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COMPARATIVE ANALYSIS OF SCANNING ACCURACY USING TWO INTRAORAL SCANNERS

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Introduction. In modern dentistry, there is an active introduction of digital technologies aimed at improving diagnosis and treatment outcomes. One of the key innovations in recent years has been the use of intraoral scanners and navigation templates, which allows for more accurate implantation planning, taking into account individual anatomy.

The aim of the work is to compare the accuracy of two intraoral scanners when creating digital impressions in patients with partial tooth loss.

Objects and methods. Two intraoral scanners were compared: TRIOS 3 (3Shape A/S, Copenhagen, Denmark) and Medit I700 (Medit Corp, Seoul, South Korea). The classic two-layer dental impressions of the patients (18 people) were removed, plaster models were cast from the impressions. The models were scanned with a laboratory scanner (ATOS Blue Light Triple Scan III, Germany) to obtain reference digital data. Next, the patients' dental rows were scanned on two intraoral scanners. A three-dimensional evaluation of the accuracy of intraoral scanners was performed in specialized software (Geomagic Qualify, 2013, Morrisville, North Carolina).

Results. The smallest arithmetic mean of all deviations was obtained using a TRIOS 3 scanner (0.005 ± 0.271 mm). The smallest standard deviation in accuracy measurements was found in the Medit I700 (0.142 ± 0.141 mm) ($p > 0.05$).

Conclusion. Given the limitations of the study, both intraoral scanners demonstrated clinically acceptable scanning accuracy results (at least 0.2 mm), with no statistically significant difference.

Keywords: intraoral scanning; scanners; accuracy comparison.

СРАВНИТЕЛЬНЫЙ АНАЛИЗ ТОЧНОСТИ СКАНИРОВАНИЯ С ПОМОЩЬЮ ДВУХ ВНУТРИРОТОВЫХ СКАНЕРОВ

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Введение. В современной стоматологии происходит активное внедрение цифровых технологий, которые направлены на улучшение диагностики и результатов лечения. Одним из ключевых новшеств последних лет стало применение внутриротовых сканеров и навигационных шаблонов, что позволяет точнее планировать дентальную имплантацию с учетом индивидуальной анатомии.

Цель работы — провести сравнение точности двух внутриротовых сканеров при создании цифровых оттисков у пациентов с частичной вторичной адентией.

Объекты и методы. Было проведено сравнение двух внутриротовых сканеров: TRIOS 3 (3Shape A/S, Копенгаген, Дания) и Medit I700 (Medit Corp, Сеул, Южная Корея). Выполнено снятие классических двухслойных оттисков зубных рядов 18 пациентов, с последующим изготовлением гипсовых моделей. Последние отсканировали лабораторным сканером (ATOS Blue Light Triple Scan III, Германия) для получения эталонных цифровых данных. Далее, зубные ряды пациентов были отсканированы на двух внутриротовых сканерах. В специализированном программном обеспечении (Geomagic Qualify, 2013, Моррисвилл, Северная Каролина) была произведена трехмерная оценка точности внутриротовых сканеров.

Результаты. Наименьшее среднее арифметическое всех отклонений было получено с помощью сканера TRIOS 3 (0,005 ± 0,271 мм). Наименьшее среднеквадратическое отклонение в измерениях точности было выявлено у Medit I700 (0,142 ± 0,141 мм) ($p > 0,05$).

Заключение. Учитывая ограничения исследования, оба внутриротовых сканера продемонстрировали клинически приемлемые результаты точности сканирования (не менее 0,2 мм), без статистически значимой разницы.

Ключевые слова: внутриротовое сканирование; сканеры; сравнение точности.

Introduction. Modern dentistry is at the stage of active implementation of digital technologies, which significantly improve the processes of diagnosis and treatment. Digitalization not only optimizes work processes, but also increases accuracy, predictability and comfort for doctors and patients. One of the most significant achievements of recent years is the use of intraoral scanners, which significantly expand the possibilities of planning dental manipulations, as well as surgical navigation templates that help to perform implantation surgery more accurately and safely, taking into account the peculiarities of the patient's anatomy. In turn, the digital impressions obtained using these scanners surpass traditional methods in such aspects as measurement accuracy, speed of obtaining results, comfort for the patient, and also facilitate the process of interaction between the dentist and the dental technician, reducing time costs and increasing work efficiency [1].

The aim of the work is to conduct a comparative assessment of the accuracy of two intraoral scanners when creating digital impressions in patients with partial tooth loss.

Objects and methods. Two intraoral scanning devices were compared: TRIOS 3 (3Shape A/S, Copenhagen, Denmark) and Medit I700 (Medit Corp, Seoul, South Korea). Digital files obtained by laboratory scanning of analog plaster models were used as a reference. The classic two-layer dental impressions of the patients (18 people) were removed, plaster models were cast from the impressions. The models were scanned with a laboratory scanner (ATOS Blue Light Triple Scan III, Germany) to obtain reference digital data. Next, the patients' dental rows were scanned on two intraoral scanners. A three-dimensional assessment of the accuracy of intraoral scanning devices was performed in specialized software (Geomagic Qualify, 2013, Morrisville, North Carolina), where all scan data sets were uploaded.

Results. According to scientific literature, the TRIOS 3 intraoral scanner demonstrated the lowest mean deviation, measured at 0.005 ± 0.271 mm. Meanwhile, the Medit I700 exhibited the lowest standard deviation (0.142 ± 0.141 mm) when assessing the accuracy between reference datasets and the corresponding intraoral scans ($p > 0.05$). A comparison with the limited number of previously published studies on the accuracy of digital dental impressions suggests improved performance in the present study.

For example, Imburgia M. et al. observed a minimum mean deviation of 0.05 mm for TRIOS 3, while the current study demonstrated an even lower value of 0.03 mm [2]. Michelinakis G. et al. also identified TRIOS 3 as the most accurate scanner, though no statistically significant difference was found between TRIOS 3 and Medit I700, which aligns with our results [3].

Two recent investigations comparing laboratory and intraoral scanners reported high accuracy for the Medit I700, reaching deviations as low as 0.02 mm — slightly better than the average value obtained in our study (0.05 mm) [4]. Discrepancies between our results and those of previous studies may be attributed to recent technological advancements in newer scanner generations, differences in operator technique, and variation in scanning strategies. It is also important to note that in vivo scanning results may be affected by factors such as the presence of saliva or blood, mucosal mobility, patient movement, clinician experience, and differences in the extent and location of the scanned area [5].

According to the literature, a deviation of up to 0.2 mm is considered clinically acceptable for full-arch scans [5]. The results of this study confirm that the evaluated intraoral scanners are suitable for clinical application, and the obtained digital models are appropriate for use in surgical planning, including procedures involving guided navigation protocols.

Conclusion. Given the limitations of the study, both intraoral scanners demonstrated clinically acceptable scanning accuracy results (at least 0.2 mm), with no statistically significant difference.

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МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ
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