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PCA: conceptualization, formal analysis, methodology, project administration, resources, supervision, validation, visualization, writing - review & editing.

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Efficacy of two intraoral scanners: perception of postgraduate students of a private university in Lima

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ABSTRACT

Objective: To determine the perception of postgraduate students of a private university in Lima on the efficacy of the intraoral scanners (IOS) Primescan Dentsply Sirona® and Virtuo Vivo Straumann®. **Materials and methods:** Cross-sectional study in which 10 students of Oral Rehabilitation participated, who, after being trained, scanned a model using both IOS; subsequently, their perceptions were collected through a questionnaire. **Results:** The Primescan Dentsply Sirona® IOS was considered by 80% (n = 8) and 100% (n = 10) of the students as having the best characteristics in scanning speed and flow, respectively; and the Straumann® Virtuo Vivo IOS was considered the most ergonomic by 100% (n = 10). **Conclusions:** The IOS Primescan Dentsply Sirona® IOS was perceived as the fastest, sharpest and with the best scanning flow; and the Straumann® Virtuo Vivo IOS was considered the most ergonomic and preferred.

Keywords: intraoral scanner; scan speed; sharpness; scan flow.

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INTRODUCTION

Technological advances applied to modern dentistry have contributed to improving the efficiency of various related procedures. One of the most significant innovations in this regard is the intraoral scanner (IOS), which has revolutionized impression-taking while also serving as a valuable tool for dental education.

In this regard, in recent years, various IOS for dental use have been launched on the market, each with particular characteristics that differentiate them from each other, such as those presented in an international dental exhibition held in Germany in 2023 (1).

These devices capture direct intraoral optical impressions by projecting a light source onto the structure to be scanned. The image obtained is processed in a software that generates a cloud of points that are triangulated to create a 3D model (2). Furthermore, new advances in the development of IOS include a reduction in tip size, decreased weight, increased speed, improved image resolution, and enhancements in imaging software. All these improvements have contributed to restorations without the need for conventional models (3).

On the other hand, it is important to consider certain criteria when selecting IOS from a clinical perspective, being the scan speed one of the most relevant factors. Generally, next generation devices are faster. Another criterion is the scanning flow, i.e. The device's versatility in capturing images in any area of the mouth, with a short recovery time after losing the image. Apart from that, the size of the scanner head and the entire device, as well as its weight, influence ergonomics. These characteristics are complemented by the ease of both the hardware and software, which simplify scanning, processing and overall workflow, as well as export feasibility. Currently, most scanners are open-type, allowing the export of STL, OBJ and/or PLY files (4).

Additionally, factors such as subscription requirements and technical support, price, autoclavable scanning tips, touchscreen functionality, wireless scanner, caries detection capability, and CAD integration are considered. Other aspects include software functions that facilitate the analysis and feedback of students' preparation based on a master image, making it a valuable pedagogical tool (5).

In this regard, it is important to investigate the effectiveness of the different IOS currently available to assist clinical professionals and professors in selecting

a device that best suits their needs. The objective of this study was to determine the effectiveness of the Primescan Dentsply Sirona® and Virtuo Vivo Straumann® IOS among first-year students specializing in Occlusion and Oral Rehabilitation at a private university in Lima.

MATERIALS AND METHODS

This was a cross-sectional study conducted within a first-year course of the specialty of Oral Rehabilitation at the Faculty of Stomatology of a private university in Lima. All enrolled students, aged between 26 and 36 years, were invited to participate. A convenience sampling method was used due to limited access to the IOS. Finally, the sample consisted of 10 participants. The inclusion criteria were as follows: voluntary consent to participate in the study, full attendance at all training sessions, scanning with both IOS devices, and completion of the questionnaire. The training was conducted by a single professor with expertise in the operation of both IOS. The content was theoretical-practical and was taught in 4 sessions of 6 hours each, as detailed below.

First session

Theoretical content included the history of the digital workflow, the history and definition of CAD/CAM, data collection through scanners, typology (intraoral, extraoral and laboratory), the most used systems, usage strategies, impression technology, and milling systems. In the practical component, training was scheduled for the recognition of both types of scanners and the milling machine, as well as a demonstration of use and practice in models with both systems.

