The Truth of What Accuracy Means for Intraoral Scanners

When it comes to accuracy, there are two important and complementary elements: "trueness" and "precision." "Trueness" refers to whether a measurement matches the actual quantity being measured, while "precision" indicates the ability of that measurement to be consistently repeated.

According to a recent study, "Accuracy of four intraoral scanners in oral implantology: a comparative in vitro study,"[1] published by the scientific journal BMC Oral Health, trueness alone is not a sufficient element for an intraoral scanner— it must also be accompanied by precision. In other words, the scanner must deliver consistent results, even when it is used to obtain different measurements of the same object. In this way, an intraoral scanner should detect all impression details and generate a virtual 3D model that is as close to the initial rendering as possible.
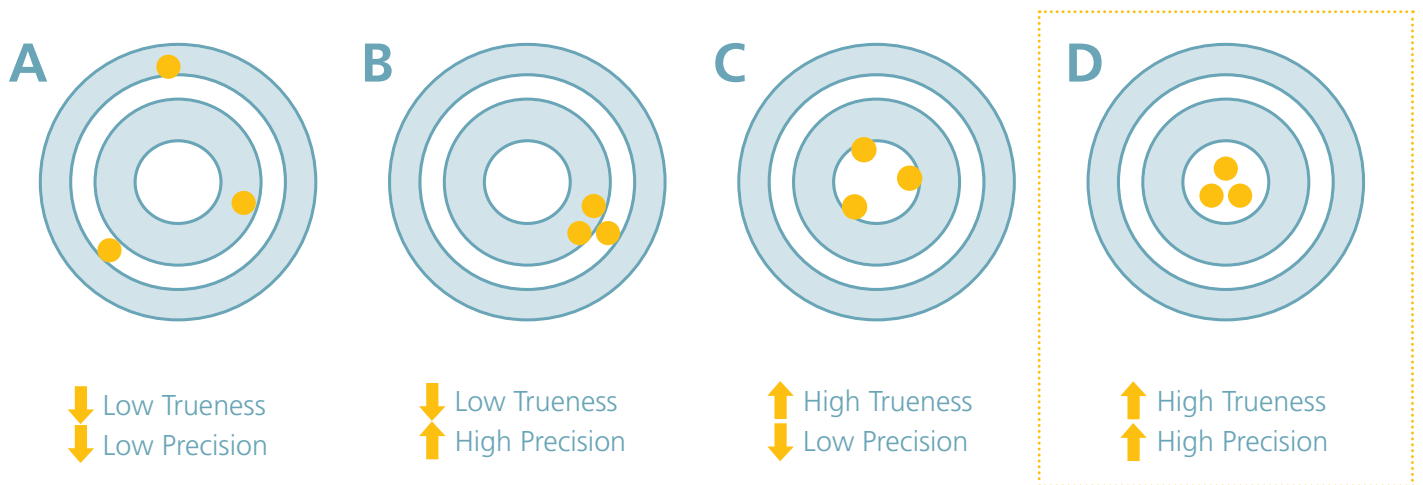
Manufacturers often use the terms "true" and "precise" to describe an intraoral scanner, but what role do these concepts play in digital impressions and the final restoration or appliance?

Trueness vs. Precision

Although "trueness" and "precision" are often incorrectly used interchangeably, the two concepts are very different, with each playing an important part in the final restoration or appliance.

To best demonstrate the difference between trueness and precision, imagine a bulls-eye. Trueness, or the "ability of a measurement to match the actual value of the quantity being measured," refers to your ability to hit your target in the correct spot, i.e., the center. "Precision," on the other hand, is the "ability of a measurement to be consistently repeated"—that is, your ability to hit the same area (whether it is the bulls-eye or the outer ring) every time you shoot.

Trueness and Precision: The Bullseye Example

A
Low Trueness
Low Precision

B
Low Trueness
High Precision

C
High Trueness
Low Precision

D
High Trueness
High Precision

The Role of Accuracy in Digital Impressions

In general, digital intraoral scanning delivers better accuracy than traditional methods; for example, digital technology eliminates inaccuracies caused when taking the impression (such as air bubbles or missing molars). Digital impressions also allow the doctor to check the impression and easily correct mistakes before submission to the lab. Plus, by using a secure online portal to send digital impressions, there's no risk of models breaking, expanding or shrinking during transport.

However, the quality and accuracy of digital scans can vary greatly from one scanner to another. Poor-quality digital impressions with "holes" (missing data, poorly marked margin lines or dull color) can lead to ill-fitting final restorations and unhappy patients. In addition, since there may be different scanner users in a practice—and each user has his or her own scanning technique—it is especially important for the scanner to deliver consistent results, regardless of who is using it.

The ideal scanner should feature a high degree of trueness to ensure detailed scans, as well as a high rate of precision to ensure consistency. Using a scanner with high accuracy ensures better fitting restorations and/or appliances.

"A Comparative in Vitro Study"

High-quality digital impressions require accuracy, with trueness providing the details of the impression while precision guarantees repeatability. This study evaluated the trueness and precision of four intraoral scanners by scanning two stone models—one partially edentulous and one completely edentulous, including three and six implant analogues respectively—to measure trueness and precision.

The study models were first scanned with an industrial scanner to create a baseline. The four evaluated scanners were then used to scan each model five times, for a total of 40 datasets. To determine trueness, the datasets were reverse engineered and the scans were superimposed onto the reference models. Next, these scans were placed into groups and superimposed onto one another to determine precision.

The study revealed "significant differences in trueness" between the four intraoral scanners that were tested—a fact that "may have important clinical implications." In addition, it found "no statistically significant differences" in terms of precision between the four intraoral scanners.

Choose the Scanner That's Proven Scientifically Superior

When the partially edentulous maxilla was scanned, the CS 3600 was significantly better in terms of its trueness—delivering 45.8 µm. Likewise, when the totally edentulous maxilla was scanned, the CS 3600 offered the best performance, with a trueness of 60.9 µm. And, not only did the CS 3600 have the best trueness results, it was also "significantly better" than the three other intraoral scanners.

In conclusion, the study determines "the use of the most accurate IOS [intraoral scanner] would seem preferable, in order to improve the quality of fit and marginal adaptation of the implant-supported prosthetic restorations." Furthermore, because the "CS 3600 gave the best trueness results," the study recommends its use in "similar clinical settings."

For more information about the CS 3600 or any of Carestream Dental's innovative products, please call **800.944.6365** or visit **carestreamdental.com**.

[1]Imburgia M, Logozzo S, Hauschild U, Veronesi G, Mangano G, Mangano FG. June 2, 2017. Accuracy of Four Intraoral Scanners in Oral Implantology: A Comparative In-Vitro Study. BMC Oral Health. 17(92): DOI 10.1186/s12903-017-0383-4