The Influence of Shape and Size of ScanBodies: An In Vitro Study on Accuracy and Precision

Text by Francesco Biaggini

In recent years, dental implants have established themselves as one of the most popular solutions for replacing missing teeth, making them a choice of choice for many patients.

However, the success of these rehabilitations depends on numerous factors, including one of the most crucial: the acquisition of an accurate digital impression.

Since the implants are located below the oral mucosa and alveolar bone, it is not possible to acquire them directly with optical scans. To overcome this limitation, devices called ScanBodies are used. These transmucosal components are designed to accurately transfer the three-dimensional position and angle of the implant.

The market offers a wide range of scan bodies, which differ in materials, shapes, sizes and surface treatments. Despite this variety, little scientific research has thoroughly investigated the impact of their characteristics on the accuracy of scans and, consequently, on clinical outcomes.

This study, therefore, aims to better understand how the shape and size of scan bodies affect the performance of optical 3D scans.

The authors hypothesized two fundamental aspects: that the shape of the ScanBody does not affect the accuracy of the data, and that the size does not have a significant impact.

To test these hypotheses, detailed experiments were conducted. Will the authors be right or wrong?

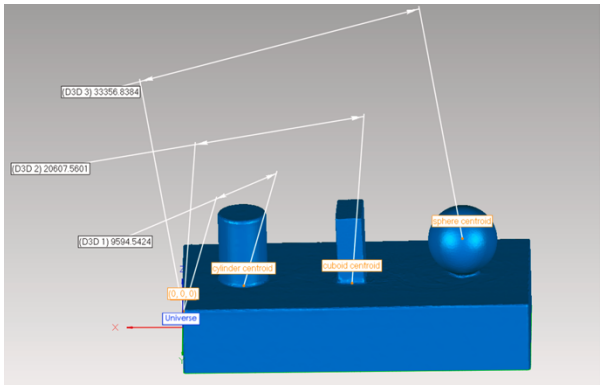
The Research Path

To begin with, fifteen ScanBodies were made using a material called polyether ether ketone (PEEK), chosen for its precise processing properties and surface quality.

These scan bodies included several shapes: nine cylinders with varying sizes, five cuboids, and a sphere with a diameter of 8 mm. Each sample was carefully mounted on PEEK bases to avoid distortion during testing.

The reference measurements were made using a coordinate measuring machine (CMM), an extremely precise instrument. With this device, it was possible to determine the position and angle of the scan body centers with a maximum linear error of just 1.8 micrometers. Subsequently, the same samples were subjected to optical scanning using a highly precise scanner laboratory.

Each sample was scanned ten times, ensuring optimal data repeatability. The analyses focused on two key parameters: veracity, i.e. how close the scan values were to the reference data, and accuracy, which measures the consistency of results between scans. The data collected were processed using advanced statistical tools to identify any significant differences.



What we discovered

The results of the study by **Yu Pan** and the other co-authors of *Effect of shape and size of implant scan body on scanning accuracy: An in vitro study* highlighted some interesting differences.

When it comes to the shape of the ScanBodies, the cylinders have proven to be particularly effective in ensuring high linear accuracy, with average values of around 9.5 micrometers.

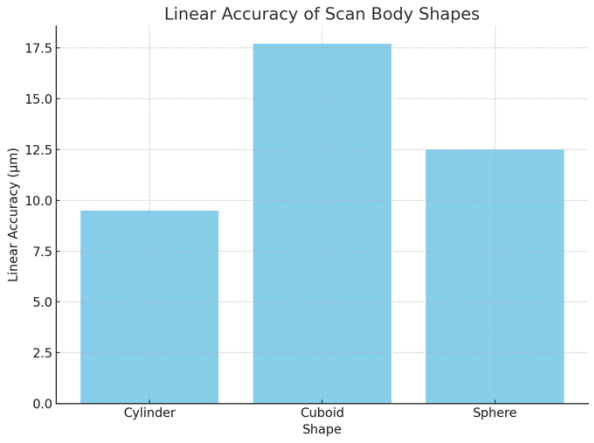
In contrast, the cuboids offered the best angular accuracy, with a superior performance compared to all the other shapes tested.