Second and third session

An hour of theory on scanning strategies for single-unit fixed prostheses, inlays, bridges and partial and complete edentulous cases. The practical component involved paired use of the Virtuo Vivo Straumann® and Primescan Dentsply Sirona® intraoral scanners.

Fourth session

Theoretical content of milling with various materials, design, staining, polishing and finishing, along with corresponding practical demonstration.

At the end of the training, students performed two digital impressions of an upper model prepared for a bridge, two crowns and two inlays using both IOS

devices. Right after, using their cell phones, they answered a five-question questionnaire via Google form to anonymously gather their perception about ergonomics, speed, scanning flow, image sharpness, and their preference between both devices—criteria that are considered when selecting a scanner (4). Each question had two response options: IOS Virtuo Vivo Straumann® and PrimeScan Dentsply Sirona®. The questionnaire was validated by four professors in charge of the IOS. The student took about 3 minutes to complete it. A descriptive analysis was conducted, and the results were presented in a frequency table.

Table 1. Perceptions about the effectiveness of both scanners evaluated.

Features	Scanner			
	Virtuo Vivo Straumann®		PrimeScan Dentsply Sirona®	
	n	%	n	%
Scanning speed	2	20.0	8	80.0
Scanning flow	0	0.0	10	100.0
Ergonomics	10	100.0	0	0.0
Image sharpness	4	40.0	6	60.0
Preference in general	9	90.0	1	10.0

DISCUSSION

The use of IOS is a practice that is spreading around the world, replacing conventional impressions. This is evidenced by a transnational research study that included professionals and auxiliary staff from 109 countries, reporting that 78.8% use IOS in their daily work, with the most commonly used being the Medit i700® and the Primescan Dentsply Sirona® (6).

The wide variety of IOS available makes their selection a complex and subjective challenge (7). Although numerous studies compare digital impressions with conventional ones and assess the accuracy and veracity between different brands (8, 9), it is necessary to investigate other aspects to facilitate the choice of the appropriate scanner. This is especially important to meet the needs of professionals and enhance the learning experience of dental students.

The Primescan Dentsply Sirona® features a sensor that processes more than one million 3D points per second. Apart from that, its dynamic depth scanning technology is responsible for its accuracy and sharpness in image acquisition. Its software technology rapidly processes a larger volume of data and with higher resolution, integrating more than 50,000 images per second (Figure 1). The device weighs between 457 and

RESULTS

It was found that postgraduate students perceive that the PrimeScan Dentsply Sirona® IOS has a higher speed (80.0%; $n = 8$), a higher flow in scanning (100.0%; $n = 10$) and generates higher sharpness images (60.0%; $n = 6$). On the other hand, 100.0% ($n = 10$) of students consider that the Virtuo Vivo Straumann® IOS is the most ergonomic and, overall, 90.0% ($n = 9$) prefer it (Table 1).

524.5 g, depending on the material of the protective sheath (7) (Figure 2).



Figure 1. Comparison of the accuracy of both IOS:

- A) Primescan Dentsply Sirona® shows greater accuracy;
- B) Virtuo Vivo Straumann®.

Meanwhile, the Virtuo Vivo Straumann® IOS weighs 130 grams and has a length of 207 mm, allowing for a pen-like grip (Figure 2). As for the speed in obtaining the image, this device captures data from different angles simultaneously due to its two small 3D scanners (8) (Table 2).

Table 2. Comparison of Virtuo Vivo Straumann® and Primescan Dentsply Sirona® Scanners (9).

Features	Scanner	
	PrimeScan Dentsply Sirona®	Virtuo Vivo Straumann®
Scanning speed	+++++	+++
Scanning flow	+++++	++++
Scanner size	+	+++++
Ease of use	+++++	++++
Investment	\$\$\$\$\$	\$\$

Source: Own preparation based on information provided by the Institute of Digital Dentistry (9) in the Review of the Intraoral Scanners in 2019.

