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"PROF. DR. PARASKEV STOYANOV" – VARNA

Faculty of Dental Medicine

Department of DENTAL MATERIALS SCIENCE AND PROSTHETIC DENTAL MEDICINE

Magdalena Norman Gugleva

ALTERNATIVE TOOTH PREPARATION METHODS FOR FULL COVERAGE CROWNS

Abstract

Of PhD Thesis

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Scientific Advisor:

Assoc. Prof. Dr. Iveta Plamenova Katreva, DMD, PhD

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The dissertation contains 192 pages and is illustrated with 12 tables, 161 figures and 4 applications. The bibliography consists of 352 sources, 32 of which in Cyrillic and 320 in Latin.

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Scientific jury:

Chair:

Prof. Dr. Metodi Zahariev Abadzhiev, DMD, PhD, DSc

Members:

1. Prof. Dr. Bozhidar Ivanov Yordanov, DMD, PhD
2. Prof. Dr. Hristo Kalchev Kisov, DMD, PhD
3. Assoc. Prof. Dr. Stefan Chavdarov Zlatev, DMD, PhD
4. Assoc. Prof. Dr. Desislava Atanasova Konstantinova, DMD, PhD

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Note: In the abstract, the numbers of the tables and figures do not correspond to the numbers in the dissertation

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ABBREVIATIONS USED

BOPT – Biologically oriented preparation technique

BP – bacterial plaque

BW – biological width

CEJ – cemento enamel junction

DMD – doctor of dental medicine

FDP – fixed dental prosthesis

FGM – free gingival margin

FL – finish line

GS – gingival sulcus

HDT – hard dental tissues

PDM – prosthetic dental medicine

PMMA – polymethyl methacrylate

CAD/CAM – computer-aided design and computer-aided manufacturing

PVES – polyvinyl ether siloxane

PVS – polyvinyl siloxane

STL – Standard Tessellation Language (stereolithography)

I. INTRODUCTION

Tooth preparation for full coverage crowns as part of the prosthetic treatment plan is an invasive procedure that involves the irreversible removal of hard dental tissues (HDT). That is why the indications for such treatment are strictly dependent on prophylactic, functional and aesthetic criteria, the observance of which is the duty of every doctor of dental medicine (DMD).

Patients in the prosthetic dental practice over the last decade are becoming increasingly informed and demanding people, driven by a desire for supreme aesthetics and no small amount of vanity. This faces us, doctors of dental medicine (DMD), with the challenge of solving questions related not only to the color, shape and position of the teeth, but also to the beauty and harmony of the surrounding soft tissues. In fixed prosthodontics in the visible area of the dentition is important both to restore function and to achieve highly aesthetic results with long-lasting and biocompatible materials.

Modern prosthetic treatment with fixed dental prostheses is necessary to ensure a harmonious relationship between restorations and the gingival tissues. A common cause of local damage of the periodontium is inaccurate fixed prosthetic restorations. Creating a prosthetic treatment plan with a predictable prognosis requires a knowledge of soft tissue reactions. Stable and healthy gingiva is a desired periodontal response and at the same time a guarantee for a successful aesthetic clinical result in a long-term.

In 2008, Ignazio Loi described and introduced the "biologically oriented preparation technique" (BOPT), which involves tooth preparation, deepithelialization of the gingival sulcus (gingitage), and placement of specifically shaped temporary restorations. The clinical advantages of the technique include: a more conservative preparation, fast and ease to execute, easy relining of the temporary crowns; and simplified impression taking technique. The method allows to create a new emergence profile, leading to an increase in the volume of gingival tissues, coronal migration and adaptation of the free gingival margin, and stability of soft tissues in a long-term.

The advantages of the method are the reason why the technique become more popular among dentists and make it preferred choice for fixed prosthetics in the aesthetic area.

II. PURPOSE AND TASKS

II.1. PURPOSE

To prove the advantage of the biologically oriented preparation technique in prosthetic treatment with full coverage crowns in the aesthetic area and to evaluate the clinical results of its application.

II.2. TASKS

1. To follow the periodontal response during the treatment with full coverage crowns after temporary restorations fabricated by direct-indirect method with the "egg-shell" technique.

2. To follow the periodontal response during the treatment with full coverage crowns after temporary restorations fabricated by indirect digital method.

3. To develop an algorithm for fabrication of provisional restorations by direct-indirect method with "egg-shell" technique in BOPT.

4. Conducting a survey:

4.1.Among doctors of dental medicine regarding awareness of BOPT and the possibility of guiding the gingival contour by the emergence profile of full coverage crowns.

4.2 Among dental technicians regarding awareness of fabrication of fixed dental restorations on teeth prepared by BOPT.

III. MATERAILS AND METHODS

The current dissertation includes a clinical study, conducted in Varna, Faculty of Dental Medicine, Department of Dental materials science and prosthetic dental medicine" and "AGPPDP - Varna" Ltd.

Participants are informed in detail about potential risks and benefits. All of them provide a written consent to participate in the scientific research by signing an informed consent form.

The research protocol was reviewed and approved by the Ethics Committee for Scientific Research at the Medical University of Varna.

To achieve the first and second tasks, a total of 34 patients within the age range of 29 to 54 years are examined, including 12 females and 22 males. The total number of prepared teeth is 66, comprising 34 incisors, 6 canines and 26 premolars.

Temporary restorations for 17 patients are fabricated by direct-indirect method with the "egg-shell" technique, while for the remaining patiens - by indirect digital method. The final restorations are manufactured of zirconium dioxide. A specialized worksheet was prepared for recording and reporting results for each patient.

The patients are selected according to the following criteria after a preventive examination:

1. Inclusion criteria for participants in the study:

- individuals above 18 years old
- participants who have signed an informed consent
- patients with good or satisfactory oral hygiene
- patients with high aesthetic requirements
- patients with indications for treatment with fixed dental prostheses in the visible area of the dentition (incisors, canines, premolars), including patients with old fixed prosthetic restorations that are not compatible with biological, prophylactic, functional and aesthetic requirements and are indicated for replacement.
- patients for whom the prepared teeth do not require a long preprosthetic treatment (e.g. teeth with periapical lesions)
- patients without parafunctions

2. Exclusion criteria for participants in the study:

- persons under 18 years old
- patients who have not sign an informed consent
- patients with poor oral hygiene
- patients in the active phase of periodontal disease
- patients unwilling to be treated with fixed dental prostheses
- patients with infectious viral diseases
- patients with diabetes and blood disorders
- patients with tumor diseases

- patients requiring a long-term preprosthetic treatment
- patients with parafunctions

For the accomplishment of the third task, an algorithm was compiled for clinical relining of temporary restorations by using the "egg-shell" technique.

For the accomplishment of the fourth task, a total of 115 people were surveyed - 72 doctors of dental medicine and 43 dental technicians.

III.1. Materials and methods for Task 1

A widespread problem in prosthetic dentistry during treatment with FDP - crowns and bridges in the visible area of the dentition is the achievement of a satisfactory contour of the gingival tissues. A common cause of gingival inflammation and recession of the margo gingivalis is inaccurate and improperly fabricated restorations, combined with a poor oral hygiene. These complications usually occur within a short time after the end of treatment (3-6 months) and lead to dissatisfaction and disappointment of the patient **(Fig.1** and **Fig.2)**.

Fig.1 *Porcelain fused to metal full coverage crowns on teeth 11 and 21, which not correspond to prophylactic and aesthetic requirements.*

Fig.2 *The condition of teeth and soft tissues after removing the old restorations*

The clinical case, presented above is common in daily prosthetic practice. This fact motivates our team to explore the influence of “egg-shell” temporary restorations as a means of gingival remodeling. During execution of the task, the occurring changes or the so-called "periodontal response" during the treatmetnt with definitive FDP were tracked and analyzed.

For the performance of task 1, two-step two-layer impressions were taken with a stock tray and C-silicone from the upper and lower jaw (Zeta flow, Zhermack, Badia Polesine, Italy) and an occlusal registration with PVS impression material (Occlufast rock, Zhermack, Badia Polesine, Italy) in a state of central occlusion. Plaster casts are poured and scanned using an extraoral laboratory scanner (D850®, 3ShapeTM), and the digital design of the temporary egg-shell restorations is created using specialized CAD software 3Shape Dental System®.

The margins of provisional restorations are designed at the level of the margo gingivalis to provide space for the excess of self-polymerizing plastic during their clinical relinig. Preliminary temporary crowns are manufactured using subtractive method from PMMA, by milling machine, with an approximate wall thickness of 0.3 mm.

Since BOPT requires both removing of teeth structures and gingival deepithelialization, a preliminary measurement of the gingival sulcus depth with a periodontal probe is necessary before starting the preparation. The measurement is performed at six points for each tooth – three vestibular and three lingual. This is necessary to determine the level of epithelial attachment and the depth of preparation without invasing the biological width of the tooth.

The preparation of the teeth is performed with a 1:5 speed-up handpiece (Ti-Max X95L, NSK, Japan) and diamond burs with different abrasiveness: coarse (Axis Dental G863.012, G862.012, 868.534.023 , G368.023), medium (Axis Dental F863.012, F862.012, F368.023) and fine (Axis Dental C863.012, F862.012, G368.023) with an appropriate shape of their working part.

Initially, the axial walls of the teeth are trimmed supragingivally with a flame-shaped diamond bur (100/200 microns) with a diameter of 1.2 mm. The circumferential reduction is about 1.0 – 1.2 mm, and the incisal/occlusal reduction – between 1.5 - 2.0 mm.

For the subgingival preparation, the bur is introduced into the gingival sulcus at a depth of 1 mm below the level of the cemento enamel junction (CEJ) at an angle of 10-15°. During the preparation, removal of crown emergence profile and rotational curettage of the gingival epithelium, covering the inner wall of the sulcus, is performed. Part of the connective tissues attachment is also removed. Gradually, the diamond bur is positioned parallel to the longitudinal axis of the tooth (0°), to prevent the creation of a finish line.

To achieve a conical shape of the tooth and to ensure a correct path of insertion of the restorations, the bur is placed with a slight converging slope of 3-6° towards the incisal/occlusal surface (coronally). The axial walls of the prepared teeth have an average inclination of 6-8°. To smooth and refine the abutment teeth, all steps are repeated with finer burs.

The "egg-shell" temporaries are clinically relined in the oral cavity with dual-polymerizing acrylic (Tempsmart DC, GC, Japan). After their removal from the prosthetic field, two separated margins and a groove between them, representing a negative copy of the gingiva, are clearly defined. The outer edge corresponds to the contour of the marginal gingiva, and the inner one imprints the subgingival prepared surface of the tooth **(Fig.3 A)**. The space between the two margin is filled with a light cured flowable composite material (G-aenial Universal Flo, GC, Japan), thickening the crown margin and creating a new convex emergence profile **(Fig.3 B)**.

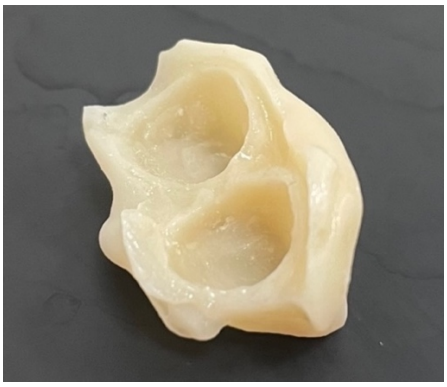
A)  **B)** 

Fig.3 *Temporary crowns after relining A)* ***Two clearly defined margins and space between them; B)*** *Filling the space with flowable composite.*

The excess material is removed. The temporary restorations are precisely shaped and a new emergence profile is created. **(Fig.4)**.

Fig.4 *Finished and polished temporary crowns with emergence profile*

The margin of the restorations is positioned at a depth of 0.5-1 mm within the gingival sulcus, preserving the biological width of the tooth. This also determines the level of the new prosthetic CEJ. The finished interim restorations, polished using a brush and paste, are cemented with non-eugenol temporary cement (DentoTemp Automix, Itena Clinical, France) for a period of 8 weeks **(Fig.5)**. Each patient has a control check-up after 5 days **(Fig.6)**.

Fig.5 *Cemented temporary crowns ot teeth 11 and 21*

A) 

B) 

Fig.6 *Contidition of gingival margin after 5 days* ***A)*** *Frontal view;* ***B)*** *Occlusal view.*

After the healing process, the conventional impressions for definitive FDP are taken with stock metal trays (Medesy, Impression trays, Italy) and polyvinylsiloxane (PVS) (Express™, 3M ESPE). A suitable-sized tray for the upper and lower jaw is selected for each patient. A one-step two-layer impression technique is applied.

Before taking the impressions, gingival retraction is performed using double-cord technique. The thickness of the cords is individually selected for each tooth, depending on the gingival biotype and the depth of the gingival sulcus (Ultrapak, Ultradent Products Inc., USA). The cords are impregnated with a 25% solution of aluminum trichloride (Alustat liquid, Cercamed, Poland). Using a specialized instrument - a packer, with a serrated working part (Pascal Retrax® System R-55 S/B #26-131) the smaller-sized cord (000) is placed at the bottom of the gingival sulcus, and above it - the larger-sized cord (00 or 0). By using this technique is achieved not only retraction of the gingival tissues, but also ensure a dry and clear view of the prosthetic field.

For the one-step two-layer impression, additive silicone material was used in two different consistencies - putty (Express ™ STD, 3M ESPE) and light body (Express ™ XT Light body, 3M ESPE). After removing the larger size cord, a light body is applied in the GS around the prepared teeth, while the putty is applied in the impression tray. After the setting time, recommended by the manufacturer, the impression is removed from the oral cavity. The smaller size retraction cord is also removed.

Occlusal contacts in state of the centric occlusion are registered using a PVS impression material (Occlufast rock, Zhermack, Dental Products, Italy). From the

antagonist teeth, a two-step two-layer impression is taken with a stock tray and C-silicone material (Zeta flow, Zhermack, Badia Polesine, Italy).

All applied materials follow the manufacturer's the instructions. Shade determination is done using the Vita Classic A1-D4 shade guide.

The impressions are scanned using an extraoral laboratory scanner (D850®, 3ShapeTM), and the digital design of the definitive FDP is created using specialized CAD software 3Shape Dental System®.

The permanent restrorations are made of multi-layered zirconium dioxide (DD cubeX2 ML, Dental Direkt, Germany) in full contour by subtractive technique using a milling machine (CORiTEC® 150i, Imes-Icore, Germany). After the milling process, the FDP are sintered in a special furnace (Amann Girrbach) and glazed.

The final fixed restorations were cemented with resin-modified glass ionomer cement (Fuji Plus, GC, Japan).

The periodontal response in each patient is assessed by measuring three indicators:

- presence or absence of bacterial plaque;
- bleeding on probing (BoP);
- thickness of the free gingival margin.

Measurements are performed at the following stages:

1. Before starting the treatment (T0);
2. 2 months after cementation of the temporary restorations (T1);
3. 6 months after cementation of the definitive restorations (T2).

The presence or absence of plaque is assessed and recored by scraping with a probe Hu-Friedy EPD6578XTS (Hu-Friedy, Chicago, ILL, USA).

The presence or absence bleeding on probing was determined using a periodontal probe (Hu-Friedy PCPUNC156). Probing in the gingival sulcus was performed at six points vestibular and lingual – medial, middle and distal for each tooth.

Measurement of the thickness of the free gingival margin was performed using 3Shape 3D Viewer® software. For this purpose, each patient was scanned with the intraoral scanning system TRIOS 3 (3Shape, Denmark) **(Fig.7)**.

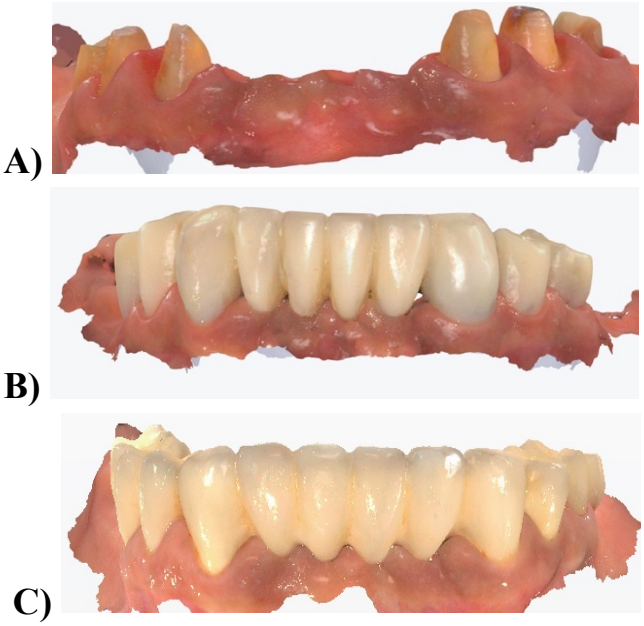


Fig.7 *Different stages of scanning.* ***A)*** *After preparation of abutment teeth;* ***B)*** *2 months after cementation of temporary restorations;* ***C)*** *6 months after cementation of definitive restorations*

Three -.stl files corresponding to the described three stages (T0, T1, T2) were obtained. Using Geomagic Control X 2022 software spatial orientation, the digital impressions are overlaid in order to ensure consistent orientation relative to the coordinate system **(Fig.8)**.

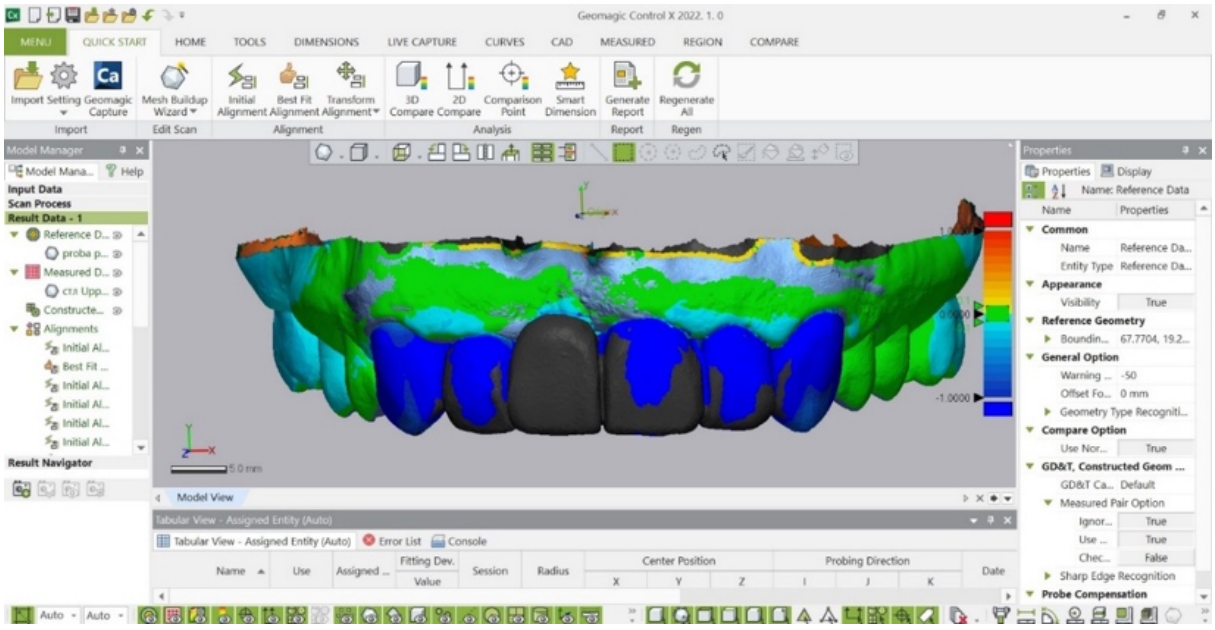


Fig.8 *Overlaid digital impressions using Geomagic Control X 2022*

The modified files are reproduced and analyzed with 3Shape 3D Viewer® dental software. Using the "2D Cross section" function, a longitudinal section is made at three points for each tooth - medial, central and distal **(Fig.9** и **Fig.10)**.

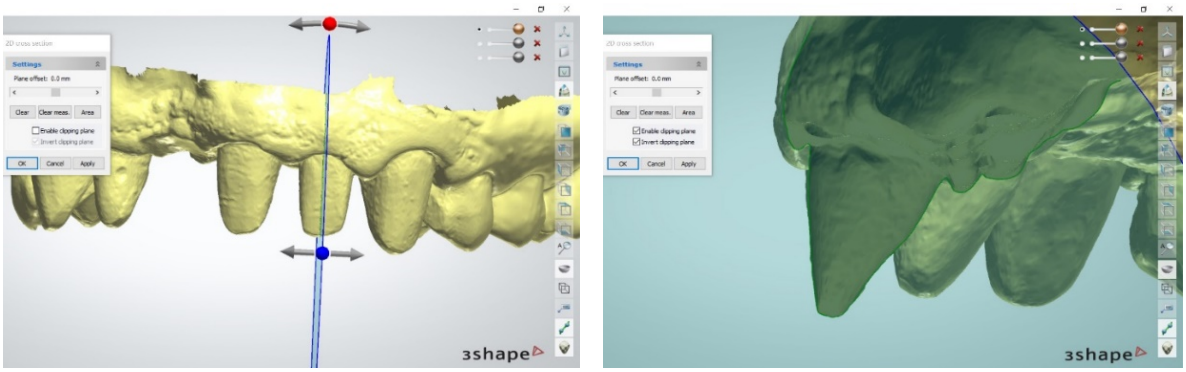


Fig.9 *Longitudinal section along the axial axis of tooth 22 after preparation.* ***A)*** *Frontal view;* ***B)*** *Sagittal view*

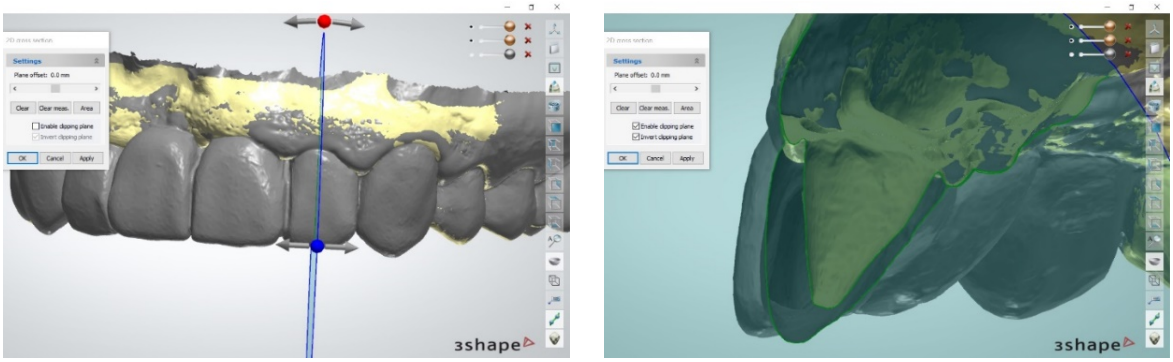


Fig.10 *Longitudinal section along the axial axis of tooth 22 with overlaid images – preparation and temporary crown****A)*** *Frontal view;* ***B)*** *Sagittal view*

In this way, a visual differentiation of the free gingival margin from the crown margin is achieved during the indicated follow-up periods. The measurement of the margo gingivalis is conducted between two reference points. The first reference point (pt.G_i) is the deepest point of the gingival sulcus. The second reference point (pt.G_e) is a projection of point G_i along the external contour of the marginal gingiva. The distance between the two points is recorded. **(Fig.11, Fig.12** and **Fig.13)**.

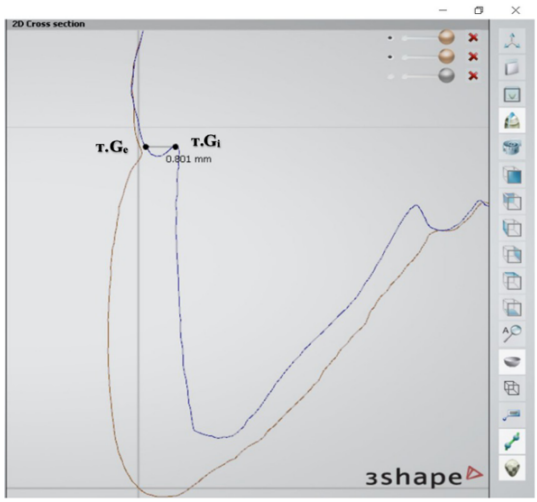


Fig.11 *Measurement of the thickness of free gingival margin (T0)*

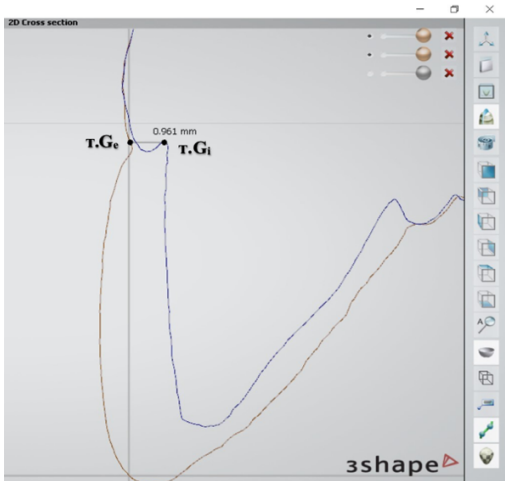


Fig.12 *Measurement of the thickness of free gingival margin (T1)*

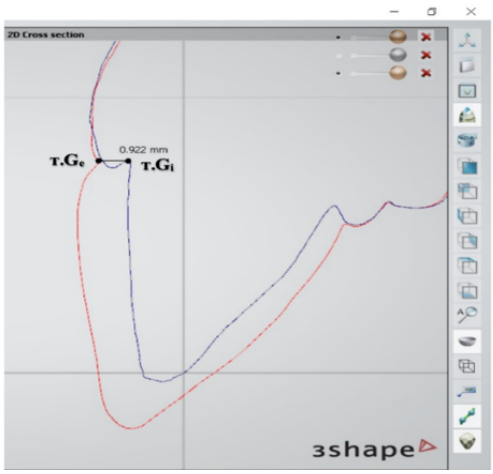


Fig.13 *Measurement of the thickness of free gingival margin (T2)*

The obtained values of the examined parameters are compared and contrasted between the different stages:

- T0 compared to T1;
- T1 compared to T2;
- T0 compared to T2.