The spheres, on the other hand, while showing a fair linear accuracy, proved to be unsuitable for transmitting information on the angle.

Below is a summary table of the results:

Form	Linear Error (µm)	Angular Error (°)
Cylinder	9,5	0,065
Cuboid	17,7	0,050
Sphere	12,5	Not applicable

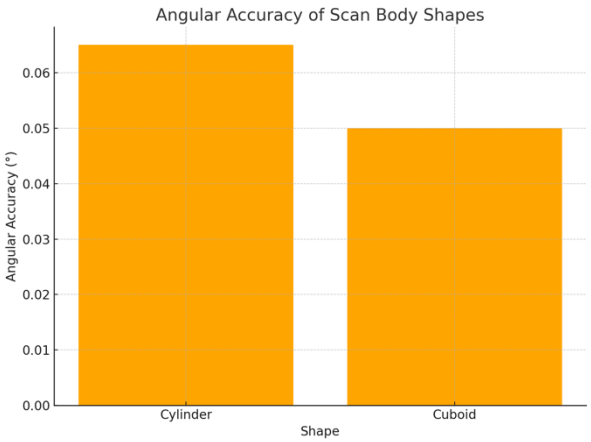
A graph to visualize linear accuracy:



Turning to the dimensions, the study showed that cylinders with a diameter greater than 4.8 mm and a height greater than 8 mm guarantee better results in terms of overall accuracy. In cuboids, sizes with a cross-sectional area of 18 to 30 mm² produced the

most satisfactory results. Conversely, smaller sizes significantly degraded performance.

A second chart for angular accuracy:



The Impact on Patients and Clinical Practice

These findings have direct implications for clinical practice. Choosing the right ScanBody is not just a technical matter, but can profoundly affect the outcome of the treatment for the patient.

For example, the cylinders prove to be ideal for transferring the three-dimensional position of the implant, ensuring that the prosthesis fits perfectly.

Cuboids, on the other hand, can be particularly useful in situations where greater angular accuracy is needed, such as in narrow interocclusal spaces.

An interesting aspect concerns the spheres. Although these offer good linear accuracy, their inability to convey angle makes them unsuitable as independent ScanBodies. However, by combining the characteristics of cylinders and cuboids, it may be possible to develop scan bodies with even better performance.

Looking to the Future

This study represents an important step towards a deeper understanding of ScanBodies, but it also leaves room for further research.

It would be interesting to explore how the design of ScanBodies can be optimized by combining different features, or how the angle of the implant influences the results. In addition, the use of alternative materials to PEEK could open up new possibilities.

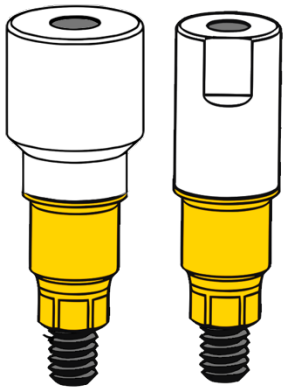
A summary table on the optimal dimensions:

Type	Optimal performance
Cylinders (Diameter > 4.8 mm, Height > 8 mm)	High linear accuracy
Cuboids (Area 18-30 mm²)	High angular accuracy

Conclusions

In summary, the shape and size of scan bodies play a crucial role in determining the accuracy of digital scans. Scan bodies with a height greater than 8 mm and a diameter greater than 4.8 mm have proven to be the most reliable. Although spheres have shown some limitations, cylinders and cuboids continue to represent the best solutions for different clinical needs. These results underscore the importance of a conscious choice of instruments in dental practice, with the aim of ensuring predictable and high-quality treatments for patients.

Why do cylinders have high linear accuracy?



Simple and regular shape: Their smooth and uniform surface offers clear reference points that are easily detectable when scanning.

Reduced complex angles: Unlike more complex shapes such as cuboids, cylinders do not generate multiple reflections that could interfere with scanning.

Constant contact area: Larger diameter cylinders (>4.8 mm) offer a wider base, which allows for greater stability and accuracy in detection.

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