Opinion
by
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on a dissertation for the award of a educational and scientific degree "Doctor"

Author: Dr. Gabriela Rosenova Kirova
Topic: „Laboratory investigation of the accuracy of cemented suprastructures on abutments manufactured using different impression taking protocols"

The thesis presented to me for review contains 190 standard typewritten pages with a bibliography consisting of 299 authors, of which 23 in Cyrillic script and 276 in Latin script, and 3 appendices. It is illustrated with 105 figures and 20 tables. The dissertation is well structured, which facilitated the review preparation.

The **Introduction** emphasizes the fact that

Currently, the issue of implant-prosthetic treatment (IPT) for defects of the dental arches (DDA) is highly relevant. This approach offers several advantages, the most significant from a preventive standpoint being the prevention of bone loss around functionally loaded implants, improvement of masticatory efficiency, and restoration of occluso-articulatory balance, which significantly increases patient comfort.

(IPT) using digital technologies has also made significant progress in recent years, displacing analog methods. Digital technologies are integrated throughout the entire process of creating prosthetic restorations, from the clinical stage of taking impressions, through planning the design in software, to its manufacturing using various methods.

The continuous improvement of digital technologies have necessitated more in-depth research into the accuracy of implant superstructures made using subtractive and additive methods.

The above facts give grounds for the candidate to formulate:

The aim of the dissertation is to conduct a comparative assessment of the accuracy of superstructures fabricated using different methods and impression taking protocols, cemented onto abutments, and measured on microsections of laboratory micro-grinds.

In order to meet the set aim, **5 tasks** have been formulated and completed.

Task 1

Survey Study

1.1. Conduct a survey among doctors of dental medicine regarding their awareness and preferences for impression techniques for transferring implant superstructures.

1.2. Conduct a survey among dental technicians regarding their awareness of protocols for transferring implant positions and fabricating fixed restorations on implant supports.

Task 2: Comparative Assessment of the Accuracy of Implant-Supported Superstructures which involves measuring the thickness of the cement layer in copings transferred using two methods with an intraoral scanner and made from zirconium dioxide via subtractive technology.

2.1. Directly scanned abutment.

2.2. Directly with a scan body.

Task 3: Comparative Assessment of the Accuracy of Implant-Supported Superstructures which involves measuring the thickness of the cement layer in copings transferred using two methods with an intraoral scanner and made from Co-Cr alloy via additive technology—selective laser melting (SLM).

3.1. Directly scanned abutment.

3.2. Directly with a scan body.

Task 4. Comparative Assessment of the Cement Layer Thickness between copings transferred using scan bodies and directly scanned abutments with an intraoral scanner, comparing subtractive and additive technologies

The materials and methods of the study are correctly and adequately selected, the use of a sufficient number of modern **statistical methods** for processing the obtained data ensures that reliable and objective **results** are attained.

The important results of the study are defined as:

Task 1

As a result of the conducted survey among dentists, it was found that most of those who fabricate prosthetic constructions on implant supports still prefer to work with the conventional method in their practice.

A larger proportion of clinicians prefer using the conventional open tray transfer impression for transferring implant supports to the dental laboratory, compared to the digital method that employs an intraoral scanner and scan body.

most clinicians using intraoral scanners encounter challenges during their work. A significant percentage (half) of participants struggle to identify the factors causing these difficulties and the specific areas of the prosthetic field that are hard to scan adequately. Frequently mentioned problem areas include the margin and proximal zones, likely due to the limited access to light in these regions of the prosthetic field.

Dentists notes that not all dental technicians in laboratories utilize scan bodies during extraoral scanning.

Task 2

The accuracy of constructions in the marginal area is crucial for the success of prosthetic treatment. Greater discrepancies in this area increase the susceptibility of the cementing agent to dissolution by oral fluids.

The manufacturing techniques, the type of material used, the milling process with different bur diameters, and the sintering cycles can all influence the results. These factors may lead to shrinkage, which can subsequently affect marginal adaptation.

The study indicates that using scan bodies during the scanning phase results in cement thickness in marginal area values below the critical of 100 microns. This suggests that this scanning method allows for more accurate and controlled positioning of the constructions, which can reduce the risk of subsequent complications and ensure clinical success

Task 3

Regarding the fit accuracy, it was found that the group of scanned analogs demonstrated better results. In all measurements, the results were consistent, with no significant deviations observed. In the group of scanned abutments, the measured values were higher. Additionally, in this group, a difference was

observed between the values on the side of the connecting beam and the opposite side at the base and middle of the axial wall.

