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THE CUTTING EDGE

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The quest for accurate recording and representation of human facial form is an ancient one, not only in history and art, but also in orthodontics. Early in the 20th century, Case experimented with plaster casts of the face, and von Loon with plaster dental casts that could be positioned within a plaster model of the patient's facial profile. Three-dimensional visualization of facial appearance and esthetics is of paramount concern to patients,1 yet the current protocol for documenting and analyzing facial esthetics still relies on two-dimensional photographs.

Three-dimensional facial imaging is a complex and multifaceted field that is just entering into mainstream clinical application. Many advances lie ahead, including improvements in the imaging devices themselves, development of methods of three-dimensional facial analysis, and compilation of three-dimensional normative data bases.

The following report describes a creative technical improvement upon a laser-based system for three-dimensional facial imaging. Currently, a few graduate orthodontic programs are using the Minolta VIVID 700 in patient care, and while devices like this are now considered the state of the art, much work remains to be done in producing clinically efficient systems. For example, most scanners available today obtain multiple views of the face (frontal, left and right, and others), which are manually "stitched" together to produce a composite view. This process requires significant post-processing time and effort. Furthermore, scientific validation of these systems must be forthcoming to ensure that each image is a truthful representation of the patient's face.

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Scanning Facial Surfaces with a Three-Dimensional Laser Scanner

More precise three-dimensional quantification of the craniofacial complex has been made possible by recent advances in computed tomography, magnetic resonance imaging, and data-analysis software.2-4 Technical limitations of these methods do not allow for accurate representation of facial tissues, however, because in most situations, the scans are performed with the patients supine. At present, laser surface scanning provides the most accurate portrayal of the facial soft tissues, and thus can produce valuable information for the orthodontist.5,6

The Minolta VIVID 700 non-contact 3D laser scanner consists of a slit laser projector (galvanometer-mirror), a charged coupled device camera, and data-processing software, with a total weight of 9kg.6 The 3D data are obtained at a resolution of 200 × 200 × 256 points; color data are obtained at 400 × 400 pixels, and the scanning time is .6 seconds.

Scanning Facial Surfaces

Imaging the areas of undercut below the eyebrows, nose, lips, and chin is a difficult challenge. The undercut impedes the straight-line access of the laser beam and results in voids and artifacts in these areas. Needless to say, the morphology of the nose, lips, and chin are essential to orthodontic

diagnosis and treatment.

Seeking to improve laser-beam access to areas of undercut when scanning dental casts, Kusnoto and Evans found that the VIVID 700 produced better detail when placed upside down.6 Therefore, we applied the same procedure to scanning facial surfaces.

The horizontal laser beam of the VIVID 700 normally moves from top to bottom. Figure 1A shows data scanned with normal handling at an object-to-scanner distance of 90mm. Figure 1B shows data scanned with the VIVID 700 placed upside down, also at an object-to-scanner distance of 90mm. With the horizontal laser beam moving from bottom to top, there was less distortion from below the nasal region to the superior labial region.

Conclusion

Our results demonstrate that more accurate scanning of the facial soft tissues can be achieved with the VIVID 700 placed upside down. Fortunately, the newer models of this scanner (VIVID 900 and 910) emit the horizontal laser from bottom to top.

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FIGURES

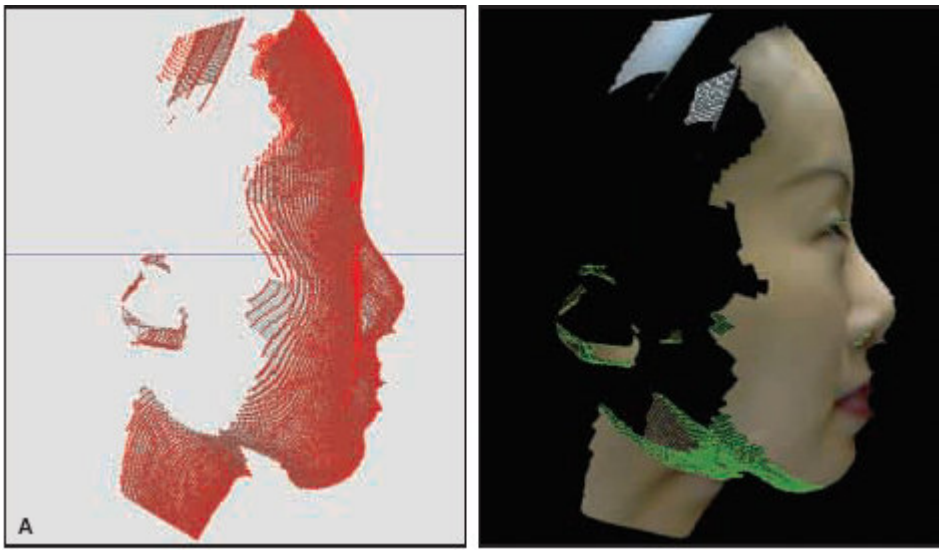

Fig. 1A Data scanned with normal handling of VIVID 700, showing distortion in the lip region.

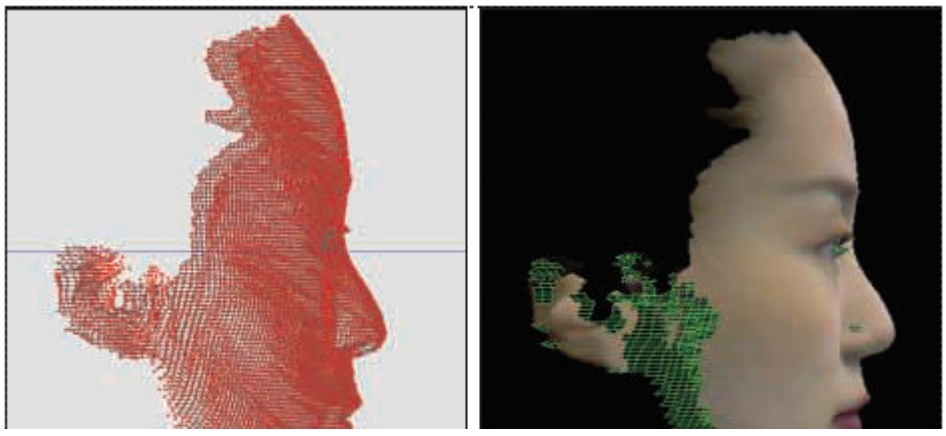

Fig. 1B Data scanned with VIVID 700 placed upside down, showing less distortion.

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FOOTNOTES

1 Minolta USA, 101 Williams Drive, Ramsey, NJ 07446.