III.2. Materials and methods for Task 2

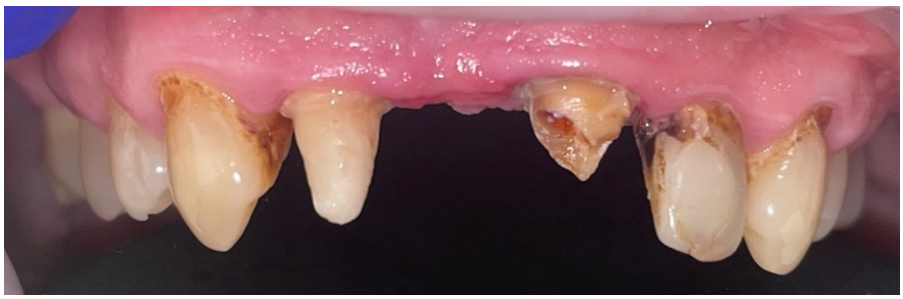
With the introduction of CAD/CAM technology, the planning and design of fixed prosthetic restorations are carried out digitally in specially developed

software. This also allows virtual compression of the gingival tissues by designing various emergence profiles of the restorations.

The same manipulations **(Fig.14** and **Fig.15)** performed in the clinical group from task 1, with the only difference in the method of fabrication of temporary restorations - indirect, are repeated on the examined patients involved in task 2.

Fig.14 *Initial situation*

A)



B)

Fig.15 *Condition of the teeth and gingival tissues after removal of restorations.* ***A)*** *Frontal view;* ***B)*** *Occlusal view*

After the abutment teeth preparation, a two-step two-layer impression is taken using C-silicone. Following its scanning with an extraoral laboratory scanner, a virtual model was created, upon which the design of the temporary constructions is created. These restorations are milled from PMMA. The fabrication and cementation of the restorations are performed on the same day **(Fig.16)**.

A)

B)

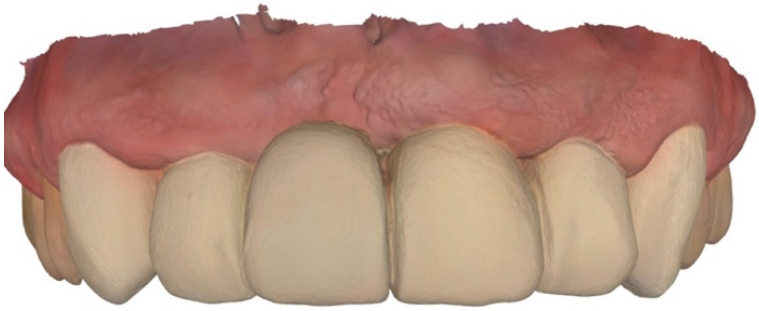
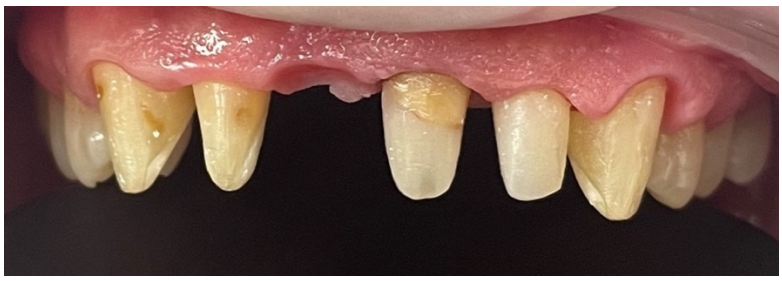


Fig.16 *Cemented temporary restorations.* ***A)****Intraoral view;* ***B)*** *Digital impression, by which the gingival thickness is measured in stage T1.*

Similarly to the patients in task 1, two months after cementing the temporary restorations and the healing of the soft tissues, a final impression is taken for the permanent FDP **(Fig.17)**. Gingival retraction is done by using the double-cord technique **(Fig.18)**, and the impression technique is one-step two-layered.

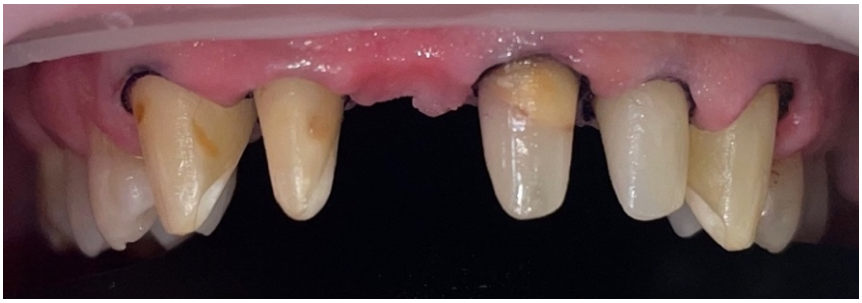
A)



B)

Fig.17 *Healing of gingival tissues after two months.* ***A)*** *Frontal view;* ***B)*** *Occlusal view*

A)



B)

Fig.18 *Gingival retraction – double-cord technique (000 u 0).* ***A)*** *Frontal view;* ***B)*** *Occlusal view*

The definitive full-contour zirconium dioxide restorations are cemented using a resin-modified glass ionomer cement **(Fig.19)**.

A)

B)

Fig.19 *Cemented permanent restorations.* ***A)****Intraoral view;* ***B)*** *Digital impression, by which the gingival thickness is measured in stage T2.*

The periodontal response was monitored by measuring the three indicators at different stages of the treatment.

III.3. Materials and methods for Task 3

An algorithm was developed for fabrication of temporary restorations by direct-indirect method with the "egg-shell" technique.

III.4. Materials and methods for Task 4

Two anonymous survey forms are prepared targeting doctors of dental medicine and dental technicians.

III.4.1. Subtask 1

A survey is conducted among DMD to assess their awareness regarding BOPT and the possibility of guiding the gingival contour using the emergence profile of the full coverage crowns. A total of 72 dentists voluntarily participate in the study. The survey form consist of 21 questions, which were coordinated with the scientific advisor.

III.4.2. Subtask 2

The level of awareness regarding the fabrication of fixed dental prostheses on teeth prepared according to BOPT is investigated among dental technicians. The study involves 43 participants. The survey form includes 21 questions related to the laboratory protocol of the technique.

III.5. Statistical Methods for Data Processing

The data are entered and processed using the SPSS (SPSS Statistics v.20, IBM Corp) and Microsoft Excel (Data Analysis). The following statistical methods were applied:

- Analysis of Variance (ANOVA)
- Variational Analysis
- Correlation Analysis
- Regression Analysis
- ROC Curve Analysis
- Comparative Analysis
- Graphical and tabular methods for representing the obtained results

For all conducted analyses, a permissible level of significance was assumed at $p < 0.05$ with a confidence interval of 95%.

IV. RESULTS AND DISCUSSION

IV.1. Results and discussion on Task 1

IV.1.1. Results from the conducted research for analysis and comparison of the indicators: presence of plaque, bleeding on probing, and thickness of the free gingival margin when treated with full-coverage crowns after temporary restorations made by the direct-indirect method using the "egg-shell" technique.

A study has been conducted on patients requiring prosthetic treatment with fixed dental prostheses in the visible area of the dentition. The participants in the study are 17, aged between 31-54 years, of which 5 are women and 12 are men. The total number of teeth prepared using BOPT is 36, of which 18 are incisors, 4 canines, and 14 premolars. Temporary restorations were made using the direct-indirect method with the "egg-shell" technique, while the final prosthetic restorations were milled from full-contour zirconium dioxide.

For each patient in the clinical group, the periodontal response was monitored by measuring the following indicators: presence or absence of bacterial plaque; bleeding on probing (BoP); thickness of the free gingival margin. The measurements were made at three different stages of treatment: before starting the treatment (T0); 2 months after cementing the temporary restorations (T1); and 6 months after cementing the permanent restorations (T2).

1. Monitoring of the periodontal response in the incisors group.

The comparative analysis based on the "plaque" indicator in the incisors group shows that bacterial plaque (BP) is detected in 67% of cases at stage T0. This percentage decreases to 33% at stage T1, and subsequently to 28% at stage T2. **(Fig.20)**

The analysis of the results indicates that before starting the treatment, bleeding is detected in 61% of the teeth in the incisors group. When studying the "bleeding on probing" indicator during the stages of temporary restorations and after cementing the permanent ones, it was found that only 11% of the incisors exhibited bleeding **(Fig.21).**

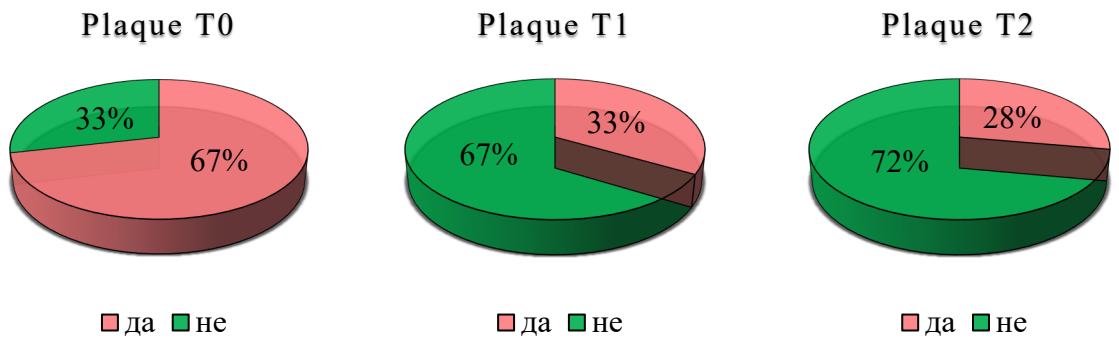


Fig.20 *Comparative analysis - presence of plaque on incisors at different stages of treatment (%).*

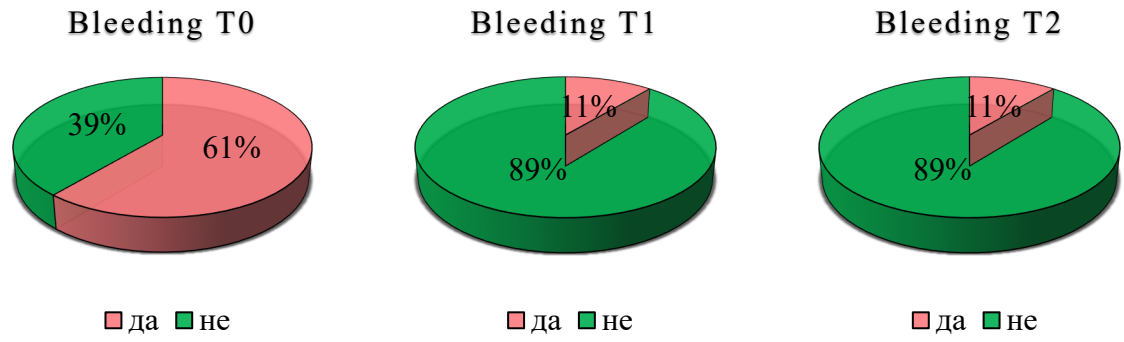


Fig.21 *Comparative analysis - bleeding on probing in incisors at different stages of treatment (%).*

The analysis of the results from the conducted measurements shows that the average thickness of the free gingival margin of the incisors at the initial treatment stage is 1.33 ± 0.29 mm, with a minimum thickness of 1.06 mm and the maximum measured being 2.00 mm **(Fig.22).**

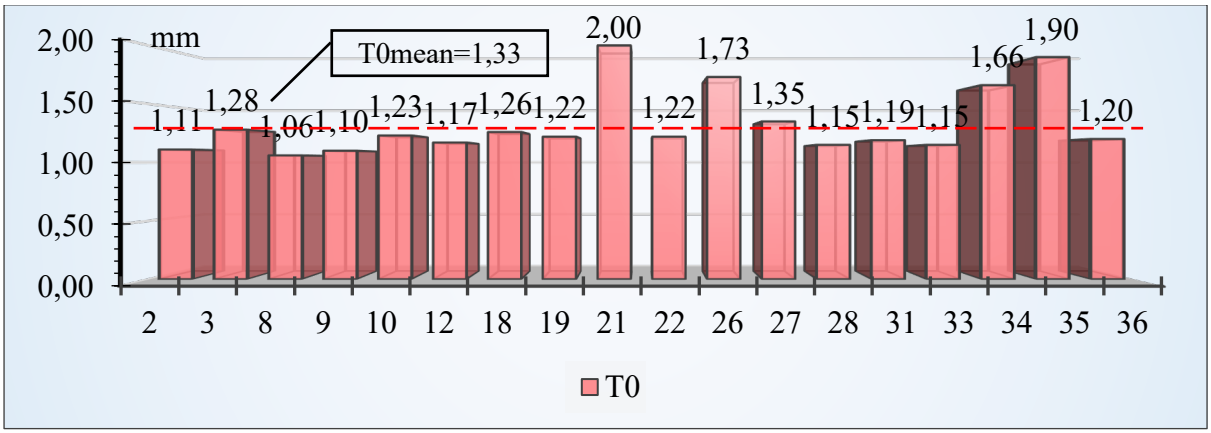


Fig.22 *Thickness of the free gingival margin of incisors at stage T0 (mm).*

Figures 23 and **24** graphically present the measurements for the same indicator at stages T1 and T2. From the two figures, it's clear that the average value for the thickness of the FGM (Free Gingival Margin) measured 2 months after the placement of the temporary structures is 1.44 ± 0.33 mm (with a minimum thickness of 1.15 mm and a maximum of 2.22 mm), and 6 months after cementing the permanent structures it's 1.45 ± 0.33 mm (with a minimum thickness of 1.18 mm and a maximum of 2.22 mm).

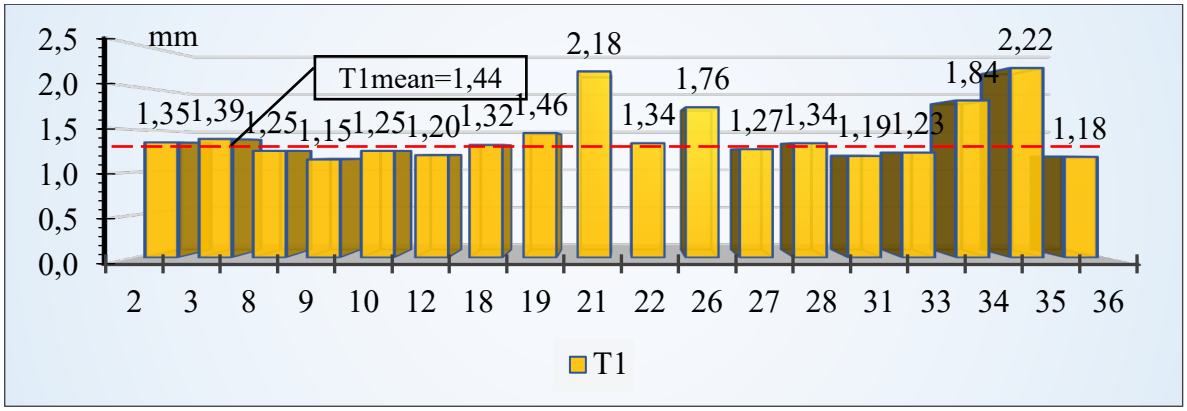


Fig.23 *Thickness of the free gingival margin of incisors at stage T1 (mm).*

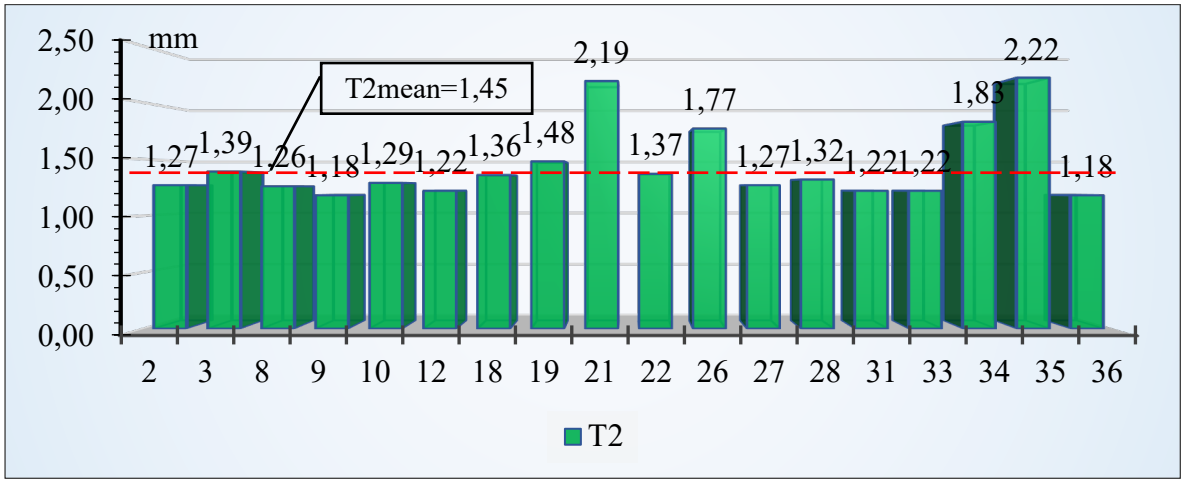


Fig.24 *Thickness of the free gingival margin of incisors at stage T2 (mm).*

The comparative analysis of the results from the observed differences in the thickness of the FGM (Free Gingival Margin) of the prepared incisors in the initial stage and the final measurement, 6 months after cementing the definitive structures, indicates an average increase of 0.114 mm. It's important to note that two of the teeth show a negative value for this indicator, meaning there is a

decrease in the measured thickness (respectively -0.02 mm and -0.08 mm), while the maximum positive difference is 0.32 mm **(Fig.25).**

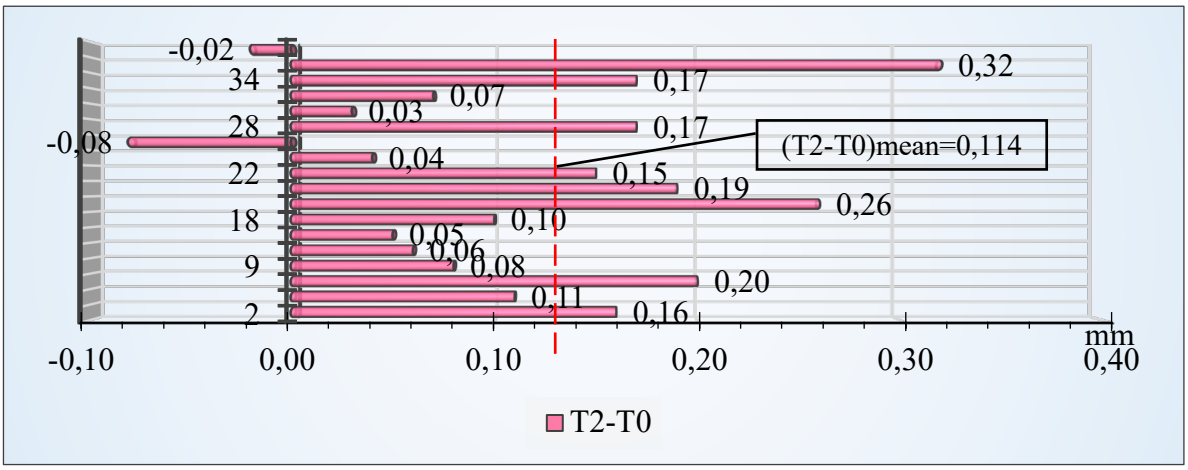


Fig.25 *Difference in the thickness of the free gingival margin of incisors between stages T0-T2 (mm).*

Based on the conducted measurements and analysis of the results, we identified a statistically significant difference in the volume of the free gingival margin in the incisors group between stages T0 and T1. In this time interval, we observe an increase in thickness with an average of 0.108 mm, with the minimum value being -0.08 mm, and the maximum measured being 0.32 mm **(Fig.26)**. The average increase in thickness, obtained when comparing these values between the stages of temporary and permanent restorations, is 0.007 mm. It should be emphasized that in this time span, negative values are observed in four teeth, and the maximum increase is only 0.03 mm.

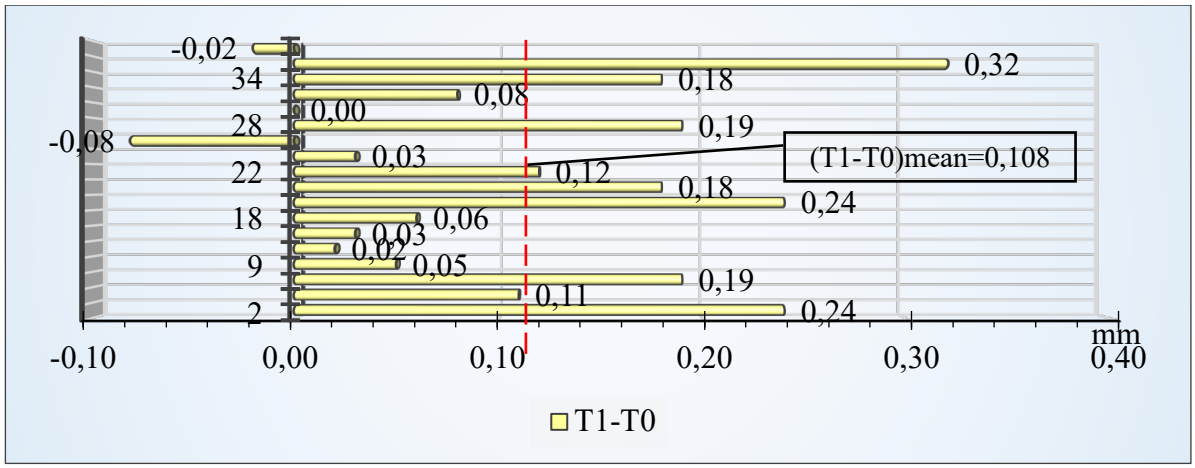


Fig.26 *Difference in the thickness of the free gingival margin of incisors between stages T0-T1 (mm)*

After statistical processing of the measured results for the thickness of the FGM in incisors at different stages, a standard error of 0.0285 (p=0.67) was identified for the T0-T2 stage; for T0-T1 it was 0.0286 (p=0.74), and for T1-T2 it was 0.1530 (p=0.67)

2. Monitoring of the periodontal response in the canine group

When comparing the presence of plaque in the canine group, a significant difference in this indicator was found at different treatment stages. In the initial phase, bacterial plaque (BP) was observed in 75% of the examined teeth (n=3), while it was absent in only one tooth. In the following two stages, the presence of plaque was recorded in only 25% (n=1) on both the temporary and permanent structures **(Fig.27)**.

Fig.27 *Comparative analysis - presence of plaque on canines at different stages of treatment (%).*

The results we obtained when measuring the "bleeding on probing" indicator at stage T0 are similar to those from the plaque study in this dental group **(Fig.28)**. Here too, the positive trend of improving results persisted, as in 100% of the prosthetically treated canines, in the stages with placed temporary and permanent restorations, bleeding was absent.

Fig.28 *Comparative analysis - bleeding on probing in canine teeth at different stages of treatment (%).*

Fig.29 presents a comparative analysis of the results from measuring the thickness of the free gingival margin in canines at different studied stages. The data shows that the average measured thickness before starting the prosthetic treatment is 0.76 ± 0.082 mm, with the minimum being 0.7 mm and the maximum being 0.88 mm. In the final measurement stage, 6 months after cementing the permanent restorations, we found that the FGM has thickened to an average of 0.95 ± 0.065 mm, with the minimum value being 0.88 mm and the maximum being 1.03 mm.

