuracy and reproducibility of the new device. The new application validated by the authors in this article provides excellent convenience for patients capturing 3D images of themselves. Although this is a very well-designed study, some issues have to be discussed. In addition, we would like to suggest future research directions in this very important research field.

Firstly, the authors used direct measurement (calipers) as the gold standard and compared the new iPad/iPhone 3D device to verify its accuracy, bias, and reproducibility. Due to simplicity and the good availability of inexpensive calipers, direct measurements have been considered the "gold standard" for anthropometric measurements in craniomaxillofacial surgery for a long time. However, recent studies have reported that novel 3D imaging techniques are less error-prone and more accurate than direct measurements using calipers. Compared to the novel 3D imaging techniques, direct measurements revealed measurement errors especially caused by involuntary blinking and soft tissue deformation. In addition, direct measurement techniques are relatively time-consuming and have a high investigator dependence as well as a high dependence on patient cooperation (2,3). Therefore, direct measurements are being replaced more and more by modern 3D imaging techniques. Previous studies already introduced the first standardized periocular anthropometric protocol (*Figure 1*) (4,5). It was demonstrated that 3D stereophotogrammetry had higher accuracy and reliability compared to direct measurements with calipers (2). As a result, static 3D camera systems (i.e., the Canfield VECTRA M3 system) may be considered the new gold standard in facial anthropometry. Furthermore, the authors should compare their device to the current gold standard—a static 3D imaging system—to validate the accuracy.

Secondly, the authors compared the new 3D imaging device with the portable VECTRA H1 camera (1). However, a new generation of portable devices is now available, the VECTRA H2. A recent study (6) showed that most periocular measurements taken with the VECTRA

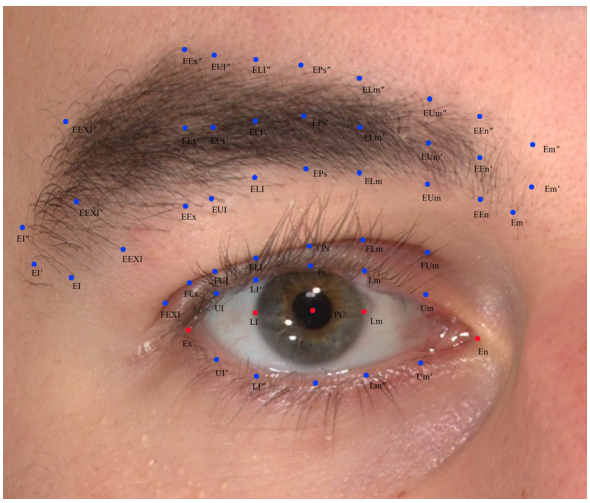

Figure 1 The detailed periocular anthropometric landmark protocol for 3D imaging includes 52 landmarks in total. 3D, three-dimensional.

H2 were slightly less reliable than those taken with the VECTRA M3 device. Accuracy differences between the static M3 system and the portable H2 device can be reduced by taking the average of two photographic measurements with the portable system. Therefore, in addition to comparing the new 3D photographic system with the current gold standard—a static 3D device—comparative analyses with a new generation of portable devices (i.e., VECTRA H2) should be attempted in future studies.

Thirdly, the anthropometric landmarks in this study involved the entire facial region, including the periorbital, the nasal, and the orolabial region (1). Except for some landmarks in the periorbital and nasal regions, most landmarks did not differ significantly between iPad/iPhone 3D photography app and calipers used in this study. Nevertheless, landmarks in the face and especially in the periocular region are still relatively too few and not specific enough. In ophthalmology and oculoplastic surgery, for example, a more detailed periocular landmark protocol is required to analyze the morphology of the periocular region. Therefore, for full validation of the iPad/iPhone 3D photography app in the periocular region, further studies using the detailed landmark system developed by Guo *et al.* (7) are necessary. That will probably be similar in other facial regions.

In summary, the authors introduce a novel 3D facial scanning system allowing patients to autonomously take 3D images of themselves. This scanning device seems to have comparable accuracy to direct measurements and may significantly increase the database of patient images before and after maxillofacial surgical procedures. However, for a full validation, further comparative studies using more detailed landmark protocols are necessary. With this letter, we hope that the proposed suggestions will make this assessment system more accurate, reliable, and widely used in various medical areas.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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