

The meaning of accuracy, trueness and precision

The term accuracy is on everyone's lips when talking about the performance of intraoral scanners and their suitability to produce exactly fitting restorations time and time again. But what are the elements determining accuracy and what does accuracy really mean? Answers to these questions fundamental to our understanding of scientific studies on scanner performance are given by PD Dr. Jan-Frederik Güth in this interview.

Dr. Güth, please describe the elements of accuracy evaluated in scientific studies.

The two elements used to determine the accuracy of an intraoral scanner are trueness and precision. In our presentations, we generally utilize the example of a target field to illustrate the meaning of the terms. Everyone who has ever played darts knows the principle: Each player has several attempts to try and hit the spot in the very middle of the board. The player who succeeds in consistently placing his dart the middle within a very small target field is both

precise and true. If a very small target field is kept, but this field is not located exactly in the middle of the board, the results are still precise, but less true. On the other hand, a player who always hits the middle of the board but whose field is large will be true, but not precise. The worst player is the one who does not succeed in hitting the middle and will spread his darts all over the board (neither true nor precise) (Fig. 1).

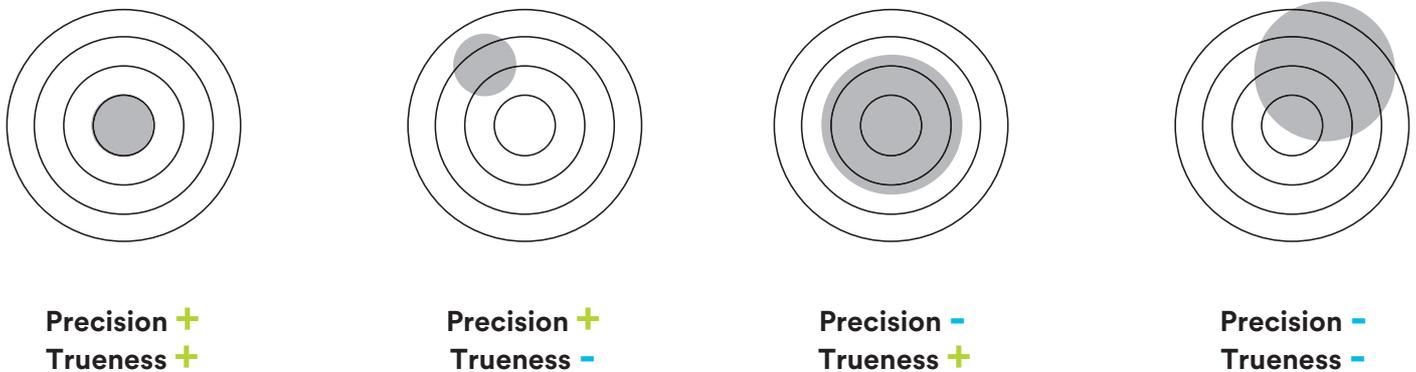


Figure 1: Explaining the two elements of accuracy: trueness and precision. (Image courtesy of Dr. Jan-Frederik Güth, University of Munich)

So I guess we should aim at developing highly true and precise intraoral scanners?

Indeed, this would be the ideal goal. However, it is likely that some deviation from the perfect condition will occur. Thus, for our evaluation of the performance, we have to ask which of the two elements is more important for intraoral scanners – trueness or precision. I guess that it is precision: Hitting the same place every time (even if it is not the middle) will lead to predictable (repeatable) results. The error in trueness can be compensated more easily.

Predictability is important since it allows us to evaluate the effectiveness of a scanner. If a dentist prepares a tooth in the same way 100 times and the results are good, he can assume that if he does the same action 101 or 102 times, the result will be the same. With a digital scanner, the goal is also to obtain the same level of accuracy every time the device is used.

Are the available intraoral scanners more precise and true than conventional impression processes?

The results of an in-vitro study on trueness and precision of traditional and digital impressions conducted by my team at the University of Munich show that this is the case. The results demonstrated that most intraoral scanning devices lead to less overall deviation than the traditional method. The 3M™ True Definition Scanner and its predecessor showed a small range of positive and negative deviations compared to the classical workflow of conventional impression, plaster cast and laboratory-based scanning, demonstrating that the digital impression systems are highly true, and highly precise for increased predictability (Fig. 2) [1].

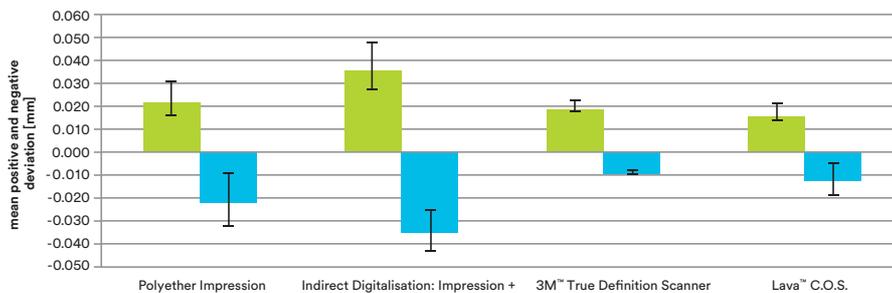


Figure 2: Mean positive and negative deviations between test and reference datasets after digital impression and conventional workflow for a 4-unit FDP. The length of the bars represents the "trueness", the standard deviation the "precision" of the digitalization methods. (Image courtesy of Dr. Jan-Frederik Güth, University of Munich)

[1] Part of the results published in Güth JF, Keul C, Stimmelmayer M, Beuer F, Edelhoff D. Accuracy of digital models obtained by direct and indirect data capturing. Clin Oral Investig. 2013 May;17(4):1201-8. doi: 10.1007/s00784-012-0795-0. Epub 2012 Jul 31.



PD Dr. Jan-Frederik Güth



Frédéric van Vliet

Contact

Frédéric van Vliet
3M Oral Care
fvanvliet@mmm.com