The specifics of the manufacturing process and technological regimen play a crucial role in creating constructions with minimal defects. Additionally, parameters such as laser power, scanning speed, particle size of the powder, the step between individual layers, and their thickness can cause uneven melting of the powder particles, which may affect the accuracy of the objects.

The comparative analysis shows a difference in the measurements between the medial and distal walls in the group of scanned abutments.

From the analysis of the results, it becomes clear that in the group of scan bodies, no significant differences are observed between the medial and distal walls of the supports. The same parameters were used for all test bodies during the software modeling stage of their design, as well as in the subsequent stages of the manufacturing process.

Task 4

method using scan bodies and both production technologies provides less marginal discrepancy, which reduces the chance of cement dissolution and inflammation of the soft tissues. This is extremely important in prosthetic constructions supported by implants. Additionally, the indicators regarding internal fit in this group are also better.

The results of the research give the doctor reason to draw the following important **conclusions:**

1. Despite the widespread adoption of modern digital technologies, most of the surveyed dental practitioners still prefer conventional working methods.
2. Most of the surveyed dentists cannot determine whether there is a difference in the accuracy of restorations produced through digital protocols compared to traditional methods.
3. Most dental laboratories perform the scanning at the cast stage with a pre selected abutment.
4. It is necessary to standardize and optimize the methods for transferring information between dental laboratories and dental practices, which can serve as a basis for future research aimed at improving communication and the precision of prosthetic construction fabrication.
5. A statistically significant difference has been established between the groups of scanned bodies and scanned abutments.

6. The use of scan bodies provides better marginal adaptation and accuracy of fit for implant suprastructures compared to scanning abutments, in both milling and selective laser melting technologies.

7. The geometry and optical properties of scan bodies ensure higher scanning precision and more accurate transfer of the implant position compared to scanning abutments.

8. It has been established that in the group of scanned abutment, the marginal fit accuracy shows higher values with both milling and selective laser melting technologies. These values are within clinically acceptable limits (under 100 μm).

9. It has been proven that the method of scan bodies provides higher accuracy compared to the method of scanning abutments.

10.It has been established that the fitting accuracy in both scanning methodologies and both manufacturing technologies is within the acceptable limits, providing marginal adaptation within the clinically acceptable threshold of 100 μm and fitting accuracy of less than 200 μm. The combination with the highest accuracy is the use of a scan body and milling, followed by scanned abutment and milling, scan body and selective laser melting, and finally scanned abutment and selective laser melting.

The more important **contributions** of the dissertation can be grouped as:

Scientific and applied contributions

Original contributions

1.For the first time in our country, a methodology has been developed to standardize the technology for investigating the adaptation accuracy of fixed superstructures using a machine for hard cuts.

2. It has been established that the strategy using a scanning analogue provides higher accuracy compared to the method of scanning the abutment.

3. It has been established that the marginal adaptation and fit accuracy, which need to be ensured during treatment with implant superstructures, are achieved with both scanning methodologies and manufacturing technologies. The combination of the scanning method and the manufacturing process are ranked according to the achieved accuracy. First is the group of scan body and milling, followed by scanning of abutments and milling, scan body and selective laser melting, and scanning of abutments and selective laser melting.

Confirming contributions:

1. The use of scan bodies provides better marginal adaptation and fit accuracy of implant suprastructures compared to scanning abutments, and this applies to both manufacturing technologies—milling and selective laser melting.
2. The geometric and optical characteristics of the scan bodies are key factors influencing the achievement of higher scanning precision and more accurate transfer of implant positions compared to abutments.

Applicable contributions:

1. A newly developed methodology for creating spicemens for studying marginal adaptation and fit accuracy has been proposed, which can be used for future similar studies.
2. A classification of the combination of scanning method and manufacturing technology based on fit accuracy has been proposed, which can be successfully utilized in clinical practice

Assessment of publication activity

In connection with the dissertation, Dr. Kirova presents 3 publications. This fact proves that the topic developed in the dissertation is his personal work.

The author's summary objectively reflects the dissertation. It is drawn up in accordance to the requirements of the law for the development of the academic staff.

I have no critical remarks on the reviewed thesis.

Conclusion:

The thesis of Dr. Gabriela Rosenova Kirova is an depth laboratory investigation of the accuracy of cemented suprastructures on abutments manufactured using different impression taking protocols

The obtained results are valuable for clinical practice and can serve as a basis for future research.

I am confidently giving my positive vote for the award of the educational and scientific degree "Doctor" to Dr. Gabriela Rosenova Kirova.

Заличено на основание чл. 5, §1, б. „В“ от Регламент (ЕС) 2016/679

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(Prof. Yavor Kalachev, DMD, PhD)