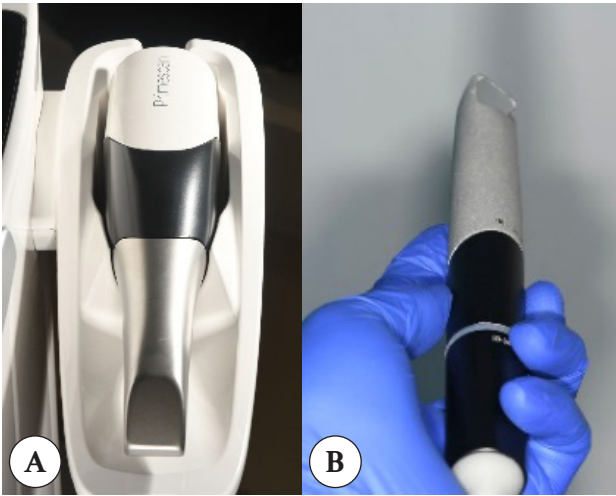


Figure 2. Size comparison of both IOS: A) PrimeScan Dentsply Sirona® weighs 457-524.5 g, has a length of 25.4 cm, and a tip of 2.75 cm wide; B) Virtuo Vivo Straumann® weighs 130 g and has a length of 20.7 cm.

In this study, most participants perceived that Primescan Dentsply Sirona® offers a higher scanning speed. This finding aligns with the results of a study where 121 users rated it with a score of 4.52 for speed, compared to 3.56 given by 16 users of the Virtuo Vivo Straumann®, on a scale where 5 represented the highest speed (6). In addition, the Institute of Digital Dentistry awarded the Primescan Dentsply Sirona® a score of 5 points in speed, compared to 3 points for the Virtuo Vivo Straumann® (9).

Another aspect to consider when selecting an IOS is the scanning flow, which refers to the smoothness of image acquisition, including the ability to capture images in hard-to-reach areas, the recovery time in the event of an interruption, and the frequency of this loss of continuity (4). In the sample, all students agreed that the Primescan Denstply Sirona® IOS provides a

better scanning flow, which is consistent with the 2019 report from the Institute of Digital Dentistry (9), which rated it with 5 points, while the Virtuo Vivo Straumann® received a score of 4 points.

The use of IOS can result in muscle fatigue, especially with heavier scanners (10). In this study, all students considered that the smallest IOS (Virtuo Vivo Straumann®) is the most ergonomic. This result aligns with the findings reported by the Institute of Digital Dentistry (9), which awarded it 5 points for its size, whereas the Primescan Dentsply Sirona® received only 1 point in the same criterion. Ergonomics is assessed by the weight and circumference of the scanner tip. Additionally, more compact designs facilitate scanning in difficult areas, improving both patient and operator's comfort, and resulting in more accurate and clinically successful digital impressions (10).

Students said that the PrimeScan Dentsply Sirona® IOS produced higher-quality images. This perception is consistent with several publications that report that this device offers better accuracy and veracity than the Virtuo Vivo Straumann® (11, 12). A desired feature of IOS is the ability to obtain accurate images, regardless of the extent of the area being scanned, while also ensuring a simplified workflow. However, not all devices adapt to different clinical needs (11).

Most of the students who participated in this research study expressed their preference for the Virtuo Vivo Straumann® IOS, a result that differs from the transnational study, which found that the three most commonly used scanners were the Medit i700® with 179 users, followed by the 3 Shape TRIOS 3® with 162 users, and the Primescan Dentsply Sirona® with 121 users, whereas the Virtuo Vivo Straumann® only had 16 users (6). This difference could be explained by the limitations in our setting for access to this variety of IOS.

The participants did not receive training in this technology during their undergraduate studies; however, they demonstrated a positive attitude toward its use, adopting it with relative ease. This coincides with some research studies that report that students perceive digital impressions as faster and easier as conventional ones (12). This positive attitude toward technology is influenced by access to it (13); in this regard, the preference for the Virtuo Vivo Straumann® IOS over the Primescan Dentsply Sirona® could be attributed to its affordability.

Students' perception of IOS helps when choosing the scanner that best suits their clinical and educational needs. A limitation of this study was the small sample size, which may be attributed to the fact that the use of these devices is introduced with the promotion of participating students. Therefore, it would be advisable to conduct future research with a representative sample.

CONCLUSIONS

The Primescan Dentsply Sirona® IOS was perceived as the scanner with the best scanning flow, the highest speed, and the highest image sharpness, while the Virtuo Vivo Straumann® IOS stood out for its ergonomics and was considered the preferred one by graduate students in Occlusion and Oral Rehabilitation.

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