The deviation between digital and silicone impression for abutment teeth

Thanh Hai Pham*, Nguyen Van Khai, Thị Huyen Nguyen

ABSTRACT

The advancement of intraoral scanners has allowed for more efficient workflow in the dental practice. The aim of this research was to analyze the impression deviation between intraoral scan technique and conventional polyvinyl siloxane (PVS) material by 3D software. A case series study was performed with 16 teeth. Tooth preparation was taken with supra- or level- gingival heavy chamfer finishing line, then all samples were taken impression using either digital intraoral scanner (Trios 3th generation, 3Shape, Denmark) (group A) and PVS material (Silagum, DMG, Germany) (group B). The analysis was performed on the abutment teeth with parameters: the number of different areas, the deviation level of the surface area, the disparity value in 3 spatial dimensions. Result showed a notably difference between the two impression methods.

Keywords: *impression, digital, silicon, intraoral scanner*.

Hai Phong University of Medicine and Pharmacy, Hai Phong, Vietnam

*** Corresponding author**
Thanh Hai Pham
Email: pthai@hpmu.edu.vn

Received: April 24, 2023
Reviewed: May 06, 2023
Accepted: June 20, 2023

INTRODUCTION

Taking impression is an important step in the dental restoration process. It helps to copy exactly characteristics of teeth, soft tissue, arch and anatomical landmarks.

In the past, dentists have taken impression with primitive materials and instruments: rulers, compasses, cardboard, acrylic resin, plaster… and polyvinyl siloxane (PVS) invented in 1955 [1]. Till now, taking impression with PVS is still widely used due to its convenience, accuracy, and affordable cost. However, it has still some weaknesses, like causing inconvenience to patients, deformation and infection.

During the last decade, digital impression systems have improved substantially. The advancement of intraoral scanners has allowed for more efficient workflow in the clinical setting by shortening treatment time, bringing comfort to both patients and doctors [2]. In Viet Nam, this is a fairly new technique, has not been widely used and studied.

Therefore, the aim of this research was to analyze the impression deviation between intraoral scan and conventional polyvinyl siloxane (PVS) material with 3D software at Haiphong Medical University Hospital.

MATERIALS AND METHODS

Subject

Criteria for selected teeth: having opposing teeth, physical contact with adjacent teeth, and indication for prosthetic restoration. Patients were explained about the aim of this study and signed in the consent form.

Taking impression process

Sixteen teeth were prepared with supra- or level-gingival heavy chamfer finishing line. Then all samples were taken impression using either a digital intraoral scanner (Trios 3rd generation, 3Shape, Denmark) (group A) and PVS material (Silagum, DMG, Germany) (group B).

Research variable

The number of different areas: The abutment images scanned by intraoral scanner and silicon model were superimposed by Exocad 3.0 software then the number of gradient regions was analyzed.

The deviation level of the surface area: The surface area of abutment teeth was measured by Materialize Magic 21.0 software to compare between two impression methods.

The disparity in 3 spatial dimensions: It was performed with Materialize Magic 21.0 software. Each subject has three values: x, y, and z

"x": buccal–lingual distance

"y": mesial – distal distance

"z": finishing line – upper surface distance

RESULTS

Table 1. *The number of different areas of abutment teeth taken by silicon and intraoral scan impression*

The number of different areas	n	%
2	4	25
3	5	31.25
4	3	18.75
5	4	25
$\underline{X} \pm SD$	3.4375 ± 1.153	

There is a certain deviation between the conventional impression by silicon and digital impression by intraoral scanner, the average of different areas is 3.4375 ± 1.153.

Table 2. *Surface areas of abutment teeth taken by silicon and intraoral scan impression*

$(DT_{Silicon} - DT_{scan})$	n	%
<0	13	81.25
>0	3	18.75

81.25% of cases using intraoral scan have a smaller surface area of abutment teeth than in group taken by silicon impression.

Table 3. *The deviation level of surface area of abutment teeth was taken by 2 methods.*

Deviation level $\lvert DT_{Silicon} - DT_{Scan} \rvert$	**n**	**%**
<1 mm^2	7	43.75
1 – 5 mm^2	4	25
>5 mm^2	5	31.25

The deviation of surface area of abutment teeth taken by silicon and intraoral scan less than 1mm is accounting for the most with 43.75%. However, the deviation of more than 5mm also reached 31.25%.

Table 4*. The disparity value in 3 spatial dimensions of abutment teeth taken by 2 methods.*

Value $\lvert Silicon - Scan \rvert$	**Min (mm)**	**Max (mm)**	$\underline{X}$ **(mm)**	**SD (mm)**
x	0.004	2.502	0.664	0.681
y	0.003	2.719	0.492	0.744
z	0.013	2.221	0.575	0.537

The disparity of 2 methods was observed in all 3 spatial dimensions with the highest difference at x-axis (0.664±0.681).

DISCUSSION

In our research, a certain deviation between the conventional impression by silicon and digital impression by intraoral scanner was showed by the number of gradient regions. In the Yang X's study, to assess precision, deviations among repeated scan model, color-coded difference images were offered [3].

In the outcome of Jeong-Hyeon Lee's study [4], when checking certain deviation of impression between silicon and intraoral scanner, they used ceramic crowns and evaluated clinical criteria such as internal fitness, marginal fitness [5], treatment comfort, bite scan, total treatment time [6]. However, it may create errors during designing and milling.

In our research, to avoid errors from crown designing and milling, we directly evaluated deviation of abutment teeth scanned by either intraoral scanner and silicon model by Materialize magic software. The analysis was performed on the abutment teeth with parameters: the number of different areas, the deviation level of the surface area, the disparity value in 3 spatial dimensions. It helps to shorten the steps and limit the errors for the study.

CONCLUSION

There is a notably difference between silicon and digital impression demonstrated by the number of different areas, the deviation level of the surface area and the disparity value in 3 spatial dimensions.

CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

REFERENCE

1. Nguyen Van Bai. Fixed prosthetic. Hanoi medical university. Publishers Education Edition; 2020.
2. Dao Ngoc Lam. Dental CAD/CAM technology: A story of past and present. Dental update journal; 2016.
3. Yang X, Lv P, Liu Y, Si W, Feng H. Accuracy of Digital Impressions and Fitness of Single Crowns Based on Digital Impressions. Materials (Basel). 2015 Jun 29;8(7):3945-3957.
4. Lee JH, Son K, Lee KB. Marginal and Internal Fit of Ceramic Restorations Fabricated Using Digital Scanning and Conventional Impressions: A Clinical Study. J Clin Med. 2020 Dec 14;9(12):4035.
5. Wu J, Xie H, Sadr A, Chung KH. Evaluation of Internal Fit and Marginal Adaptation of Provisional Crowns Fabricated with Three Different Techniques. Sensors (Basel). 2021 Jan 22;21(3):740.
6. Yuzbasioglu E, Kurt H, Turunc R, Bilir H. Comparison of digital and conventional impression techniques: evaluation of patients' perception, treatment comfort, effectiveness and clinical outcomes. BMC Oral Health. 2014 Jan 30;14-10