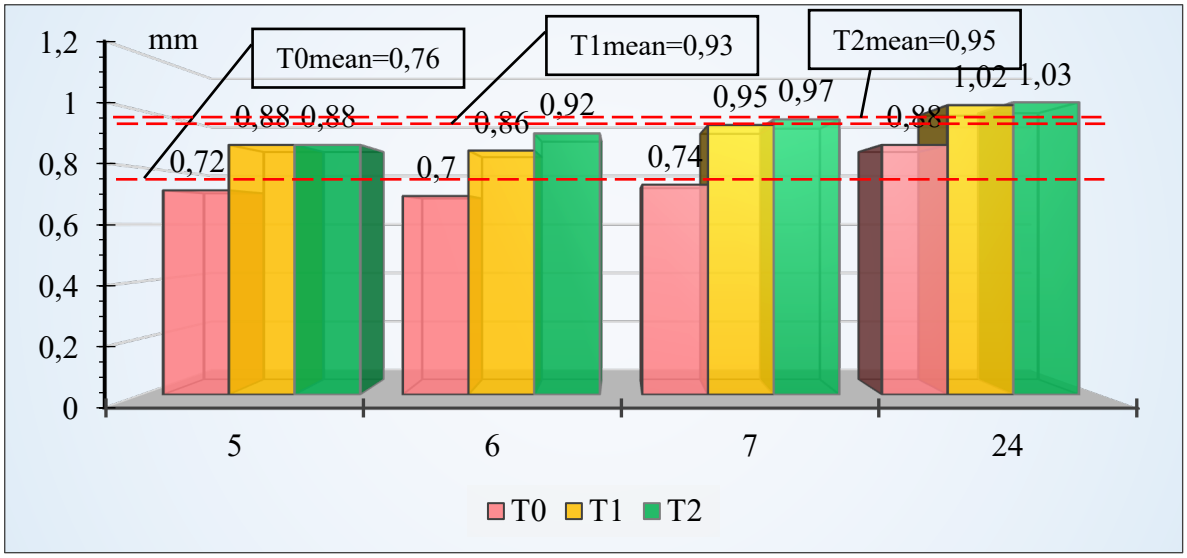


Fig.29 *Thickness of the free gingival margin of canine teeth at different stages (mm).*

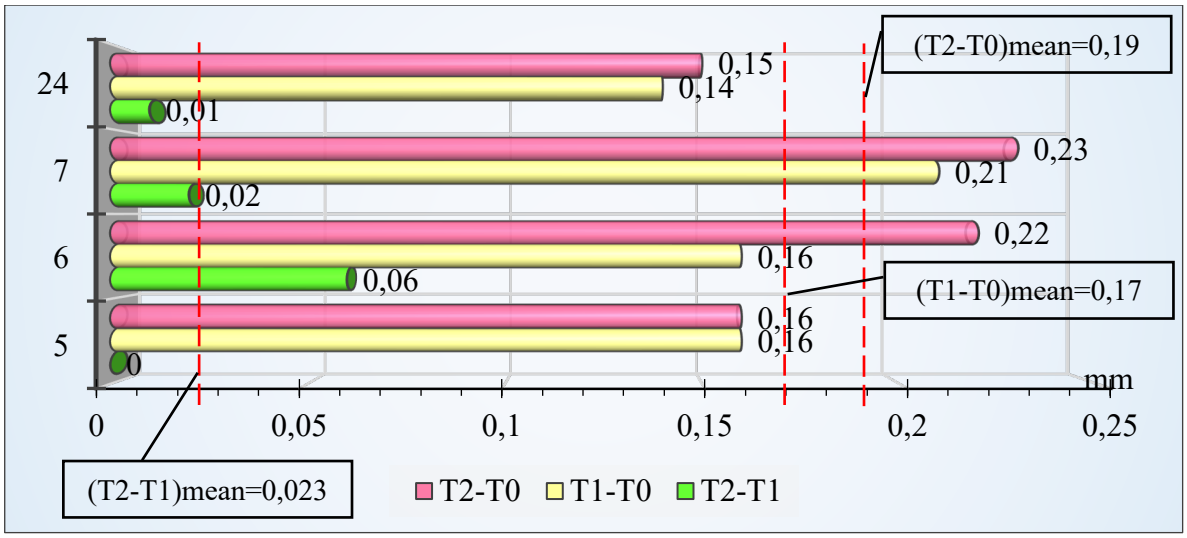


Fig.30 *Difference in the tchickness of the free gingival margin of canines between different stages (mm)*

3. *Monitoring of the periodontal response in the premolars group*

In the initial treatment stage (T0), when studying the "plaque" indicator in the group of premolars that will be prepared for fixed dental prostheses, we detected its presence in 71% of the teeth (n=10). Two months after placing the temporary structures, we noted a significant decline in the presence of bacterial plaque compared to the initial situation – in 50% of the cases, and at the final evaluation of this indicator, the percentage was 43% **(Fig.31).**

Fig.31 *Comparative analysis - presence of plaque on premolars at different stages of treatment (%)*

Fig.32 presents a comparative analysis of the "bleeding on probing" indicator for premolars at different stages of treatment. Here too, as in the previous group, we have a match in the percentage distribution of results in the initial phase – bleeding was detected in 71% of the teeth. Comparing the results, it's clear that this percentage dramatically decreases in the next study stage to 21%. In the final evaluation of this indicator, bleeding was recorded in only 14% of all prosthetically treated teeth in the group.

Fig.32 *Comparative analysis – bleeding on probing in premolars at different stages of treatment (%)*

The analysis of the results from the conducted measurements shows that the average thickness of the free gingival margin of the premolars before starting treatment is 1.01 ± 0.21 mm, with a minimum thickness of 0.77 mm and the maximum measured being 1.49 mm **(Fig.33).**

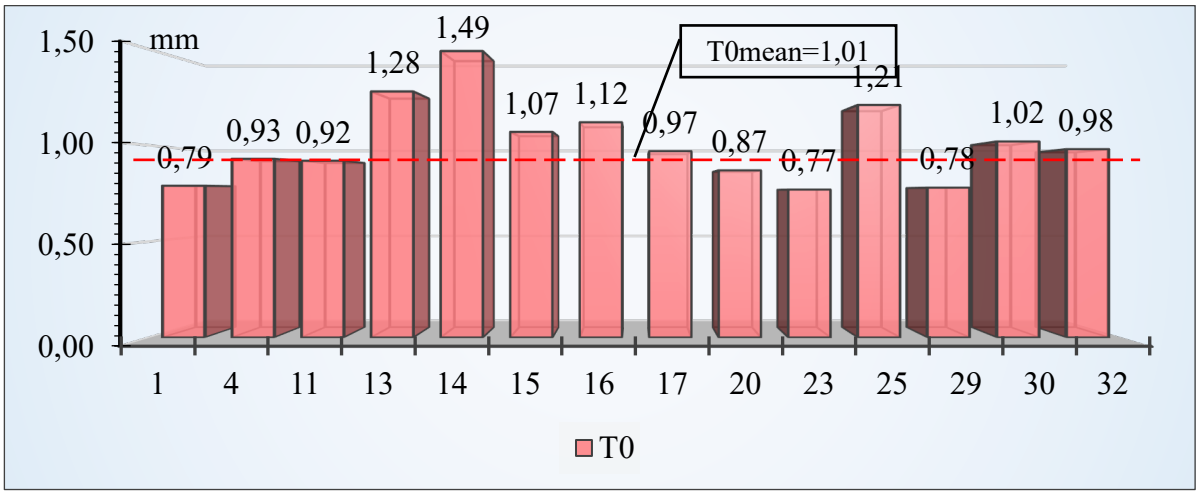


Fig.33 *Thickness of the free gingival margin of premolars at stage T0 (mm).*

The comparative analyses of the results from the measurements of this indicator at stages T1 and T2 are presented in **Fig.34** and **Fig.35**. From the first figure, it's clear that the average thickness value of the FGM, measured 2 months after placing the temporary structures, is 1.06 ± 0.23 mm (with a minimum thickness of 0.55 mm and a maximum of 1.40 mm), and 6 months after installing the permanent structures, it's 1.08 ± 0.24 mm (with a minimum thickness of 0.50 mm and a maximum of 1.45 mm).

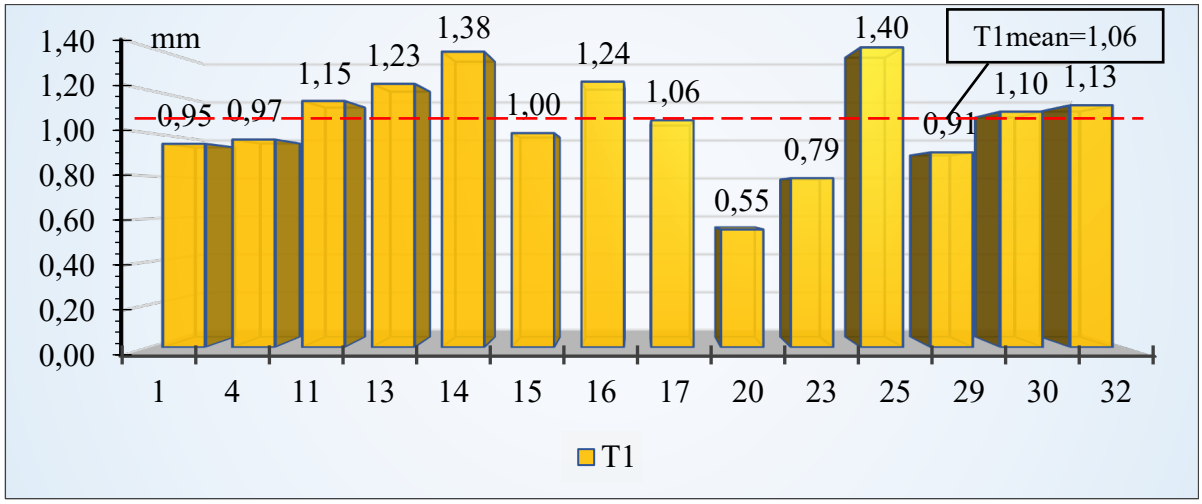
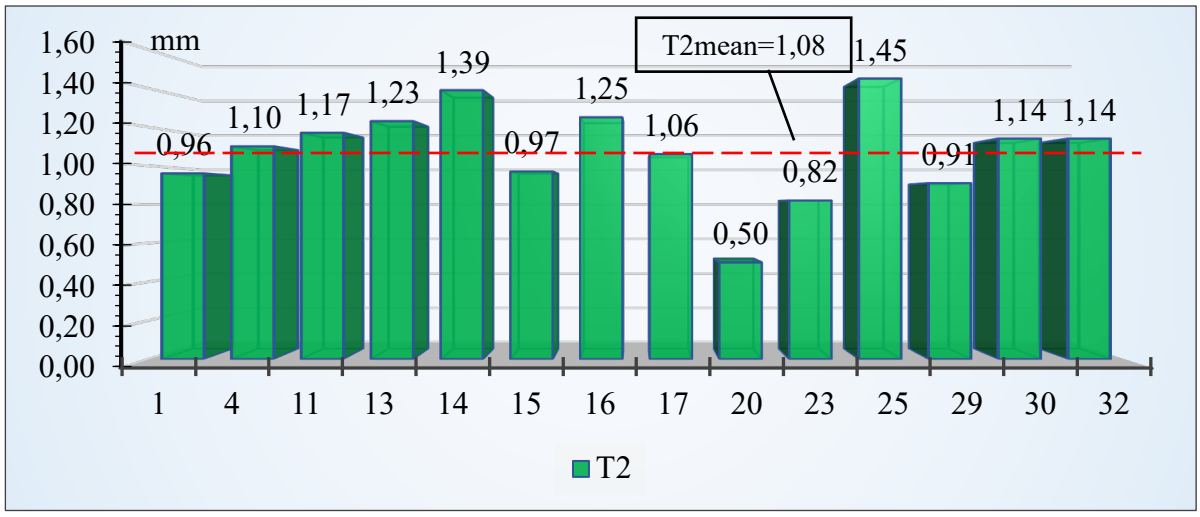


Fig.34 *Thickness of the free gingival margin of premolars at stage T1 (mm).*



Фиг.35 *Thickness of the free gingival margin of premolars at stage T2 (mm)*

Based on the results presented in **Fig.36**, obtained by comparing the difference in the thickness of the free gingival margin of the prepared teeth in the premolar group during the T0-T2 period, two statistically significant opposite conclusions can be drawn. In four of the teeth, a reduction in the thickness of the marginal gingiva was observed with an average of 0.16 mm (minimum value of 0.05 mm and maximum of 0.37 mm) at the final assessment stage after placing the permanent structures. In the other 10 premolars, an increase in the gingival margin was observed with an average of 0.15 mm, with the minimal increase in this value being 0.05 mm and the maximum being 0.25 mm. The average increase in the volume of the FGM is 0.05 mm.

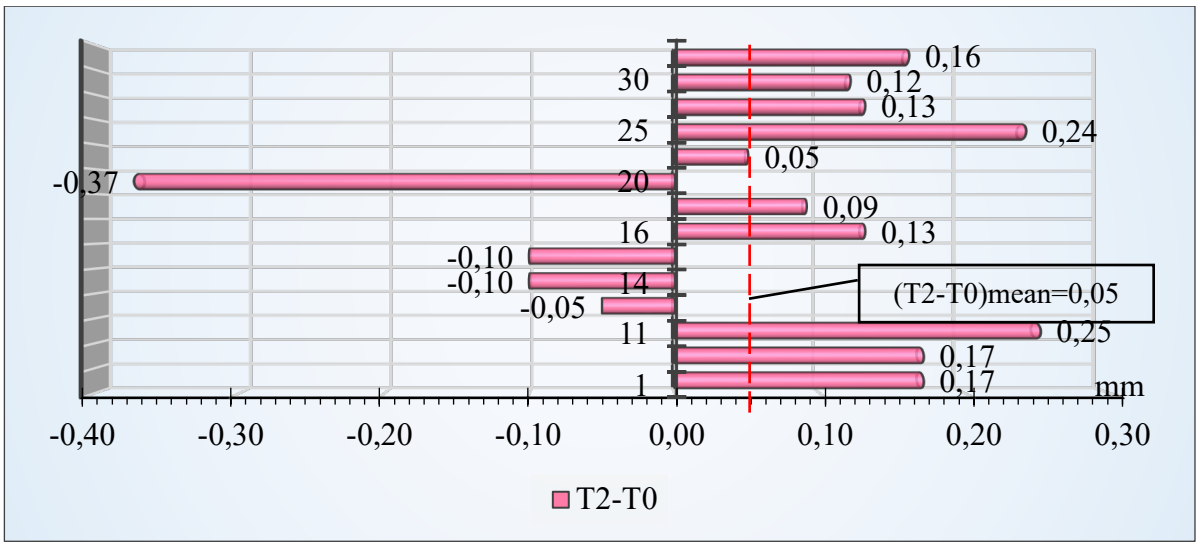


Fig.36 *Difference in the thickness of the free gingival margin of premolars between stages T0-T2 (mm).*

Based on the measurements made and the subsequent analysis of the results, it can be said that the reduction in the thickness of the free gingival margin in the aforementioned four premolars is observed as early as stage T1. The average value of this negative result is 0.14 mm, with a minimum of 0.05 mm and a maximum of 0.32 mm. At the same measurement stage, in the other 10 teeth, a positive result and thickening of the marginal gingiva were observed, with an average of 0.12 mm (minimum value of 0.02 mm and maximum of 0.23 mm) **(Fig.37)**. The increase in volume averages 0.06 mm. As with the incisors and canines, so too with the premolars, we noted minimal changes in the FGM's thickness between the stages of temporary and permanent structures, with an average thickness increase of 0.02 mm. During this time frame, negative values were observed in two of the teeth.

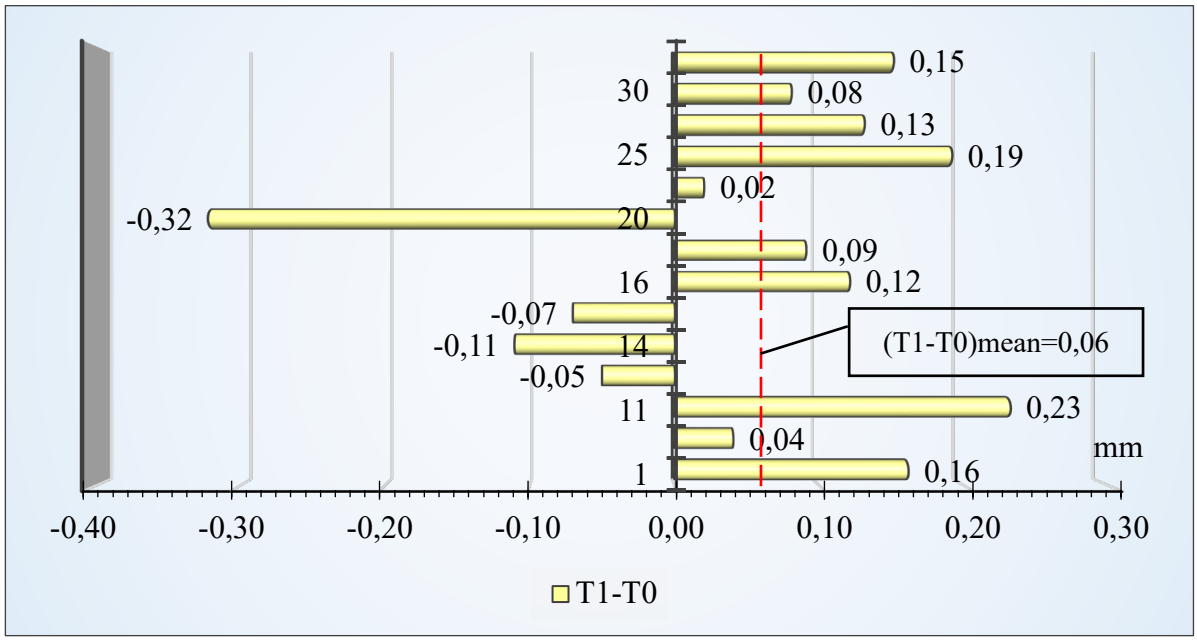


***Fig.37** Difference in the thickness of the free gingival margin of premolars between stages T0-T1 (mm).*

Monitoring the periodontal response in all examined teeth after temporary constructions made by the direct-indirect method using the "egg-shell" technique.

Fig.38 presents a comparative analysis of the "plaque" indicator in the examined teeth at different treatment stages. It shows that at stage T0, bacterial plaque is detected in 69% of cases. This percentage drops to 39% at stage T1, and to 33% at stage T2.

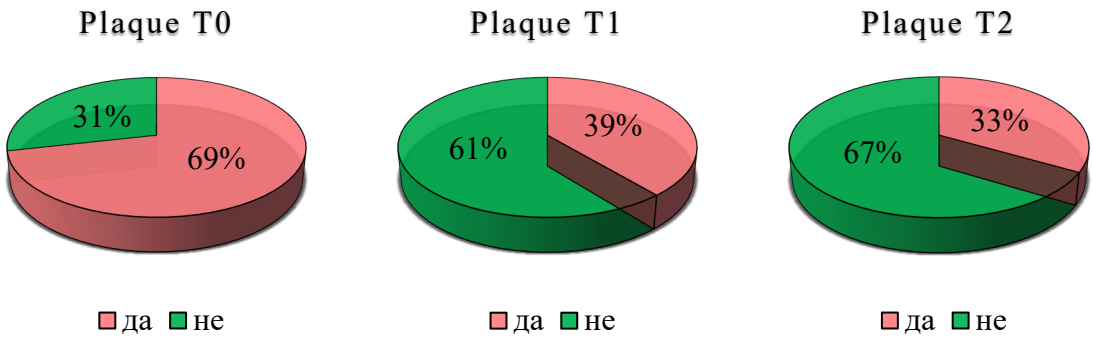


Fig.38 *Comparative analysis - presence of plaque in the examined teeth at different treatment stages (%).*

The results of the comparative analysis on the "bleeding on probing" indicator for all examined teeth show that bleeding is observed in 66% of them before the start of treatment. When comparing the results, there is a drastic reduction in this percentage to 14% two months after cementing the temporary crowns, and six months after placing the permanent ones, this percentage is 11% **(Fig.39).**

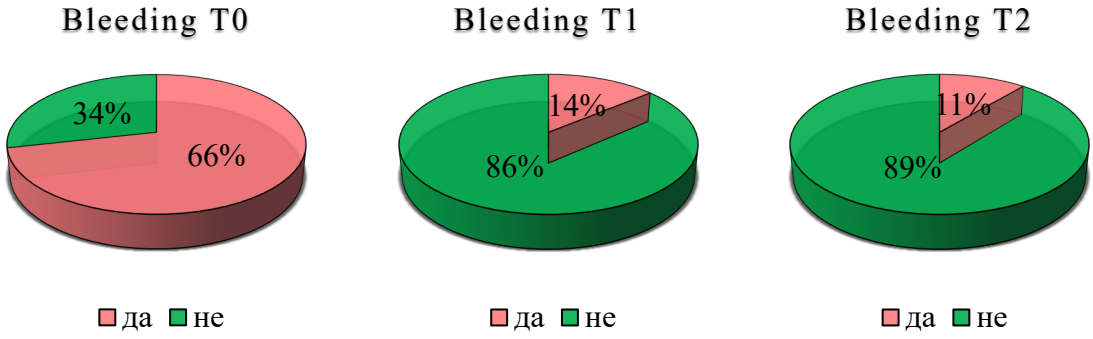


Fig.39 *Comparative analysis - bleeding on probing in the examined teeth at different treatment stages (%).*

After reviewing the data from the measurement of the free gingival margin's thickness in the examined teeth during the initial stage, values between 0.7 mm and 2 mm were recorded, averaging 1.145 ± 0.313 mm. During the subsequent measurement in stage T1, changes in the volume of the marginal gingiva were observed, with the minimum measured thickness being 0.55 mm and the maximum being 2.22 mm, or an average of 1.236 ± 0.343 mm. The increase in the Free Gingival Margin averaged 0.091 ± 0.03 mm. In the intermediate stage T1-T2, a positive change in thickness was noted, averaging only 0.012 ±0.001 mm. Six months after the cementation of the permanent

structures, when determining the FGM's thickness, a minimum value of 0.5 mm was measured, a maximum of 2.22 mm, and an average of 1.248 ± 0.342 mm. The average increase in the crown edge's thickness during the period T0-T2 was 0.103 ± 0.029 mm **(Table 1).**

Table 1. *Average value of the free gingival margin's thickness, measured during different stages (mm)*

Gingival thickness (mm)	Minimal	Mean	Maximum	Standard deviation
T0	0,7	1,145	2	±0,313
T1	0,55	1,236	2,22	±0,343
T2	0,5	1,248	2,22	±0,342

IV.1.2. Discussion of the results from the study on the first task regarding tracking the periodontal response when treated with full coverage crowns following temporary restorations made by the direct-indirect method using the "egg-shell" technique.

The results of the comparative analysis show that before starting the treatment, bacterial plaque accumulation was detected in 69% of the examined teeth. The presence of plaque in such a high percentage of the studied teeth prior to treatment can be attributed to several factors. Some of these teeth were fractured, had cervical caries, or had poorly polished fillings. In other clinical cases, there had been previous prosthetic treatment using old and imprecise fixed partial dentures that did not meet preventive and aesthetic requirements. Poor marginal adaptation, over-contouring of the emergence profile, and short crown edges were observed both in the preparations with margins and those without. All these findings act as local factors that retain plaque, making cleaning around them challenging.

We note a significant decrease in this percentage in the subsequent stages - 39% at T1 and 33% at T2. The accumulation of plaque might be related to the type of prosthetic restoration used, be it a single crown or a bridge. With the

latter, there's a risk of a larger spread of bacterial plaque due to the connections between individual retainers and pontics.

After analyzing the results for the indicator "bleeding on probing", we found that in the initial stage, a significant portion of the studied teeth showed bleeding - 66%, which could correspond to the high prevalence of bacterial plaque. Two months after cementing the temporary restorations, there was a decrease in the bleeding percentage - 14%, which could be directly related to the plaque index. In the subsequent measurement, six months after cementing the permanent zirconia restorations, there was a significant improvement in the state of the marginal gingiva, with the absence of bleeding in most of the teeth - 89%. This indicates the absence of an inflammatory process. However, positive values were obtained for the remaining 11%. These results might be attributed to inaccuracies in the laboratory stages of fabricating the permanent structures: improper emergence profile design, over-contouring of the restoration, as well as challenges in determining the position of the crown edge within the gingival sulcus boundaries.

Based on the results obtained from measuring and comparing the thickness of the free gingival margin across the three different stages, we observed that the primary increase and change occur mainly during the period when the patient has cemented temporary structures and the soft tissue healing process is underway (T0-T1), with an average of 0.091 ± 0.03 mm. An eight-week tenure of the temporary structures provides stability to the gingival tissues and is sufficient for them to adapt to the newly created forms of the restoration. During the last measurement stage, we noted a minimal additional thickening compared to T1 - 0.012 ± 0.001 mm.

Analysis of our study data indicates that when applying a biologically oriented preparation technique, there is an increase in the thickness of the FGM Comparing the values obtained from the measured thickness in the initial stage and six months after cementing the permanent structures, an increase of an average of 0.103 ± 0.029 mm was observed. These ensuing changes in the volume of the marginal gingiva are due to the fact that the regeneration of the gingival tissues after preparation and gingival curettage follows the same mechanism as the healing of injured tissues. During the healing period, a cascade of processes occurs, where new blood vessels are formed, fibroblasts

and myofibroblasts grow and accumulate at the base of the gingival sulcus. The contraction of the latter, combined with the conical shape of the prepared tooth stump, causes apical migration of the FGM. After cementing the temporary structures, the connective tissue cells receive various mechanical stimuli during mastication and speech, which are transformed into chemical signals, stimulating cellular growth and proliferation.

IV.2. Results and discussion on Task 2

IV.2.1. Results from a study analyzing and comparing indicators for the presence of plaque, bleeding on probing, and thickness of the free gingival margin when treated with full veneer crowns after temporary restorations, made by an indirect digital method

A study was conducted on patients requiring fixed prosthetic treatment in the frontal area. A total of 17 participants were included in the study, consisting of 7 women and 10 men, aged between 29 and 48 years. In total, 30 teeth were prepared using the BOPT method, including 16 incisors, 2 canines, and 12 premolars. Temporary restorations were fabricated using an indirect digital method, while the final prosthetic restorations were made entirely of zirconia dioxide. Each patient in the clinical group had their periodontal response monitored across several stages using the same indicators as in Task 1.

