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READER'S FORUM

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Accuracy and precision of integumental linear dimensions in a three-dimensional facial imaging system.

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In this article the authors presented an interesting topic, a three-dimensional (3D) scanner, in a systematic manner. And I hope to share my inputs regarding the following points.

Q1. The two factors, which could affect accuracy and precision, have not been mentioned in the article. First, when the 3D study photos were taken in 3 directions, it could have made a significant difference whether the images were captured in all 3 directions simultaneously or in 1 direction at a time with 3 separate images merged as on at a later time. Also, since the 3D photos were analyzed with placement of dots on the face, the applied dots should be pointed accurately from all angles regardless of the direction of the scan images on a monitor.

Q2. While the accuracy of Ex-Ex, Tra-Ck and La1-La2 measurements was relatively low, the precision was high in both the 3D photo and caliper methods. In discussion the authors tried to explain this fact with repetition or loss of the landmark due to muscle constriction or integration line. However, some readers including myself may find it difficult to follow the proposed causes. Thus, I'd like to request that the authors provide an additional explanation.

Q3. The accuracy and precision were high with exception of the landmark measurements on integration lines. Then, would it be still true that it was able to reproduce overall 3D structures of the face? Since the scope of the study was limited to linear measurements only, there may be room to improve in the future by evaluating reproducibility of the surface structures.

Questioned by
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Thank you for your valuable opinions and questions. Our responses are presented below.

A1. Three images were taken from three different horizontal angles (the front, right, and left sides at an angle of 45°) one at a time and then merged into a single 3D facial image. The Morpheus 3D® scanner (Morpheus Co., Seoul, Korea) used in this study is an example of a 3D photogrammetry imaging device that uses a structured light scanning system. As the method can measure shapes from one perspective at a time, complete 3D shapes have to be combined from different measurements in different angles. This can be accomplished by attaching marker points to the object and combining images from different perspectives afterwards by matching these markers. Thus the manufacturer explained that minor positional change of the head while taking 3D photos from different angles doesn't harm the result as long as the markers are positioned on repeatable sites. This study was designed

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to evaluate the accuracy and precision of Morpheus 3D® scanner under clinical settings, in which minor changes of subjects' positions or photographing angles could be acceptable.

And, as pieces of the surface data were gathered from the 3D scanner, pointing was feasible from most of the angles. However, we rotated and looked for the angle that showed the marked dots most clearly and tried to point the centers of the positioned dots.

A2. Differences in accuracy of such measurements may be due to the movement of subjects or errors associated with the integration process of the Morpheus 3D® system. Even so, we assumed that precision could be high if the errors were repeated. We experienced that the same error was repeated in two images acquired from one subject when using the 3D scanner.

A3. According to our study, 3D scanning images have high levels of precision and fairly good congruence with traditional anthropometry methods. The landmarks were located to cover the whole area of the face, and both vertical and horizontal measurements were compared. However, the limitation of using linear measurements in evaluating accuracy and precision of a 3D facial image is definite. Further studies such as superimposition of the images from cone-beam computed tomography and Morpheus 3D® scanners may further disclose the reliability of a 3D scanner in the future.

Replied by
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