1. Monitoring the Periodontal Response in the Incisor Group

The comparative analysis based on the "plaque" indicator for the incisor group at different assessment stages is graphically represented in **Fig.40**. It was found that before the start of treatment (T0), a higher percentage (87%) of the studied teeth showed the presence of plaque. In comparison, subsequent measurements indicated a significant reduction in this percentage (44%).

Fig.40 *Comparative analysis - Presence of plaque in incisors at different stages of treatment (%)*

The analysis of the data shows that before the start of the treatment, 87% of the examined teeth exhibited bleeding on probing. In the subsequent stages, T1 and T2, a significant reduction was observed - only 19% of the incisors showed bleeding **(Fig.41).**

Fig.41 *Comparative analysis - bleeding on probing in incisors at different stages of treatment (%)*

The analysis of the results from the measurements indicates that the thickness of the free gingival margin in the incisors before starting the treatment averages 1.28 ± 0.173 mm. The minimum measured thickness is 1.1 mm, and the maximum is 1.73 mm **(Fig.42).**

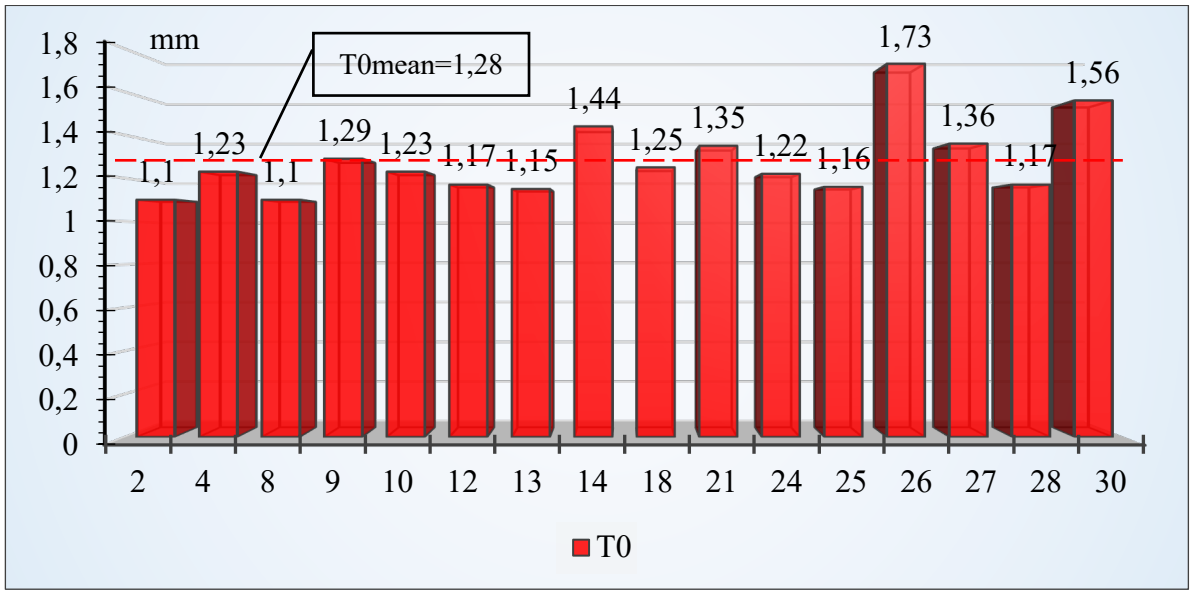


Fig.42 *Thickness of the free gingival margin in incisors at stage T0 (mm)*

On **Fig.43** and **Fig.44**, the measurements of the same parameter in stages T1 and T2 are graphically represented. From the two figures, it becomes clear that the average thickness of the FGM (Free Gingival Margin) measured 2 months

after the placement of the temporary restorations is 1.36 ± 0.171 mm (with a minimum of 1.11 mm and a maximum of 1.76 mm). Six months after the placement of the permanent structures, the thickness is 1.37 ± 0.174 mm (with a minimum thickness of 1.09 mm and a maximum of 1.77 mm).

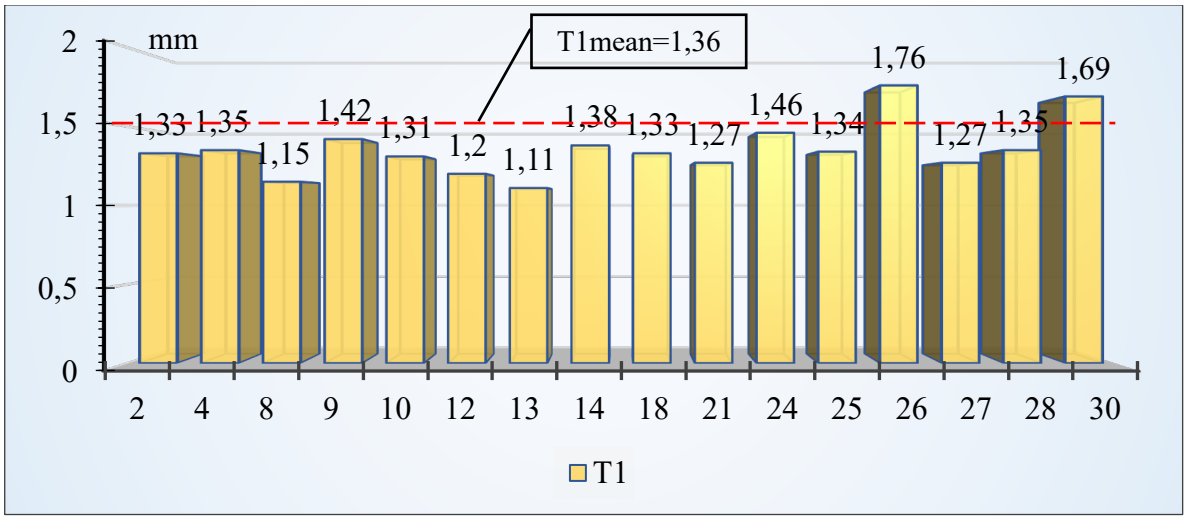


Fig.43 *Thickness of the free gingival margin on incisors at stage T1 (mm)*

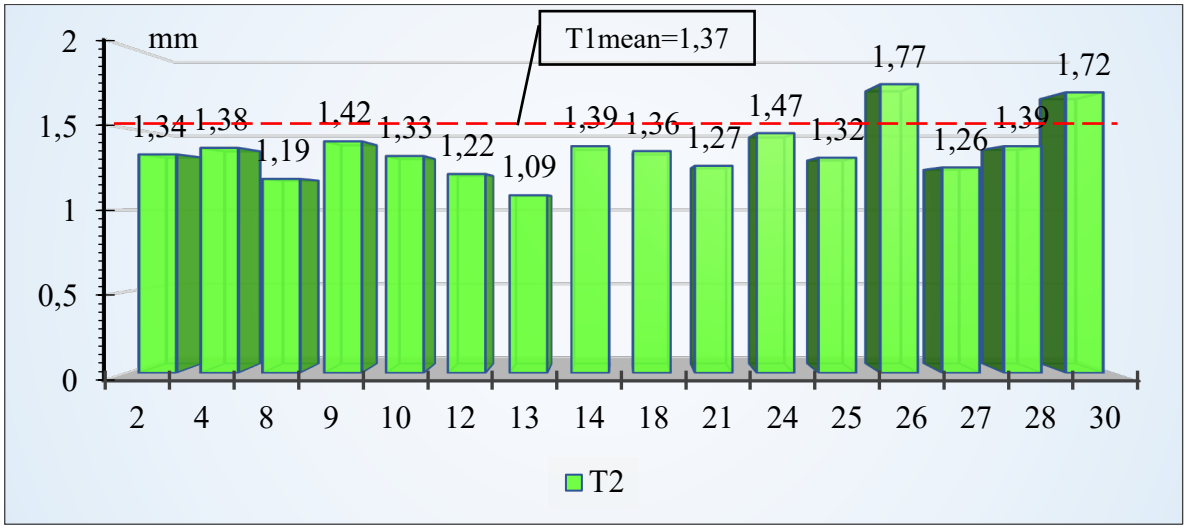


Fig.44 *Thickness of the free gingival margin on incisors at stage T2 (mm)*

The comparative analysis of the results from the observed differences in the thickness of the free gingival margin in the incisor group between stages T0 and T2 shows an average increase of 0.09 mm. For four of the teeth, a negative value for this parameter was recorded, indicating a decrease in the measured thickness by up to 0.1 mm. The measured maximum positive difference is 0.25 mm **(Fig.45).**

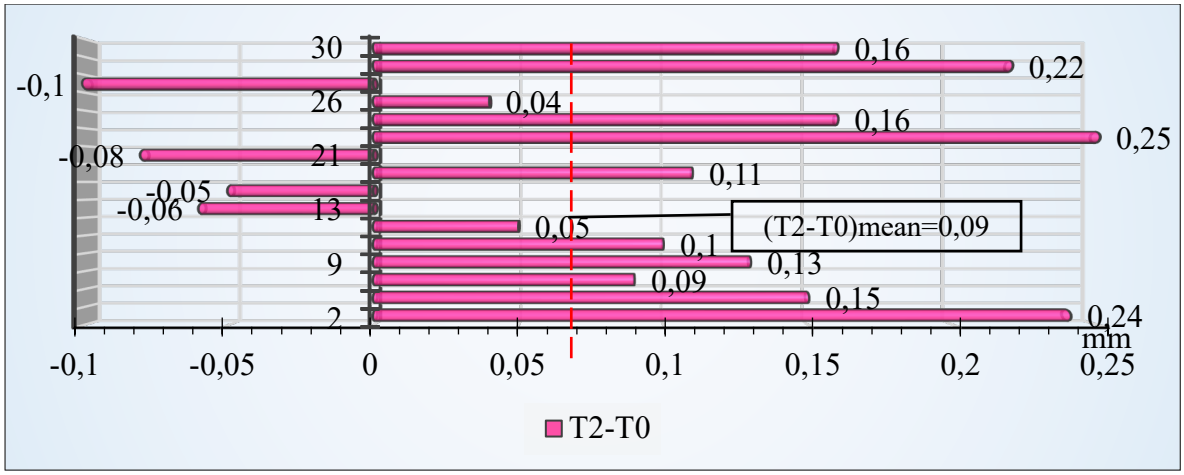


Fig.45 *Difference in the thickness of the free gingival margin on incisors between stages T0-T2 (mm)*

Based on the measurements taken and the analysis of the data, a statistically significant difference in the volume of the free gingival margin of the examined incisors was established between stages T0 and T1. During this period, an increase in thickness of an average of 0.08 mm was observed, with the minimum value being -0.09 mm, and the maximum measured value being 0.24 mm **(Fig.46)**. When comparing these values between the stages of temporary and permanent constructions, an average increase in thickness of 0.01 mm was recorded, with negative values observed in three teeth - up to -0.02 mm, while the maximum increase in thickness was 0.04 mm.

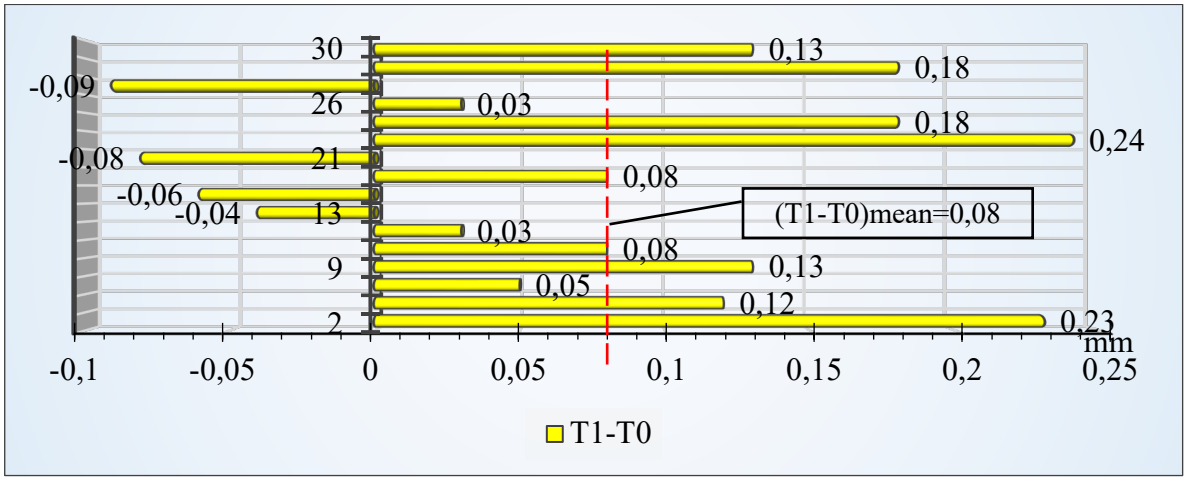


Fig.46 *Difference in the thickness of the free gingival margin on incisors between stages T0-T1 (mm).*

After statistical processing of the measured values for the thickness of the free gingival margin in incisors at different stages, a standard error of 0.0179 was

established for stage T0-T2, 0.0197 (p=0.032) for T0-T1, and 0.1052 (p=0.29) for T1-T2.

2. Monitoring the periodontal response in the group of canine teeth.

In **Fig.47** and **Fig.48**, the results obtained from comparing indicators for the presence of plaque and bleeding on probing in canines are presented. From the graphical representation, it can be seen that 100% of them lack plaque and bleeding.

***Fig.47** Comparative analysis - presence of plaque on canines at different stages of treatment (%)*

***Fig.48** Comparative analysis - bleeding on probing in canines at different stages of treatment (%).*

Fig.49 presents a comparative analysis of the results from measuring the thickness of the free gingival margin in canines at different stages. From the obtained data, it becomes clear that the average measured thickness before starting the prosthetic treatment (T0) is 0.81 ± 0.15 mm, with the minimum being 0.7 mm, and the maximum – 0.91 mm. In the subsequent measurement stage - 2 months after the placement of temporary constructions (T1), an increase in the thickness of the free marginal edge is recorded, averaging 0.92 ± 0.078 mm. The maximum measured difference at this stage is 0.97 mm, and the minimum – 0.86 mm. In the final measurement stage, 6 months after cementing the permanent

constructions (T2), a thickening of the free gingival margin is observed, averaging 1.02 ± 0.14 mm, with the minimum value being 0.92 mm, and the maximum – 1.12 mm.

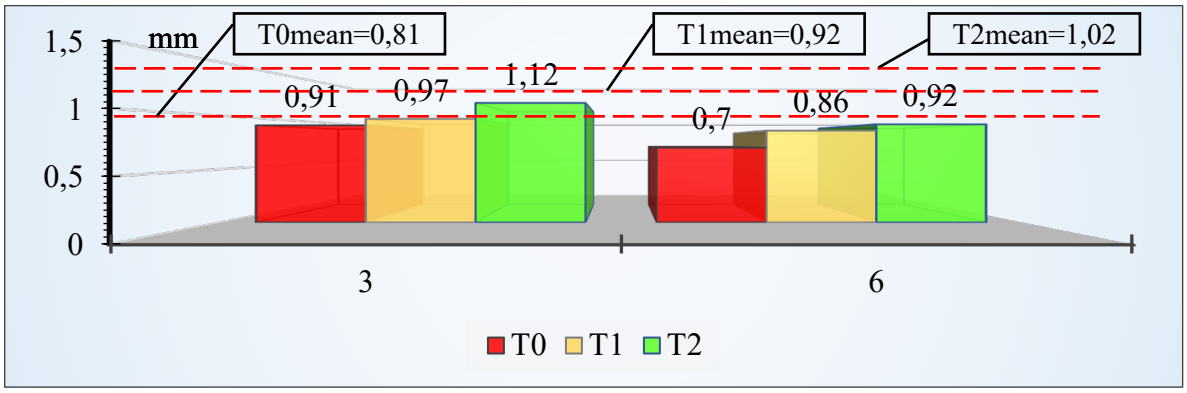


Fig.49 *Thickness of the free gingival margin on canines at different stages (mm)*

Following a comparative analysis of the results from the observed differences in the thickness of the free gingival margin of the examined canines over the three treatment stages, a statistically significant difference in the measured values was identified. In the period T0-T1, there was an average increase in the thickness of the marginal gingiva of 0.11 mm, while between T1 and T2, it was 0.105 mm. The differences in the thickness of the free gingival margin of the canines at the initial stage and when measured 6 months after cementing the permanent constructions showed an average increase in thickness of 0.215 mm (with the minimum value being 0.21 mm and the maximum being 0.22 mm). No negative measurement value was observed in this dental group, in contrast to the incisors **(Fig.50).**

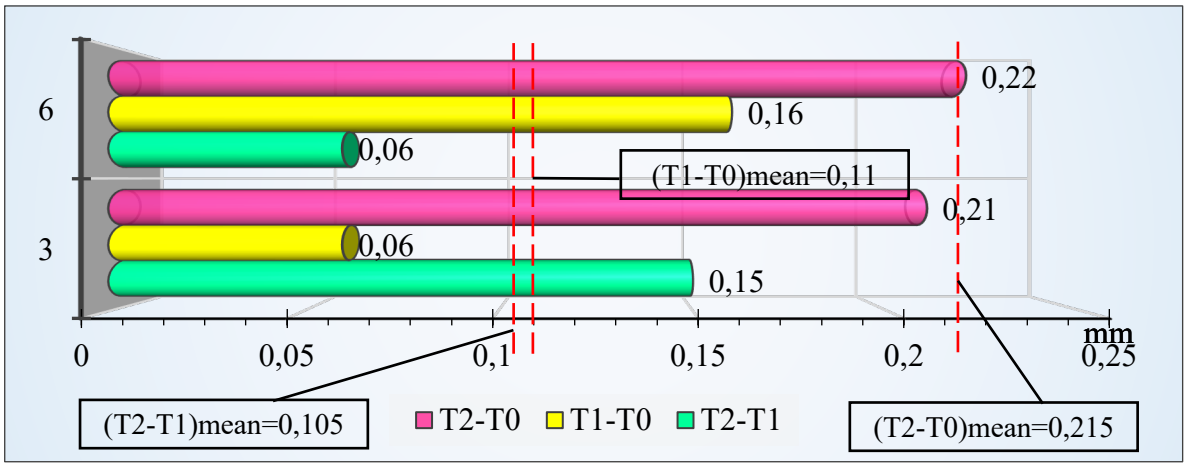


Fig.50 *Difference in the thickness of the free gingival margin on canines between different stages (mm).*

3. Monitoring the periodontal response in the group of premolars.

The comparative analysis for the "plaque" indicator in the group of premolars shows that in stage T0, the presence of plaque is detected in 50% of cases. In the following two stages, a statistically significant difference in this indicator was recorded, with the percentage dropping to 42% in stage T1 and to 25% in stage T2 **(Fig.51).**

Fig.51 *Comparative analysis - presence of plaque on premolars at different stages of treatment (%)*

The results we obtained when measuring the "bleeding on probing" indicator at stage T0 are similar to those from the plaque study in this dental group **(Fig.52)**. From the graphical representation, it can be seen that here too, an improvement in the results is observed. Only 8% of the examined premolars showed bleeding during the stages of cemented temporary and permanent constructions.

Fig.52 *Comparative analysis - bleeding on probing in premolars at different stages of treatment (%)*

The analysis of the data from the measurements shows that the average thickness of the free gingival margin on the premolars before starting treatment is 0.91 ± 0.12 mm, with the minimum measured thickness being 0.77 mm, and the maximum – 1.13 mm **(Fig.53).**

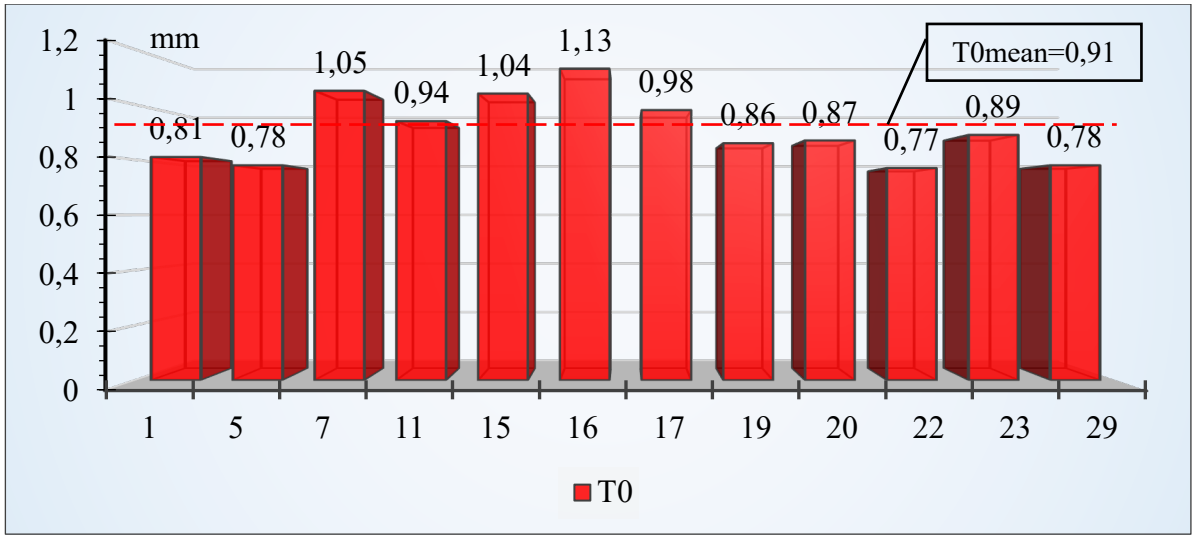


Fig.53 *Thickness of the free gingival margin on premolars at stage T0 (mm)*

The comparative analysis of the results from measurements on the same indicator at stages T1 and T2 is graphically presented in **Fig.54** and **Fig.55**. From the first figure, it is evident that the average thickness of the free gingival margin when measured 2 months after the placement of the temporary restorations is 1.05 ± 0.151 mm, with the minimum thickness being 0.79 mm and the maximum – 1.26 mm. The second figure shows that 6 months after the placement of the permanent restorations, it is 1.08 ± 0.149 mm (with a minimum thickness of 0.83 mm and a maximum of 1.29 mm).

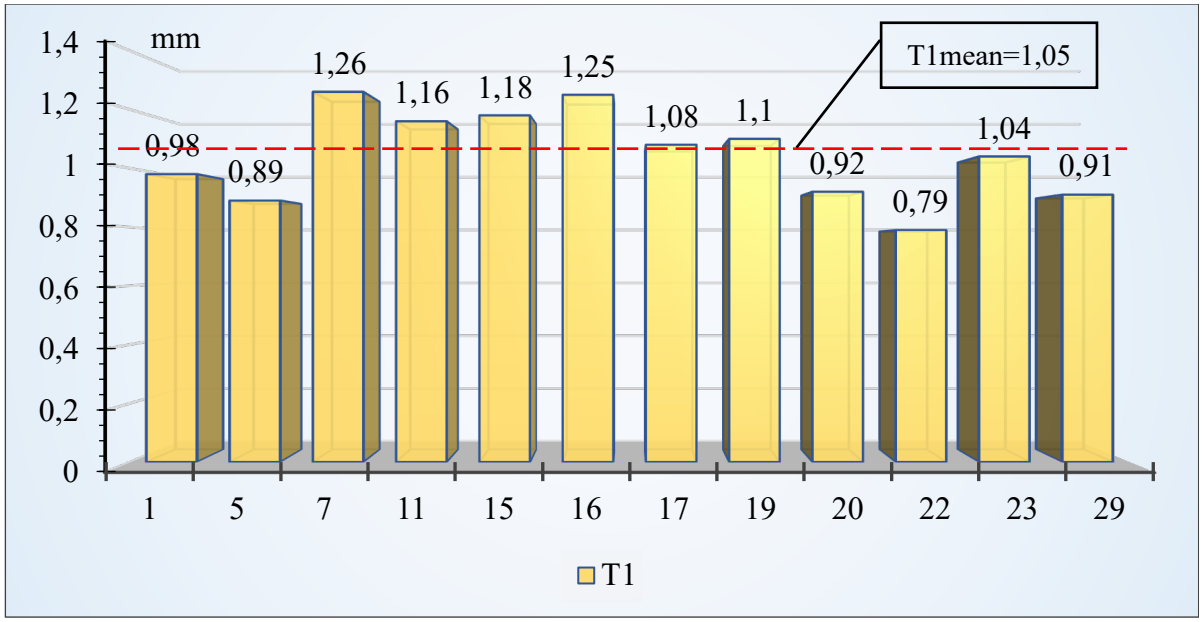


Fig.54 *Thickness of the free gingival margin on premolars at stage T1 (mm).*

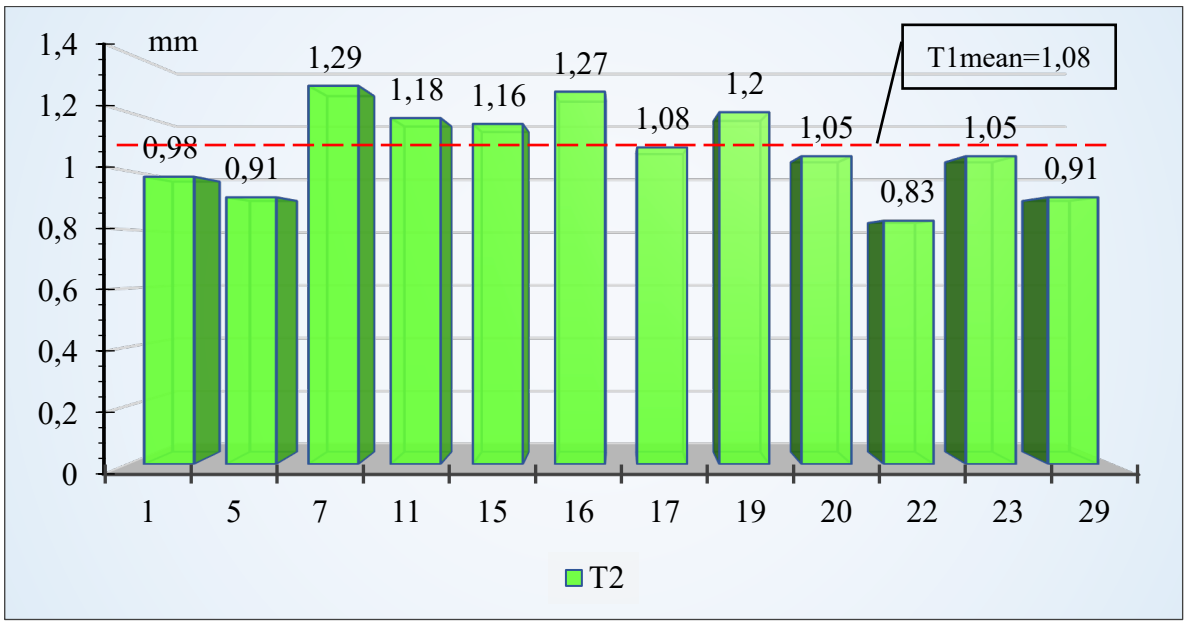


Fig.55 *Thickness of the free gingival margin on premolars at stage T2 (mm).*

Based on the results presented in **Fig.56**, obtained from comparing the difference in the thickness of the free gingival margin of the studied teeth from the premolar group over the T0-T2 period, a statistically significant difference was identified. The measured average increase in thickness was 0.17 mm (with a minimum of 0.06 mm and a maximum of 0.34 mm). As with the canine teeth, this dental group also did not show a negative measurement value.

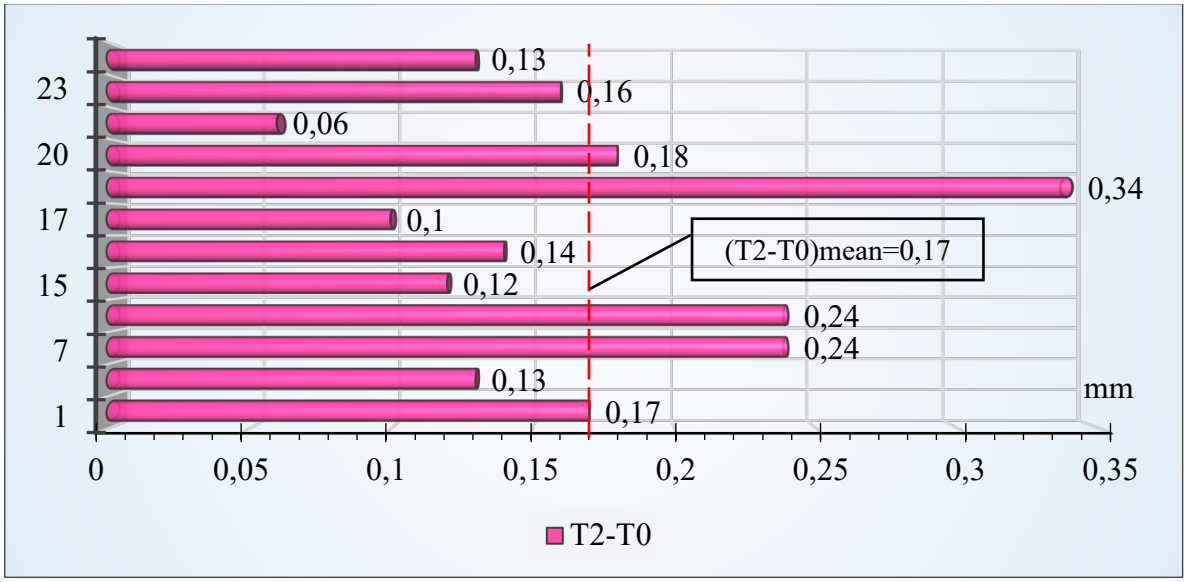


Fig.56 *Difference in the thickness of the free gingival margin on premolars between stages T0-T2 (mm)*

Based on the measurements taken and the subsequent analysis of the obtained results, we found that the difference in the increase in the volume of the free gingival margin before starting treatment and 6 months after cementing the temporary restorations has an average value of 0.14 mm, with the minimum being 0.02 mm, and the maximum measured value being 0.24 mm **(Fig.57)**. As with the incisors and canines, the premolars also show a minimal change in the thickness of the FGM between the stages of temporary and permanent constructions. In this period, an average increase in thickness of 0.03 mm is recorded (minimum - 0.01 mm, maximum - 0.13 mm). It is important to note that in this time interval, three of the studied teeth showed no change in the volume of the margo gingivalis, and one tooth showed a decrease of 0.02 mm.

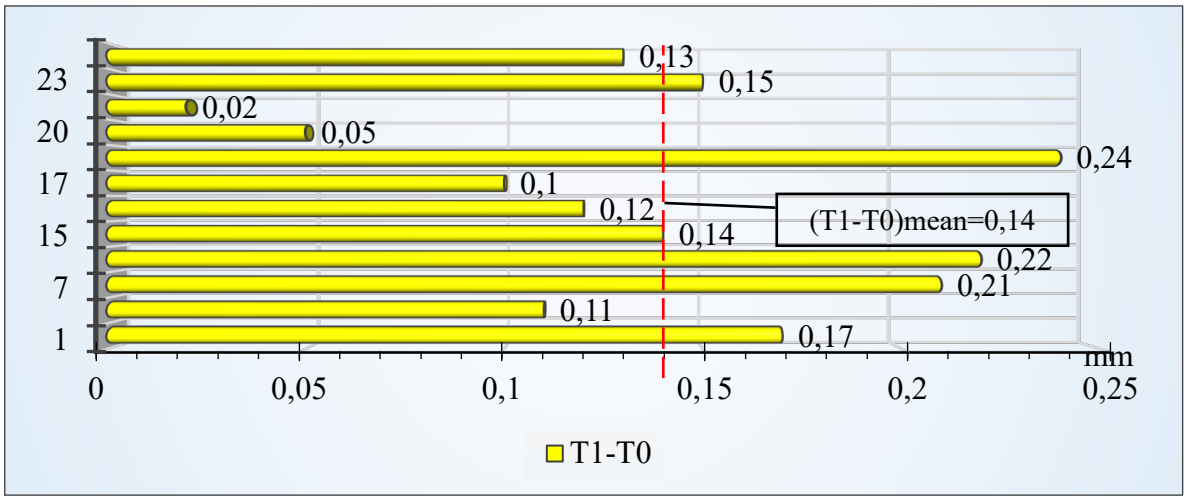


***Fig.57** Difference in the thickness of the free gingival margin on premolars between stages T0-T1 (mm)*

After the statistical processing of the measured values for the thickness of the marginal gingiva in premolars at different stages, a standard error was determined to be 0.0387 (p=0.01) for stage T0-T2, 0.0464 (p=0.091) for T0-T1, and 0.139 (p=0.091) for T1-T2.

Monitoring the periodontal response in all examined teeth after temporary constructions made using an indirect digital method.

Fig.58 presents a comparative analysis of the "plaque" indicator for the examined teeth at different stages of treatment. Before starting the treatment, plaque was detected in 67% of them. When assessing the presence or absence of

plaque 2 months after cementing the temporary constructions and 6 months after cementing the permanent ones, a decrease in the value was observed – respectively 40% and 33%.

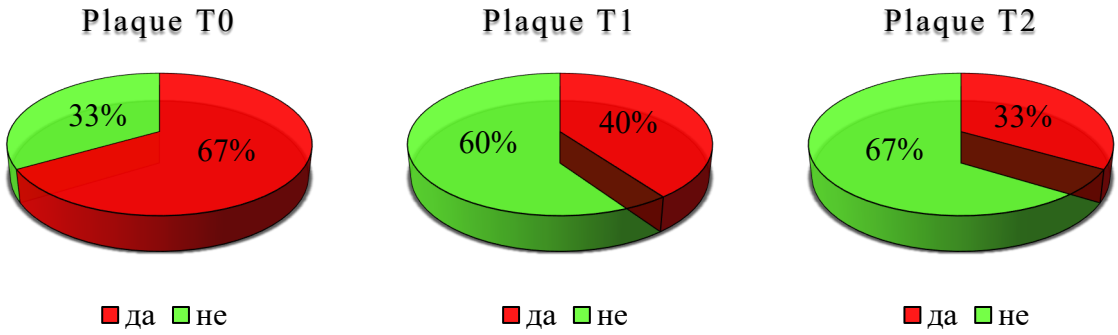


Fig.58 *Comparative analysis - presence of plaque on the examined teeth at different stages of treatment (%)*

The results from the comparative analysis based on the "bleeding on probing" indicator for all examined teeth show that in the initial stage, it is observed in 60% of them. As with the "plaque" indicator, a significant decrease in this percentage is also observed here when comparing the results in subsequent stages – bleeding is observed in only 13% **(Fig.59).**

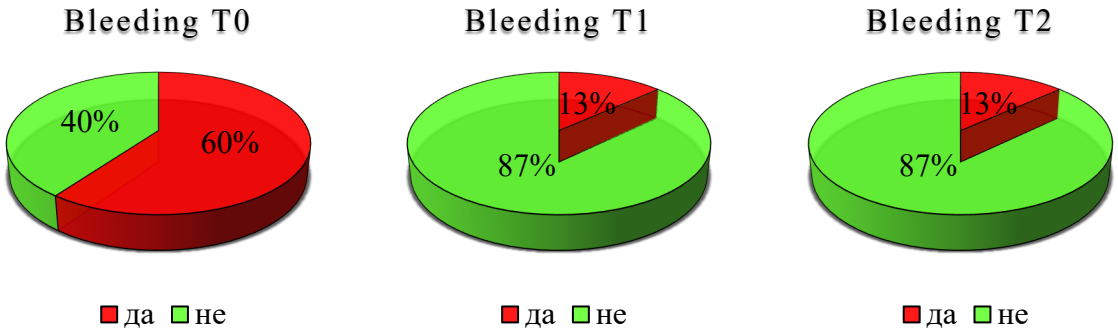


Fig.59 *Comparative analysis - bleeding on probing in the examined teeth at different stages of treatment (%)*

After reviewing and analyzing the data from the measurement of the thickness of the free gingival margin of all examined teeth before starting the treatment, an average value of 1.101 ± 0.247 mm was recorded, with the minimum reported value being 0.7 mm, and the maximum 1.73 mm. In stage T1, values between 0.79 mm and 1.76 mm were measured, averaging 1.204 ± 0.230

mm, showing an increase in the thickness of the free gingival margin by an average of 0.103 ± 0.017 mm. In the final stage, the minimum measured thickness was 0.83 mm, the maximum 1.77 mm, and the average thickness of the marginal gingiva was 1.229 ± 0.220 mm. The increase in the thickness of the FGM over the period averaged 0.128 ± 0.027 mm, and during the intermediate measurement, a change of 0.025 ± 0.01 mm on average was recorded **(Table 2).**

Table 2. *Thickness of the free gingival margin measured at different stages (mm).*

Gingival thickness (mm)	Minimum	Mean	Maximum	Standard deviation
T0	0,7	1,101	1,73	±0,247
T1	0,79	1,204	1,76	±0,230
T2	0,83	1,229	1,77	±0,220

Comparing and analyzing the results obtained from measuring the difference in the thickness of the free gingival margin of all examined teeth for task 1 and task 2 at different stages - T0, T1, and T2.

The statistical analysis of the data obtained from measuring the thickness of the free gingival margin in the T0-T1 period for task 1 and task 2 shows that similar values have been recorded **(Fig.60)**. The consolidated data regarding the average values of all examined teeth for task 1 is $(T0-T1)avg.-Task1=0.091$ mm, and for task 2 is $(T0-T1)avg.-Task2=0.103$ mm. A significant approximation of the two tasks based on similarity has been determined through the F-test. Upon obtaining positive values from the examined teeth with $F=1.757(p=0.0617)$, it can be concluded that the results from the two tasks overlap in certain sections of the figure. During the statistical data processing, a histogram was constructed, and significant minor differences in the thickness of FGM were identified during the T0-T1 period.

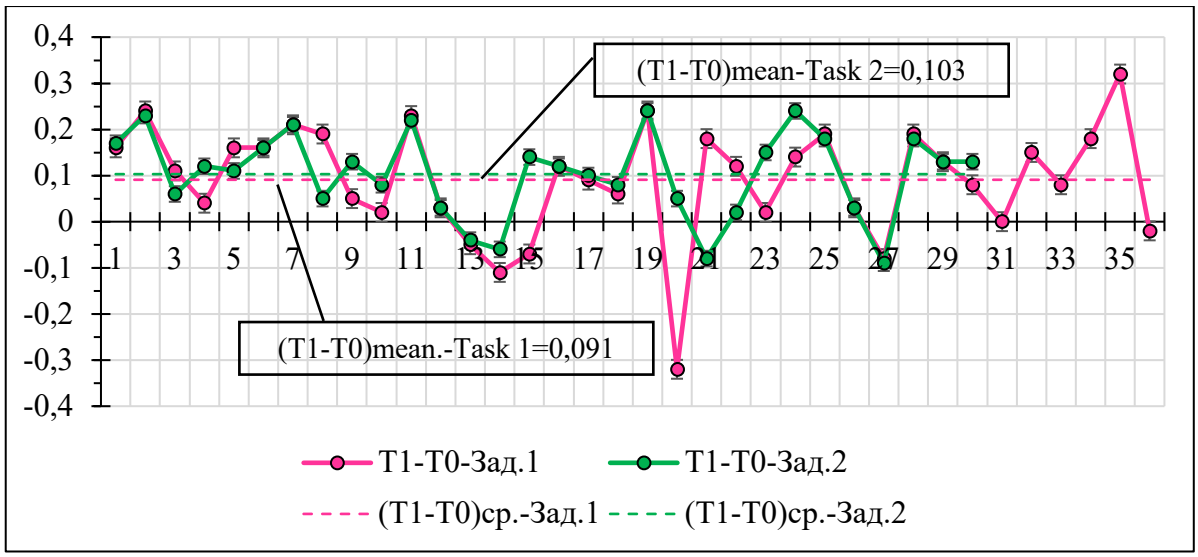


Fig.60 *Change in the difference in gingival thickness measured in stage T0-T1 for task 1 and task 2 (mm)*

After the statistical analysis of the data from measuring the thickness of the marginal gingiva in the T0-T2 period, average values were recorded: $(T2-T0)avg.-Task1=0.103$ mm for task 1 and $(T2-T0)avg.-Task2=0.128$ mm for task 2. Here, too, a significant approximation of the two tasks based on similarity to the median (F-test) was determined. Positive values were obtained from the examined teeth with $F=1.559(p=0.112)$. From the statistical processing of the results, significant minor differences in the thickness of the free gingival margin were identified during the T0-T2 period **(Fig.61)**.

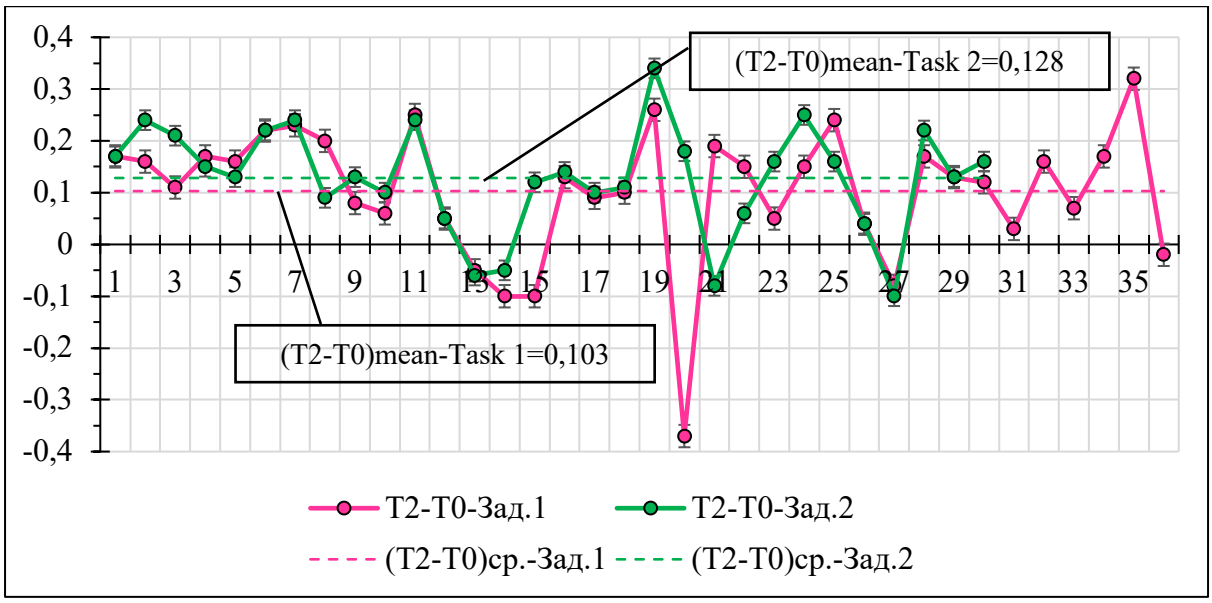


Fig.61 *Change in the difference in gingival thickness measured in stage T0-T2 for task 1 and task 2 (mm)*

The statistical analysis of results obtained from measuring the thickness of the free gingival margin in the T1-T2 period for task 1 and task 2 shows the following recorded average values: for task 1 - $(T2-T1)avg.-Task1=0.012$ mm, and for task 2 - $(T2-T1)avg.-Task2=0.025$ mm. Positive and negative values were obtained from the examined dental groups with $F=0.7(p=0.156)$ **(Fig.62).**

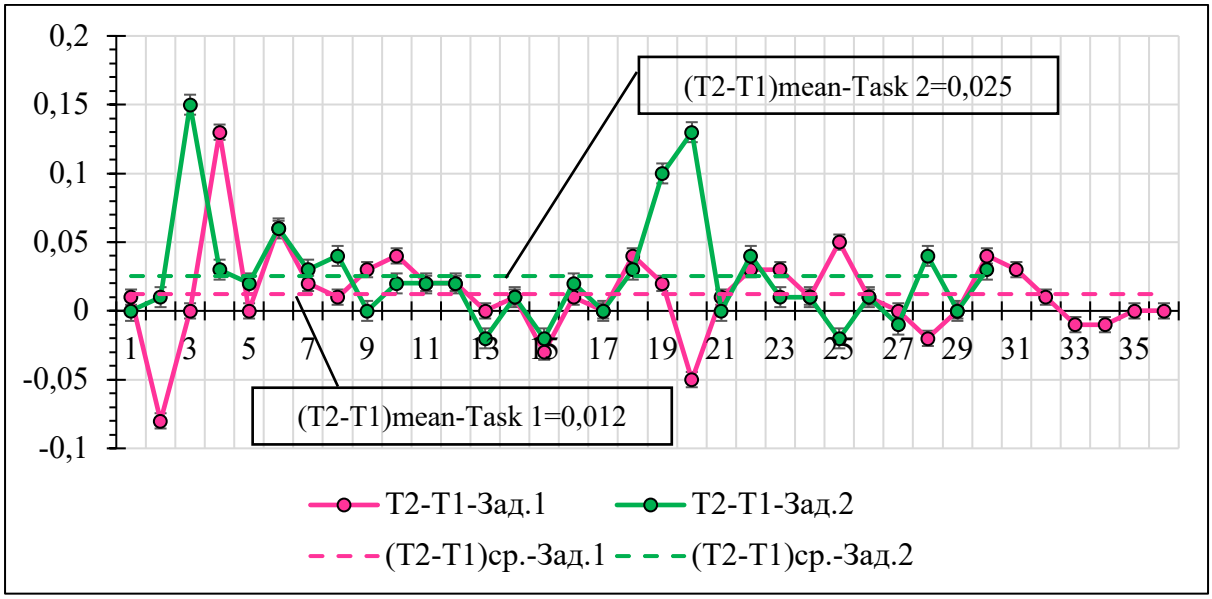


Fig.62 *Change in the difference in gingival thickness measured in stage T1-T2 for task 1 and task 2 (mm)*

IV.1.2. Discussion of the results from the study on the second task for monitoring the periodontal response during treatment with full-coverage crowns after temporary restorations made by the indirect digital method.

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Following the analysis of our results, it was clear that at the initial stage of treatment, bacterial plaque accumulation was observed in 67% of the studied teeth. Based on the obtained results, a significant reduction in this percentage was noted in the subsequent stages – 40% at T1, and 33% at T2. The retention of less plaque with permanent restorations, compared to the temporary ones, could be attributed to the properties of the material from which they were made – smoothness and polishability. Additionally, improved oral hygiene maintenance by the patients may also have played a role.

The results obtained from the analysis, when considering the bleeding on probing indicator, show that before starting the treatment, more than half - 60% of the examined teeth exhibited bleeding. When measured in the stages - 2 months

after placing the temporary restorations and 6 months after cementing the permanent ones, bleeding was observed in only 13%, while the remaining 92% showed no bleeding. Analysis of the data has revealed a significant improvement in the condition of the marginal gum after undergoing prosthetic treatment.

And here, as with Task 1, after analyzing and comparing the data from our study, an increase in the thickness of the FGM was observed. When measuring the thickness of the marginal gum, two months after cementing the temporary restorations made by the indirect digital method, an average increase of 0.103 ± 0.017 mm was recorded. In the final stage of the assessment - six months after cementing the permanent restorations, we noted an increase in the values with an average of 0.128 ± 0.027 mm.

Discussion of the results from the study on monitoring the periodontal response obtained from Task 1 and 2:

After analyzing and comparing the data from our study, obtained for **tasks 1** and **2**, we found that similar results were achieved.

For the "plaque" indicator, using both methods of creating temporary restorations (direct-indirect with the "egg-shell" technique and indirect digital), there is a significant improvement in the results. The percentage of teeth that have been found to have bacterial plaque around the temporary restorations has decreased compared to the initial stage of treatment. Regardless of the fabrication method, well-polished crown margins do not retain plaque, ensuring better cleaning.

In most of the studied teeth, two months after cementing the temporary restorations, an absence of bleeding was noted.

Based on the results obtained from measuring and comparing the thickness of the free gingival margin of the studied teeth for tasks 1 and 2, it was found that with both methods of fabricating temporary crowns, there is an increase in the thickness of the free gingival margin. When measuring the differences in the thickness of the marginal gingiva in stages T0-T1, similar average increases were observed. The results from comparing the recorded changes in thickness over the T0-T2 period are also roughly equivalent. These results lead us to conclude that when applying BOPT, there is a thickening of the gingival margin, regardless of the method of fabricating the temporary restorations.

During the study of patients from both clinical groups, a decrease in the thickness of the FGM was observed in a small percentage (13%) of the teeth during the T0-T2 period, with negative values being recorded.

It was determined that the method of fabricating temporary structures on teeth prepared according to BOPT does not influence the periodontal response and the results obtained from the treatment. Positive changes in the condition of the soft tissues are observed with both methods: reduced accumulation of bacterial plaque and bleeding on probing, and an increase in the thickness of the free gingival margin.

IV.3. Results and discussion on Task 3

Creating precise temporary restorations is crucial in prosthodontic treatments involving fixed prosthetic structures and is a prerequisite for achieving successful outcomes. With the help of Biologically Oriented Preparation Technique (BOPT), an opportunity for the regeneration of soft tissues is created, ensuring stability and support for the marginal gingiva. Among the most popular methods for fabricating temporary restorations is the direct-indirect method. The working protocol is described in details in **Task 1**.

As some dental practitioners have indicated encountering frequent challenges in rebasing the temporary structures in the oral cavity when working with BOPT, we directed our focus towards devising a clinical algorithm. This algorithm is designed to assist colleagues in the process of creating temporary structures using the direct-indirect method. The main objective of this algorithm is to ensure repeatable and predictable outcomes **(Fig.63).**

1. Taking a preliminary impression
2. Fabrication of a temporary restoration "egg-shell" typewith approximate thickness 0,3-0,5 mm (laboratory stage)
3. Checking the fit of the pre-fabricated temporary restorations to the prepared teeth
4. Isolation of the prepared teeth and adjacent teeth with vaseline or artificial saliva
5. Application of self-polymerizing or dual-polymerizing resin in the prosthetic restoration.
6. Positioning of the temporary restoration on the prepared teeth and performing multiple control removals.
7. After the removal of the restoration, a double crown edge with a space between them is observed, which represents a negative copy of the free gingival margin.
8. Filling the space with a flowable composite and thickening the crown edge.
9. Individualizing the crown margin and shaping an appropriate convex emergence profile.
10. Shaping and refining
11. Adjusting the crown margin in depth of 0,5-1mm in the gingival sulcus.
12. Adjusting towards the adjasent teeht and antagonists.
13. Polishing.
14. Isolating the crown margin with artificial saliva or vaseline for easier removal of excess temporary cement.
15. Cementation with non-eugenol temporary cement.

Fig.63 *Algorithm*

IV.4. Results and discussion on Task 4

IV.4.1. Analysis of the opinion of doctors of dental medicine regarding the biologically oriented preparation technique and the possibility of guiding the gingival contour using the emergence profile of full coverage crowns.

In the survey regarding the biologically oriented preparation technique and its clinical application, a total of 72 dental practitioners participated. The results of the survey indicate that a larger proportion of the DMD are male (54%), while females constitute 46%. The majority of DMD are the age group of 31-40 years, accounting for 40% of all respondents **(Fig.64)**.

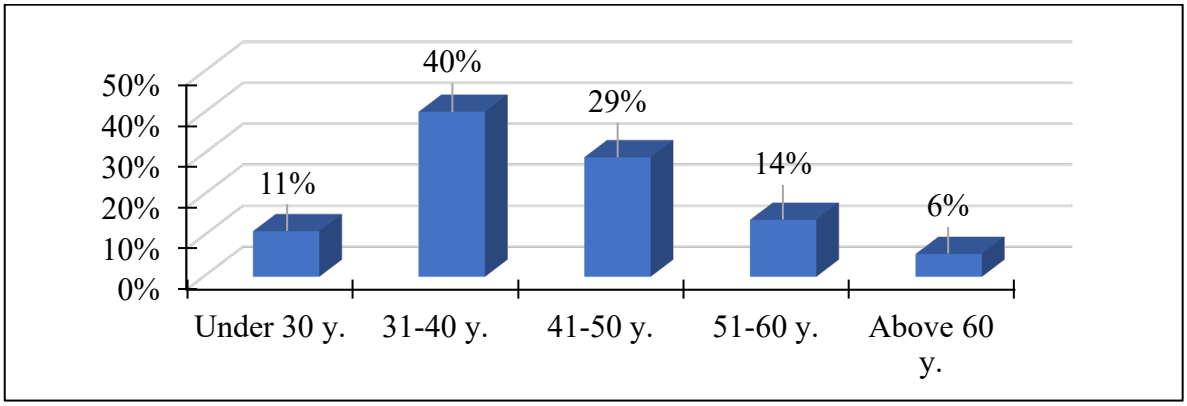


***Fig.64** Percentage distribution by age groups*

The results of the analysis of the surveyed DMD according to their work experience show a relatively even distribution between two main groups - those with 5 to 10 years of experience (31%) and those with 20 to 29 years of experience (28%) **(Fig.65)**.

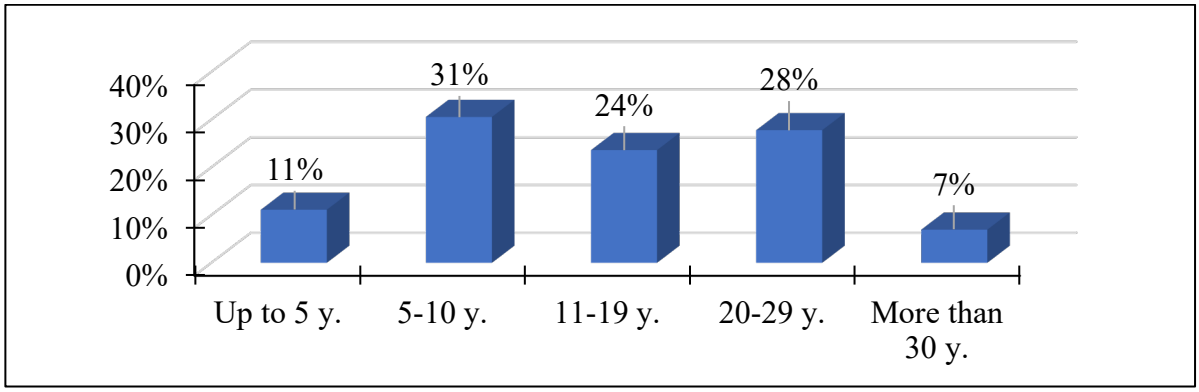


***Fig.65** Percentage distribution based on years of professional experience of DMD*

In the survey, more than half of the surveyed DMD have a specialty (57%) **(Fig.66)**, with the majority specializing in Prosthetic Dentistry. 23 participants or 32% of all respondents indicate that they do not have a specialty, while 8 (11%) are currently pursuing specialization.

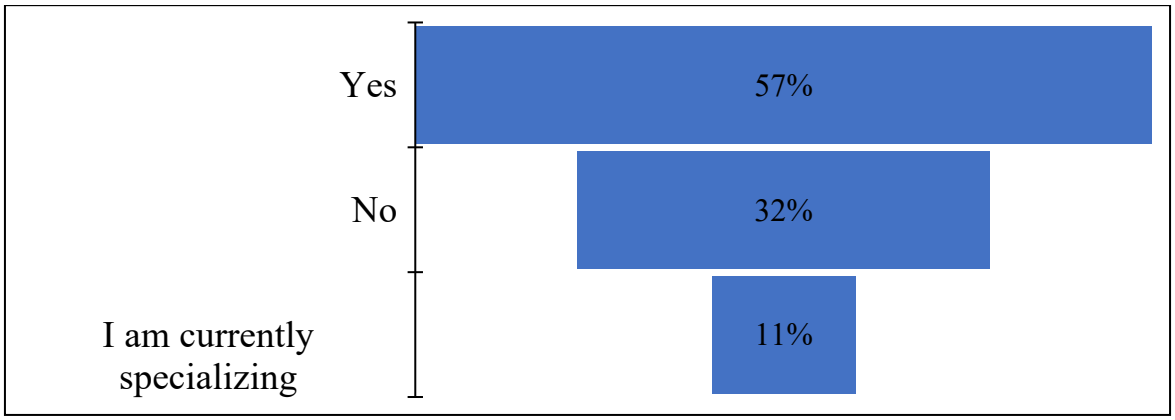


Fig.66 *Percentage distribution based on having a specialty*

From the analysis of the obtained results, it is found that DMD most commonly use the vertical (knife-edge) finish line (25.2%) and the biologically oriented preparation technique (25.98%) when preparing teeth for full coverage crowns. Clearly defined horizontal preparation margins (shoulder), horizontal with rounded inner angle, and chamfer finish line are preferred choices in 19.69% and 20.47% of the cases, respectively **(Fig.67)**.

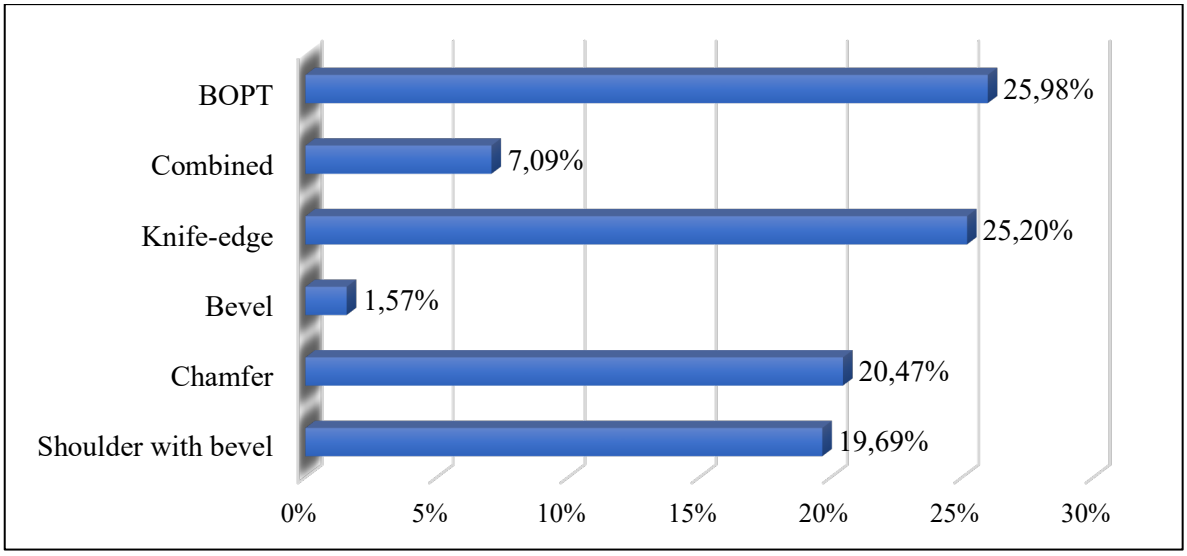


Fig.67 *Distribution according to the preferred finish line when preparing teeth for full coverage crowns by DMD (%)*

The relationship between age and the preferred finish line was investigated, revealing that BOPT is the preferred method among dental professionals in the age range of 31-39 years **(Fig.68)**.

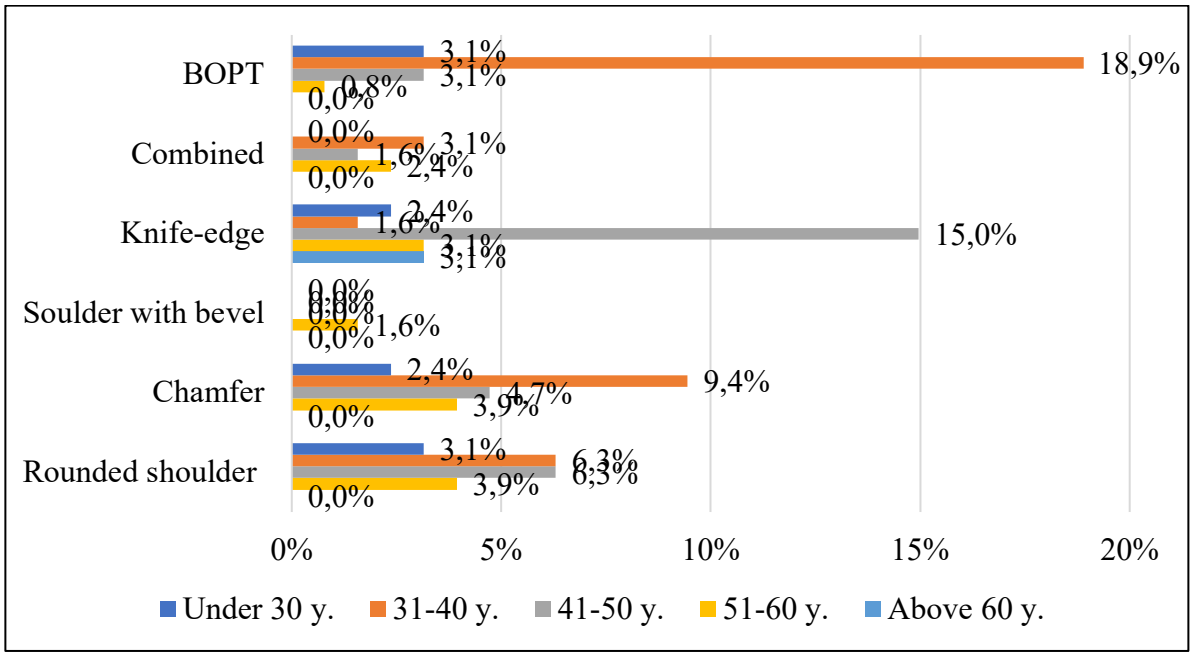


Fig.68 *Preferred finish line by DMD according to age (%)*

The majority (75%) of the participants in the study reported experiencing complications when using preparation technique with defined FL. Among them, the most common complications are gingival recession (32%), followed by excessive removal of tooth structure (30%), and gingival inflammation (21%) **(Fig.69)**.

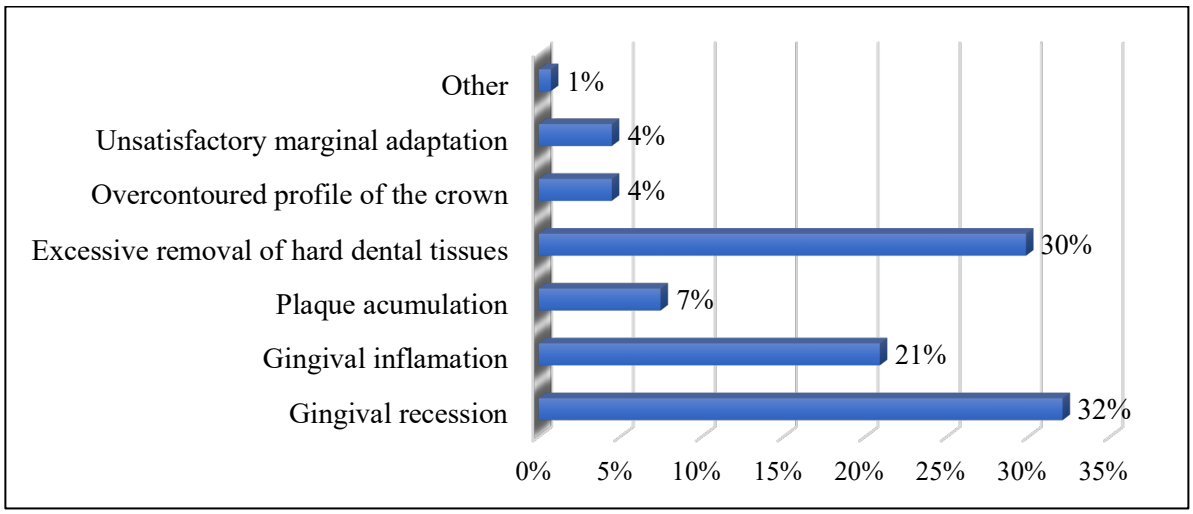


Fig.69 *Percentage distribution of observed errors when using preparation technique with defined finish line*

A significantly smaller portion (35%) of DMD report complications when using the vertical preparation technique. According to the respondents, the most common complications are gingival inflammation (32%) and overcontoured crown profile (33%), while the least encountered issues are plaque accumulation (5%) and excessive removal of tooth structure (4%) **(Fig. 70)**.

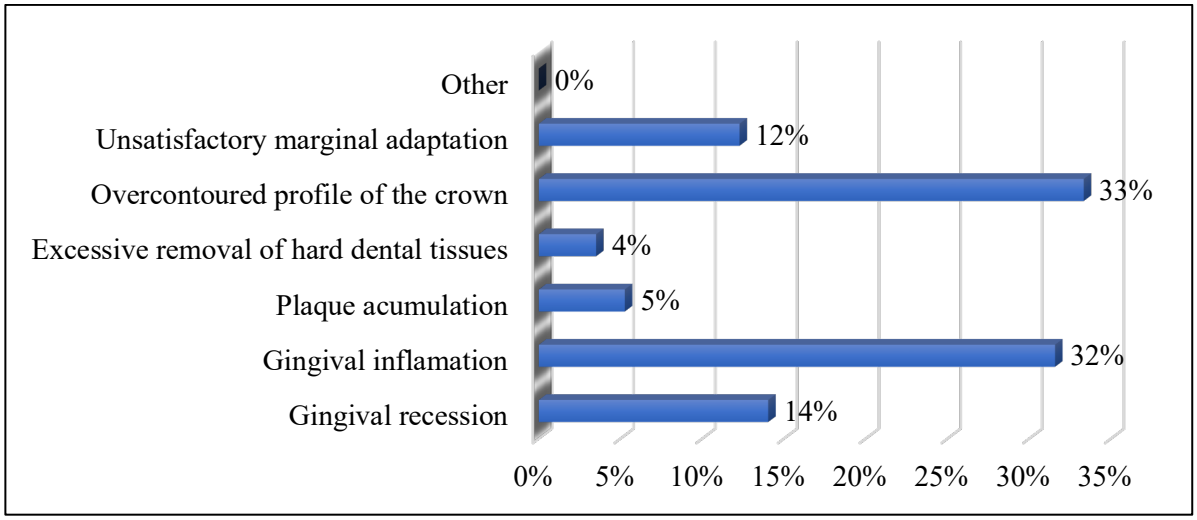


Fig.70 *Percentage distribution of observed errors when using the vertical preparation technique*

In their clinical practice, almost all of DMD report placing temporary crowns during treatment with full coverage crowns - 56% in every clinical case. Only three respondents stated that they do not protect prepared teeth with temporary restorationstions **(Fig.71)**.

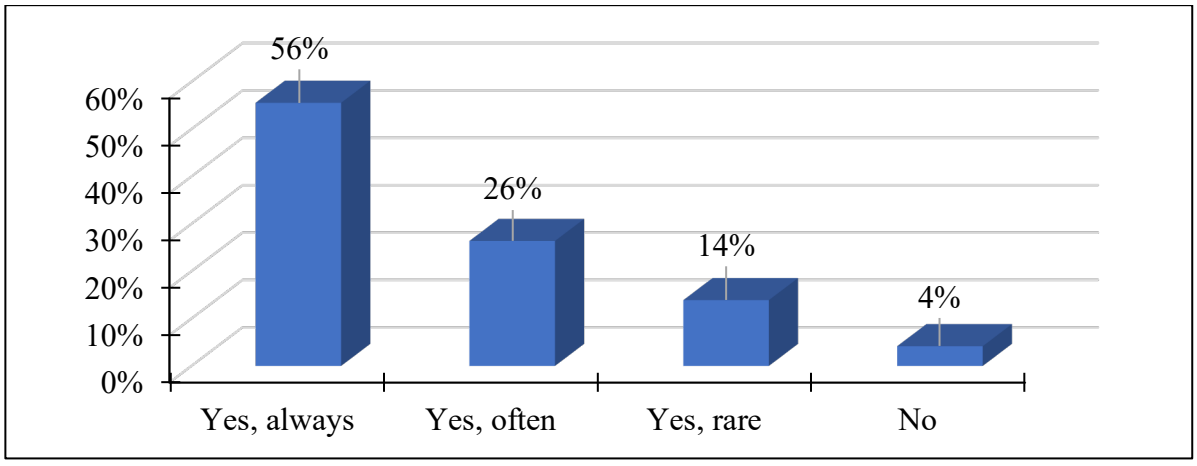


Fig.71 *Placement of temporary crowns by DMD during treatment with full coverage crowns (%)*

From **Fig.72**, it can be observed that DMD who do not place temporary restorations during prosthetic treatment are those above 50 years of age.

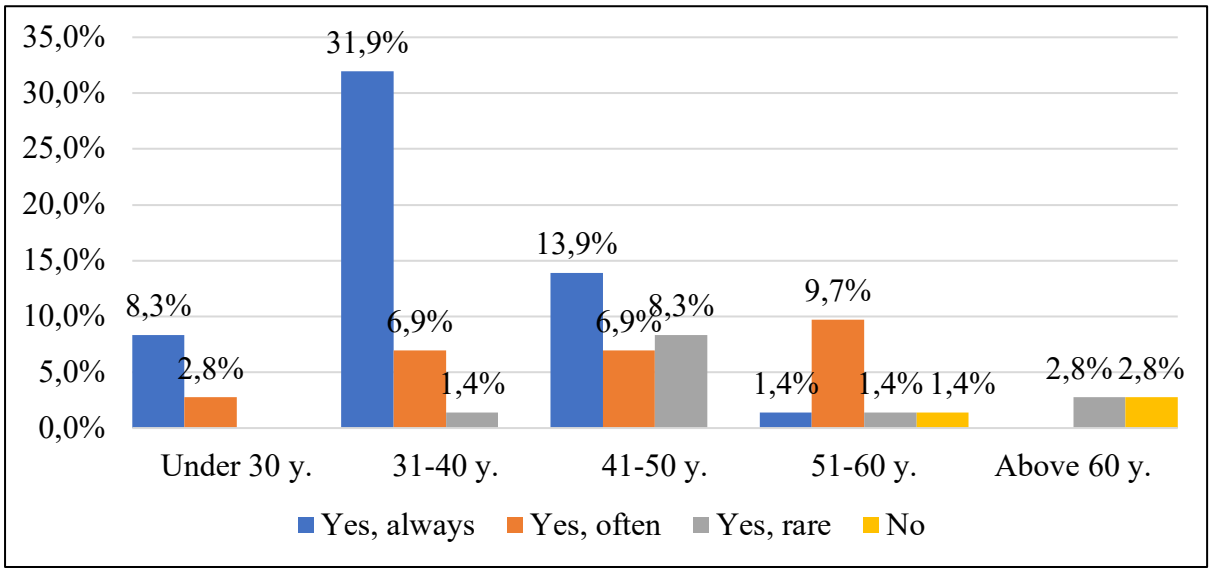


Fig.72 *Percentage distribution of placing temporary crowns by age of DMD (%)*

Percentage distribution of the preferred method for fabrication temporary restorations shows that the majority (51%) of DMD prefer the indirect method for making temporary constructions. The distribution is relatively even between the other two methods: direct (20%) and direct-indirect (29%) **(Fig.73)**.

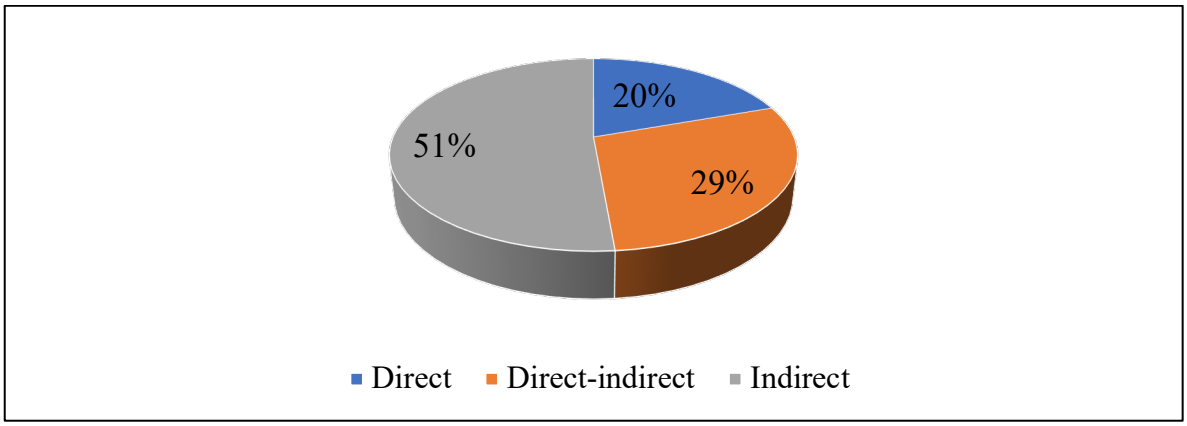


Fig.73 *Percentage distribution of used method for fabrication temporary restorations by DMD*

33% of DMD apply temporary crowns for a period of 1-2 weeks. A significant portion of them assess the interval individually based on the case

(30%), while the smallest percentage, respectively 10% and 1%, is for the time intervals of 3-4 weeks and over 4 weeks **(Fig.74)**.

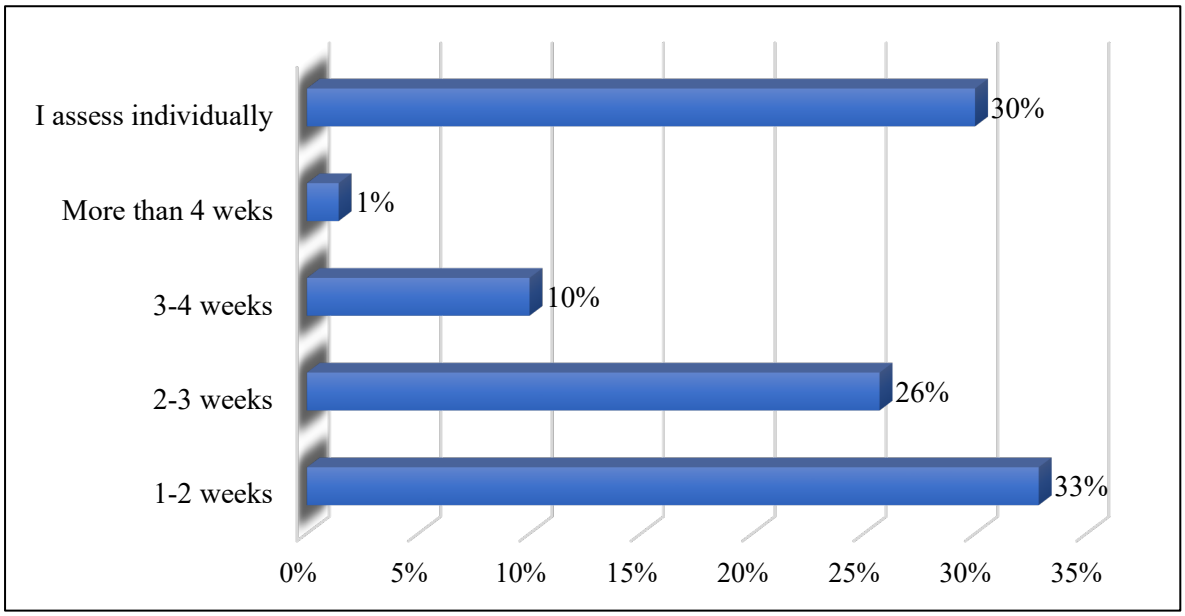


***Fig.74** Period of applying temporary crowns (%)*

The results obtained regarding the relationship between the preferred method for fabricating temporary restorations by DMD and the duration for which they apply them are depicted in **Fig.75**.

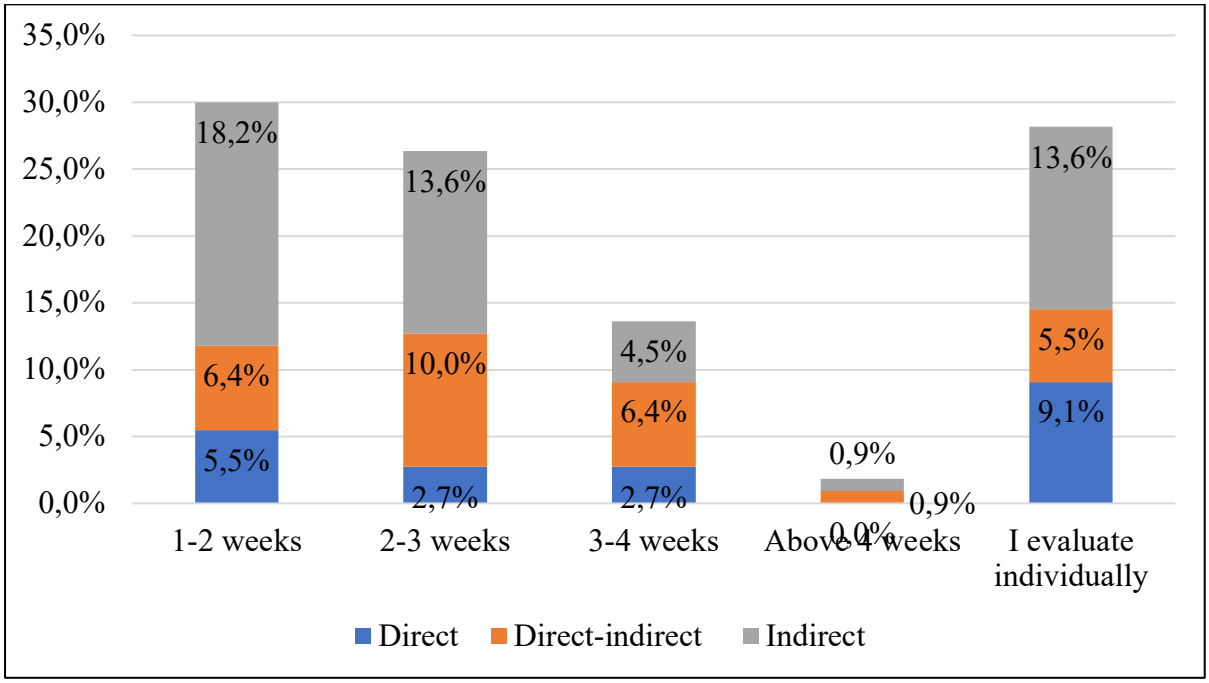


***Fig.75** Percentage distribution of DMD's preferences for the method of fabricating temporary restorations and the duration for which they apply them.*

72% of all surveyed specialists report that they individualize the crown margin of the temporary restorations. Among them, 49% do it in all cases **(Fig.76)**.

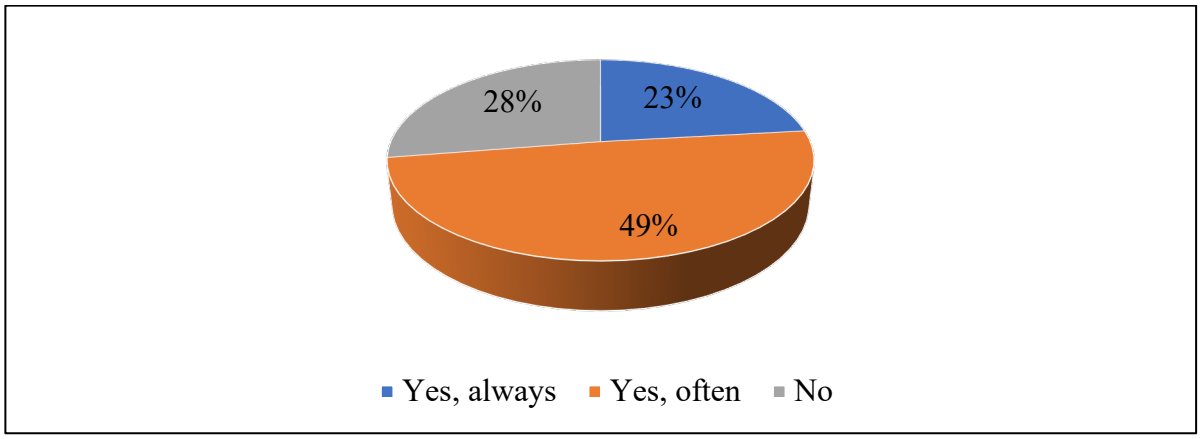


Fig.76 *Individualization of the crown margin of the temporary restorations (%)*

61% of the surveyed DMD are familiar with the biologically oriented preparation technique. Among them, 82% utilize it in their practice **(Fig.77)**.

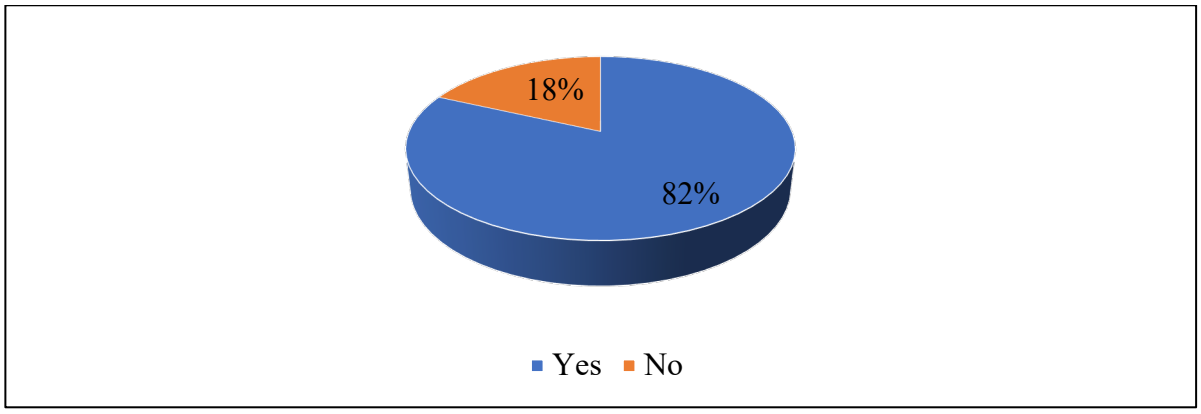


Fig.77 *Are you familiar with the biologically oriented preparation technique, and do you use it? (%)*

Results from the analysis, presented in **fig.78**, show that DMD most commonly apply the biologically oriented preparation technique (BOPT) when replacing FDP with prepared finish line is indicated (28%), followed by prosthetic treatment in the visible area of the dentition (26%), and as an alternative to vertical preparation techniques (26%). 8% of dental professionals prefer it in cases with high aesthetic demands from the patient. A relatively small portion applies it in cases of gingival recession (13%).

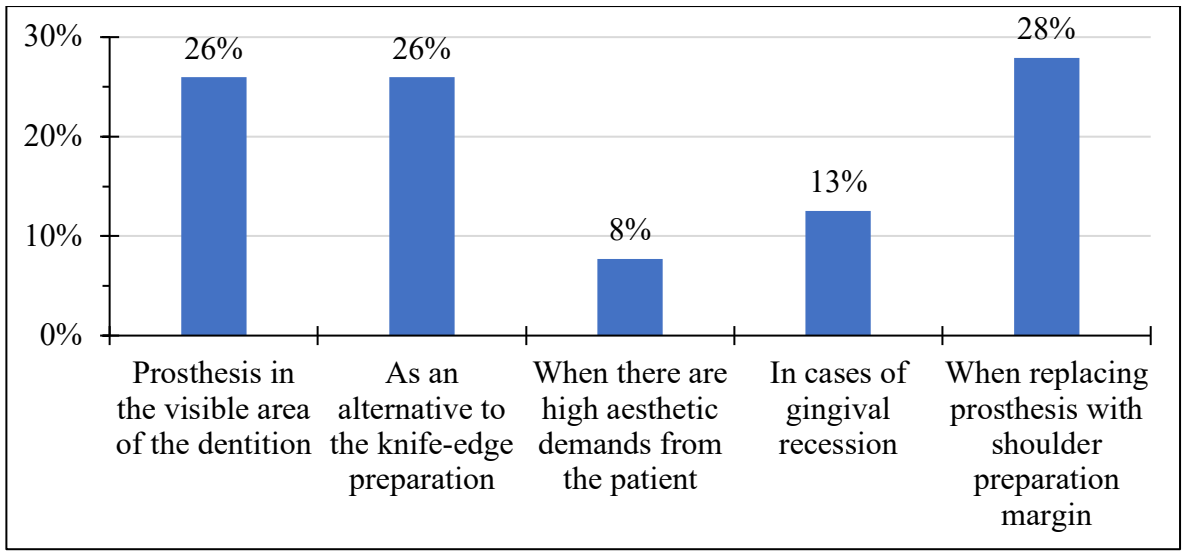


Fig.78 *In which cases do you apply the biologically oriented preparation technique (BOPT)? (%)*

DMD who apply the biologically oriented preparation technique (BOPT) in their practices highlight the most significant advantage of the technique as a more conservative removal of hard dental tissues compared to preparation with a horizontal margin (24%). The other most commonly cited advantages include a quick and easy technique, simplified impression technique, increased thickness and volume of gingival tissues, and achieving stability of the gingival margin for a long-term **(Fig.79)**.

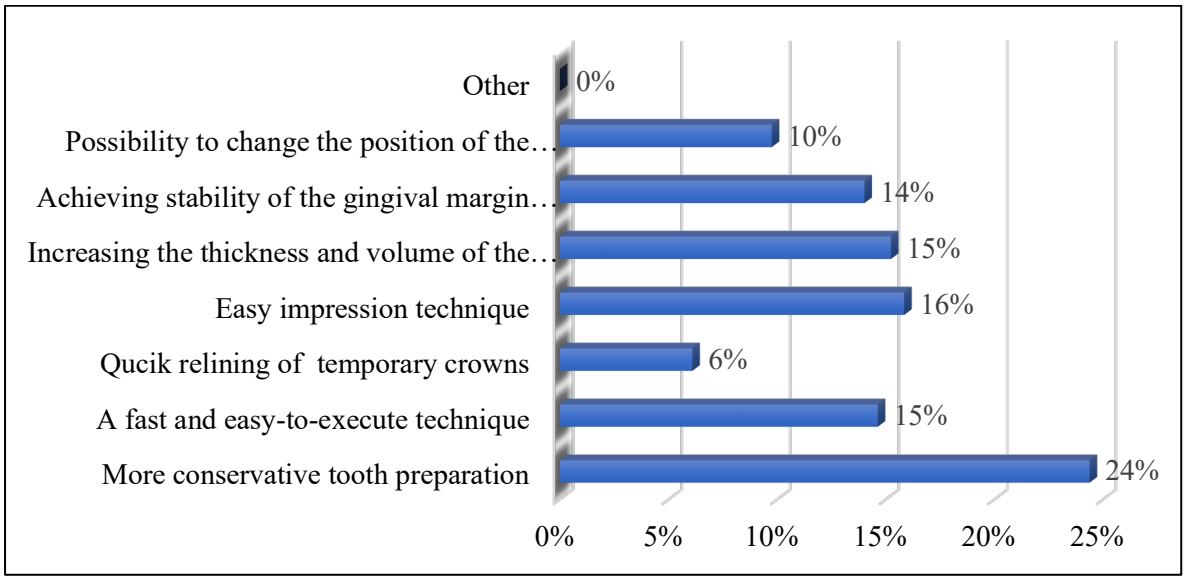


Fig.79 *Advantages of BOPT as indicated by DMD (%)*

The main challenge encountered by nearly 57% of DMD, when performing the biologically oriented preparation technique, is the clinical relining of

temporary crowns. This percentage is significantly lower to tooth reduction (preparation) at 12% and executing the impression technique for definitive restorations at 10%. 22% of the respondents indicated that they do not encounter any difficulties when using the technique **(Fig.80)**.

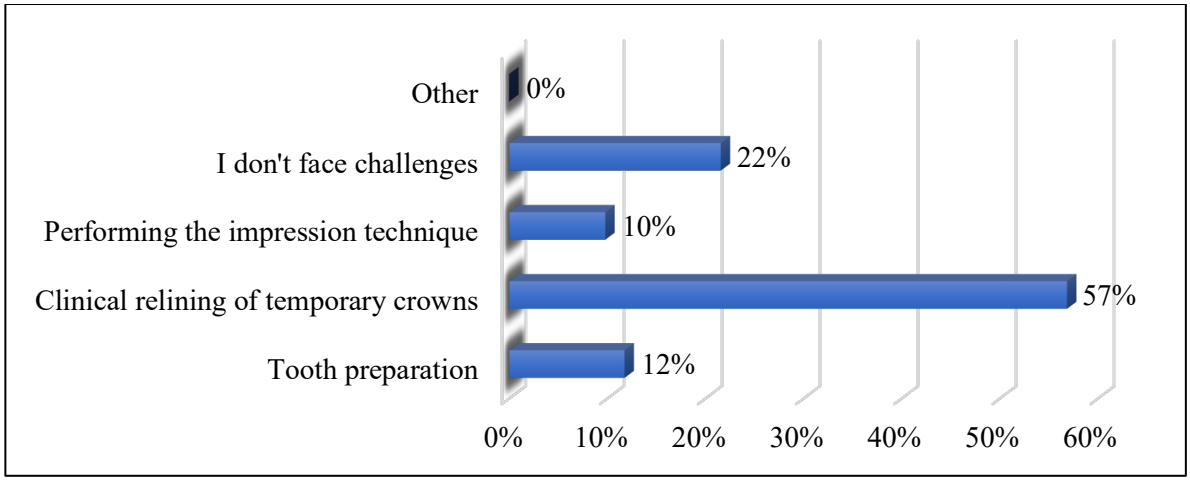


Fig.80 *Difficulties encountered when performing BOPT (%)*

Nearly 70% of DMD indicate that they are not familiar with the protocol for the fabrication and relining of temporary restorations according to BOPT.

A comparative analysis of the most frequently used material for fabricating full coverage crowns in the esthetic area is presented in **fig.81**. The results show that DMD mostly use metal-ceramic restorations (36%), followed by full-contour zirconium dioxide crowns (32%).

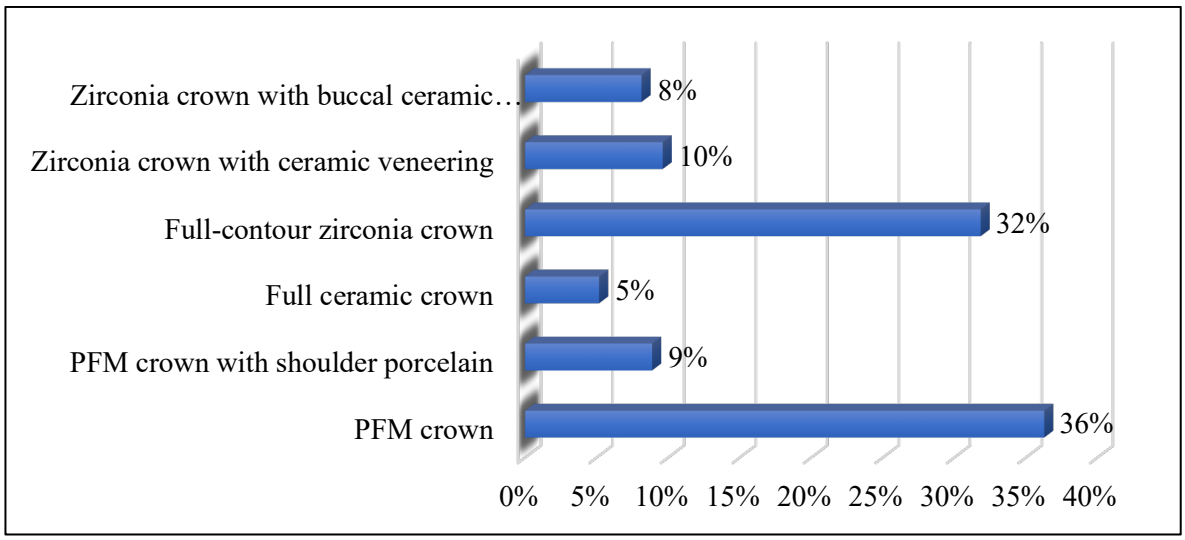


Fig.81 *Most commonly used material by DMD for fabricating full coverage crowns in the esthetic area (%)*

The obtained results regarding the relationship between the age of DMD and the preferred material for prosthetic treatment with full coverage crowns in the visible area of the dentition are shown in **fig.82.**

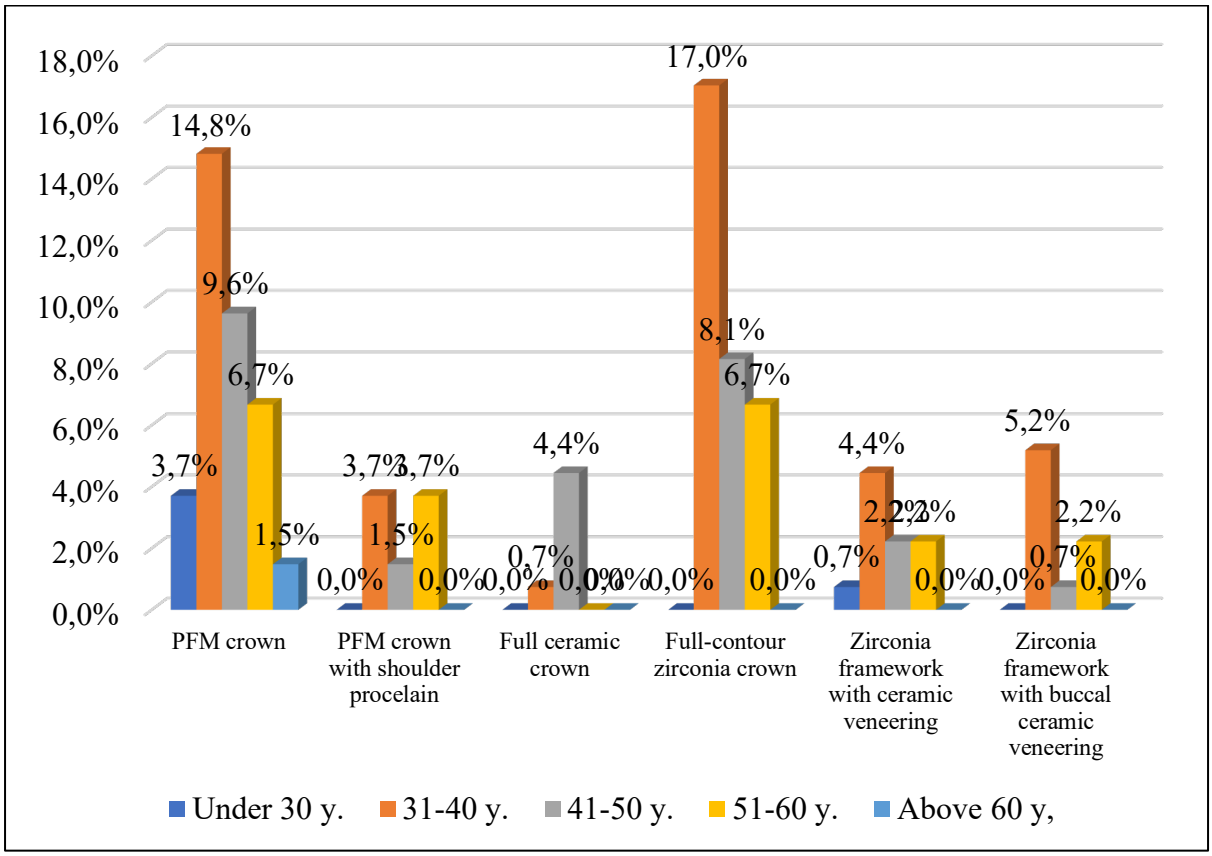


Fig.82 *Percentage distribution of the preferred material for fabrication of full coverage crowns in the visible area of the dentition according to the age of surveyed DMD (%)*

Almost 80% of DMD indicate that they would or already implement Biologically Oriented Preparation Technique (BOPT) in their practice.

IV.4.2. Analysis of dental technicians' opinion on the fabrication of fixed dental prosthesis on teeth prepared using a biologically oriented preparation technique among dental technicians

The results of the analysis show that the majority of dental technicians are male (65%), while females represent 35%. The age distribution indicates that the majority of participants fall into the age group of 41-50 years (44%). The remaining participants are relatively evenly distributed across the other age groups, as depicted in **fig.83**.

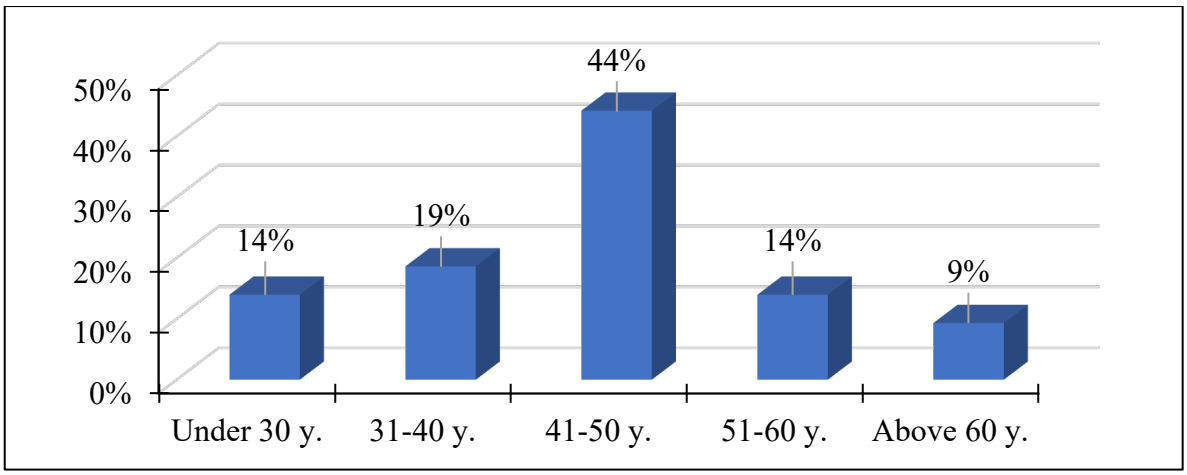


Fig.83 *Percentage distribution by age of dental technicians*

The results of the analysis according to the work experience of dental technicians show a prevalence in two main groups - those with experience from 11 to 19 years (28%) and those in the range of 20-29 years (30%) **(Fig.84)**.

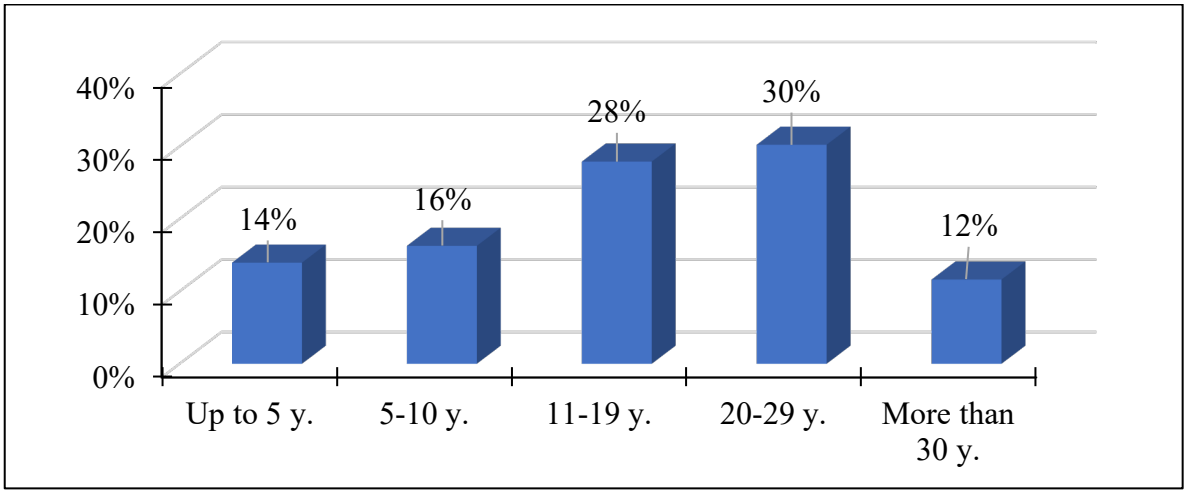


Fig.84 *Percentage distribution according to the work experience of dental technicians.*

The following figure illustrates the distribution of dental technicians according to the number of collaborating dentists. The analysis shows that the majority work with 6 to 10 dentists (47%), followed by 11 to 19 dentists (28%), and less than 5 dentists (21%) **(Fig.85)**.

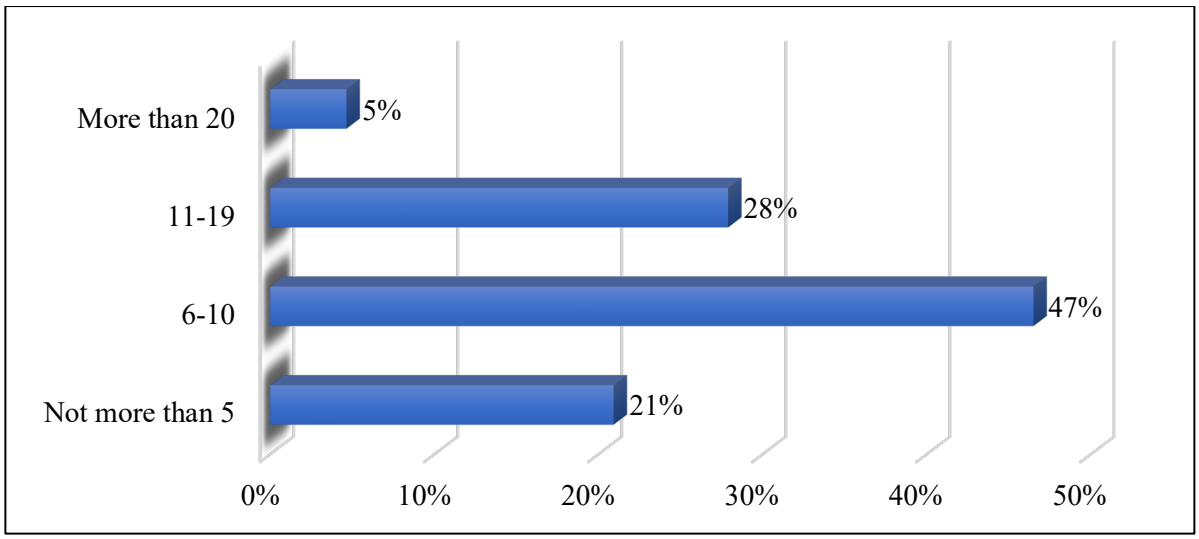


Fig.85 *Distribution of dental technicians according to the number of collaborating DMD (%)*

The **fig.86** presents the results regarding the types of fixed dental prostheses that dental technicians most commonly fabricate in their practices. It shows that two main types predominate: metal-ceramic restorations (32%) and full-contour zirconium dioxide restorations (29%), followed by zirconium dioxide frameworks with vestibular ceramic veneer (14%).

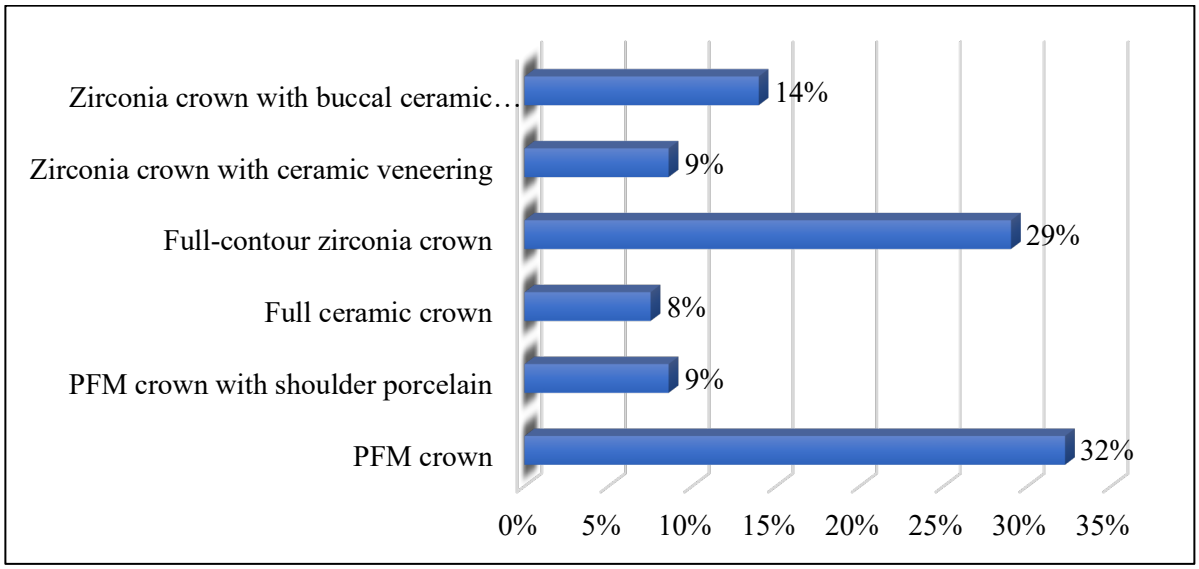


Fig.86 *Percentage distribution of dental technicians based on the most commonly used material for fabricating fixed dental prostheses (%)*

Comparative analysis of the most commonly used material for fabricating FDP by dental technicians based on their age is presented in **fig.87**.

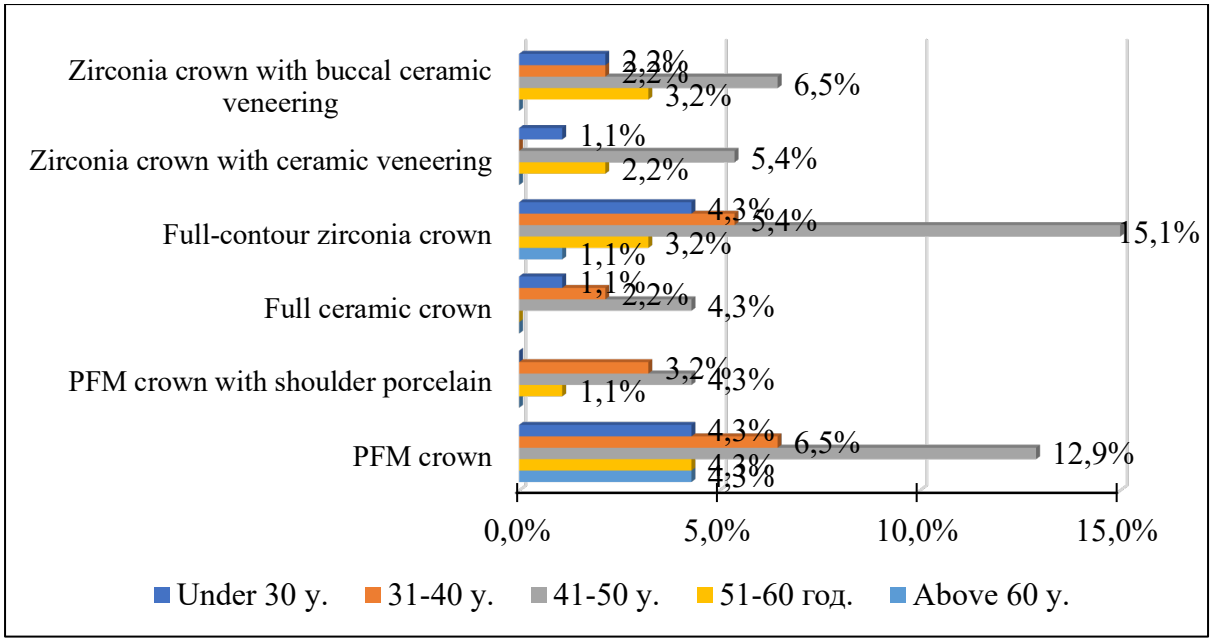


Fig.87 *Percentage distribution of preferred materials for fabricating FDP according to the age of surveyed dental technicians.*

Fig.88presents a comparative analysis of the most commonly used materials for fabricating fixed prosthetic restorations by dental technicians and DMD. The results show that both groups of specialists most frequently use metal-ceramic constructions (32.3% for dental technicians and 36.3% for dentists), followed by zirconium dioxide full-contour constructions (29% for dental technicians and 31.9% for dentists).

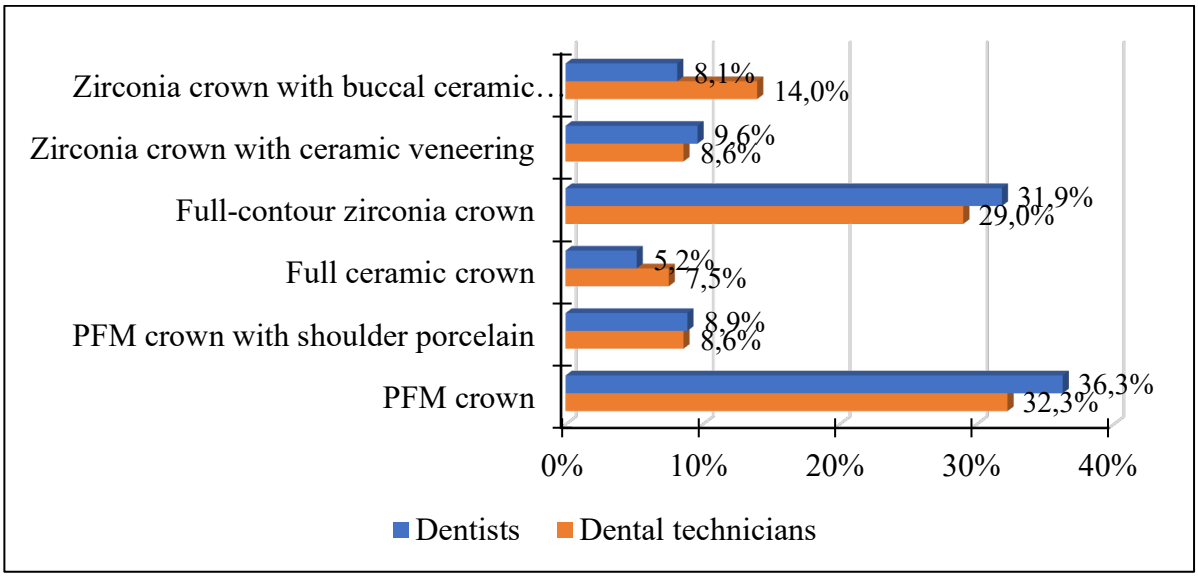


Fig.88 *Distribution according to the most commonly used material for fabricating FDP by dental technicians and DMD (%)*

Participants in the survey indicate that the main impression material used by dentists when taking an impression is silicone, with a slight preference for addition silicones (38%) compared to condensati silicones (32%)**(Fig.89)**.

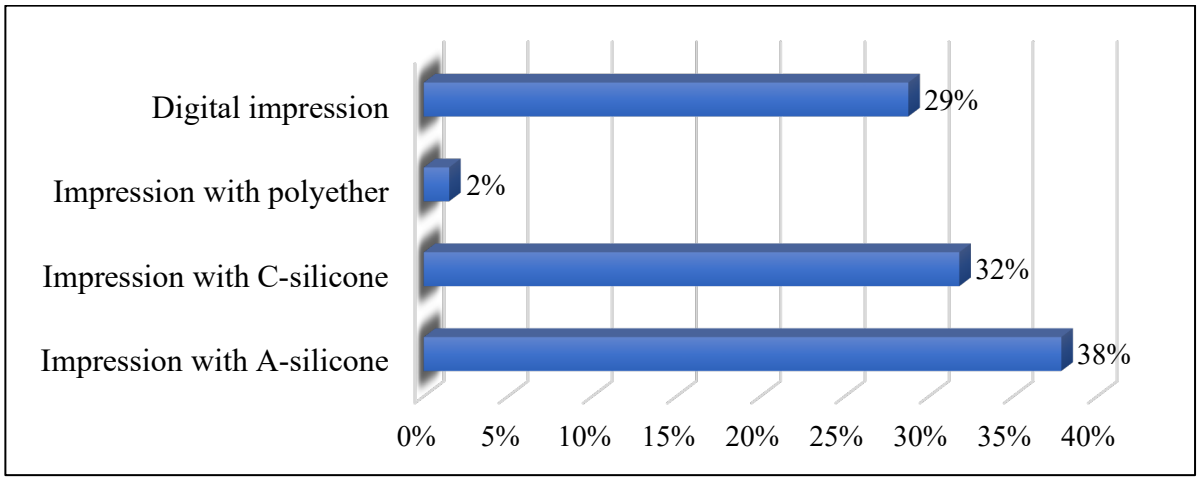


Fig.89 *Types of impression materials used by DMD (%)*

79% of surveyed dental technicians report observing errors in the obtained impressions. Based on the analysis conducted, it can be summarized that the most common errors made by dentists when taking an impression, whether conventional or digital, are the lack of a clearly visible finish line (26%), followed by the presence of voids (30%) and "dragging" of the material in different parts of the impression (16%) **(Fig.90)**.

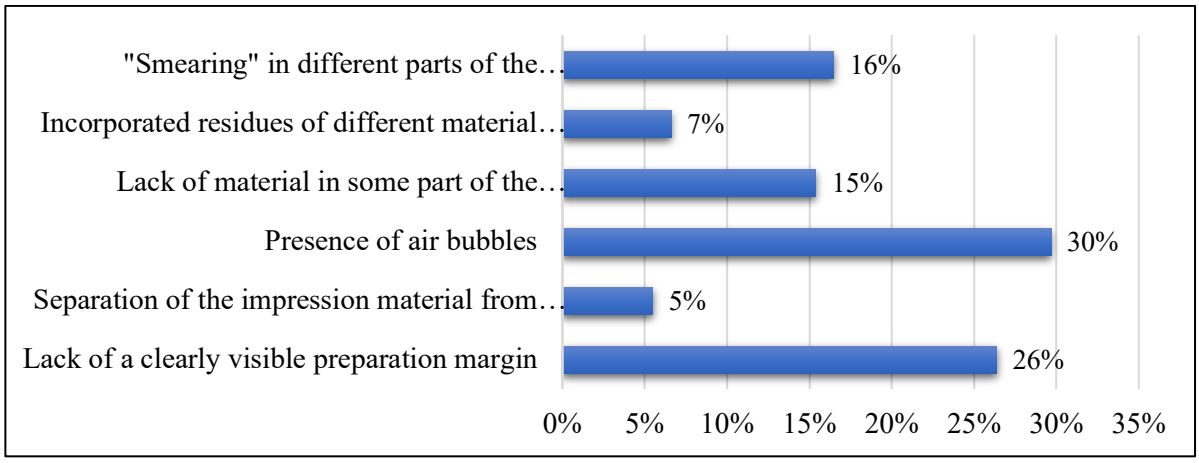


Fig.90 *Types of errors in obtained impressions (%)*

The main inaccuracies observed by dental technicians during the preparation of hard dental tissues can be seen in **fig.91**. It is noteworthy that the lack of a clearly visible preparation margin and the presence of retentive grooves are the

two most commonly mentioned responses (in 24% of cases), followed by preparation of axial walls in a single plane (19%).

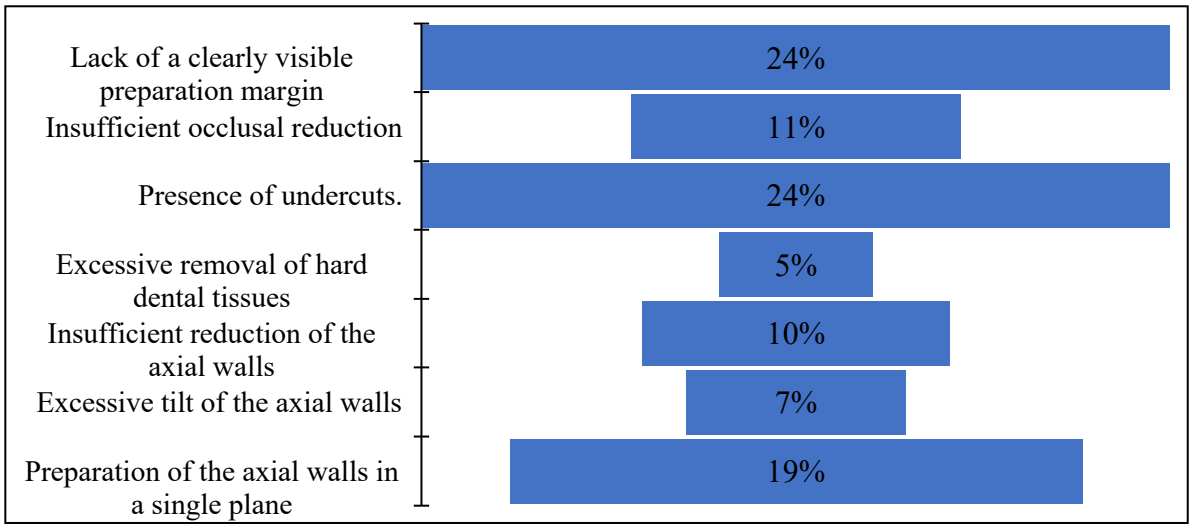


Fig.91 *Inaccuracies in the preparation of hard dental tissues identified by dental technicians (%)*

Approximately half of the dental technicians (39%) share with the dentists that they have identified some inaccuracies in the preparation of the abutment tooth and corrections are needed, a new impression needs to be taken to create an accurate construction **(Fig.92)**.

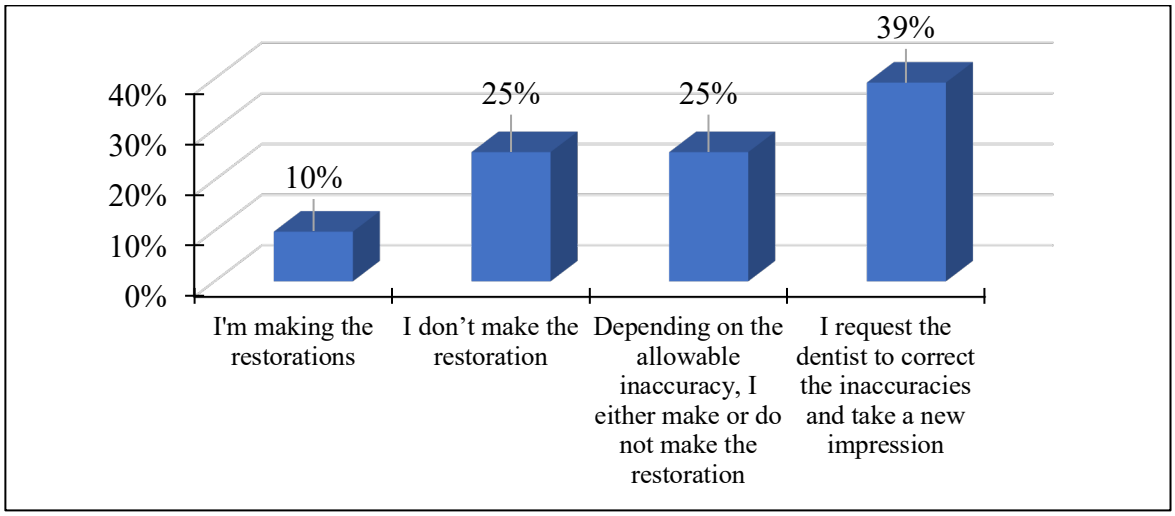


Fig.92 *Percentage of dental technicians who proceed/decline to fabricate the restorations when inaccuracies are detected (%)*

The majority of dental technicians (69%) indicate that the primary method of fabricating temporary restorations preferred by dentists is the indirect method.

In second place, according to 25% of the surveyed participants, is the direct-indirect method, and lastly, the direct method is preferred **(Fig.93)**.

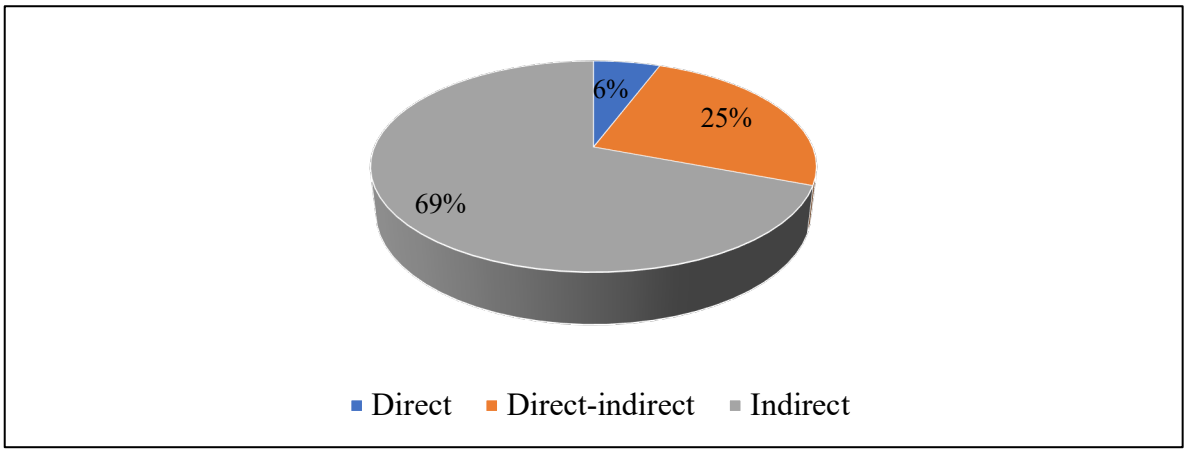


Fig.93 *Method of fabrication of temporary restoratios by dental technicians (%)*

According to 40% of the participants in the survey, between 50% and 75% of DMD they work with place temporary restorations in all cases of tooth preparation **(Fig.94)**.

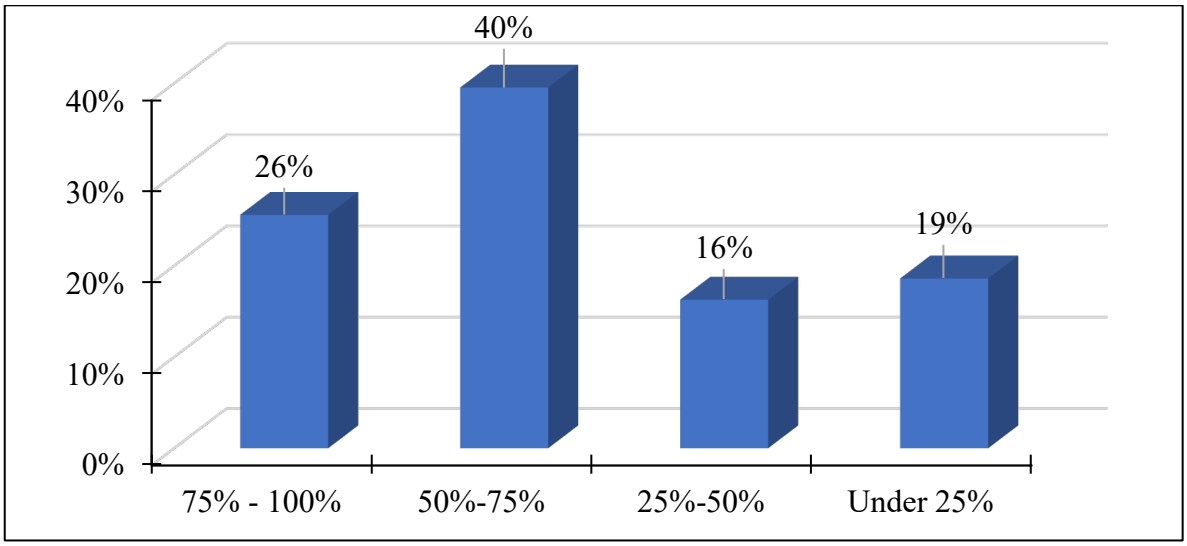


Fig.94 *Percentage of DMD who place temporary restorations*

The **fig.95** presents a comparative analysis of the most commonly used method for the fabrication of temporary restorations by dental technicians. The results show that the pressing technique is the most preferred (43%), followed by CAD/CAM milling (30%) and 3D printing (21%). The least popular among the surveyed is the method of layered pressing with dentin and enamel (6%).

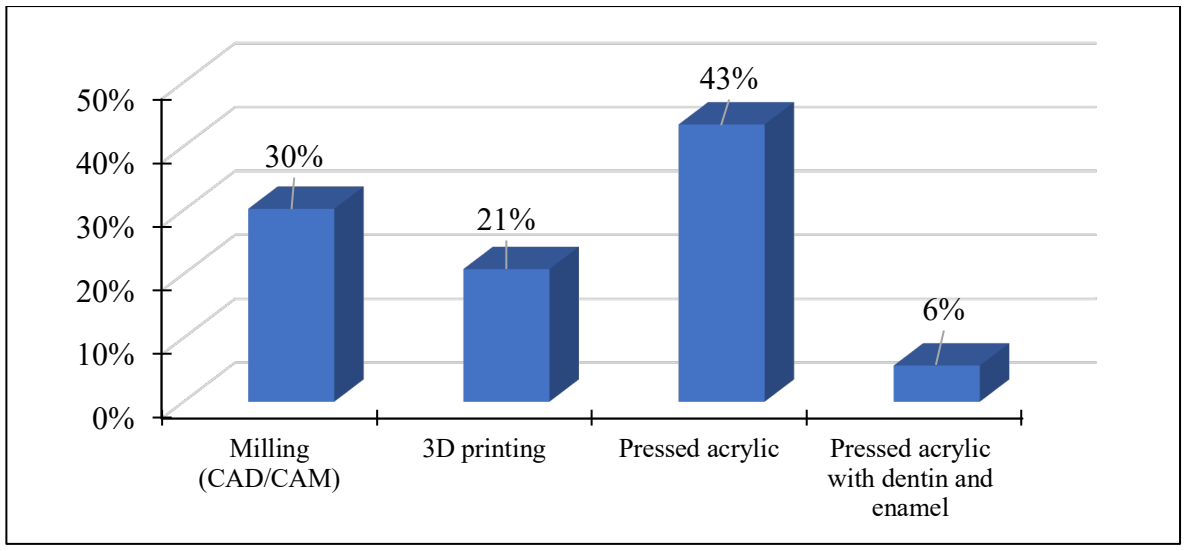


Fig.95 *Preferred method for the fabrication of temporary restorations (%)*

In **Fig.96**, results are presented from a study examining the relationship between the preferred method of fabricating temporary restorations by dental technicians and their age.

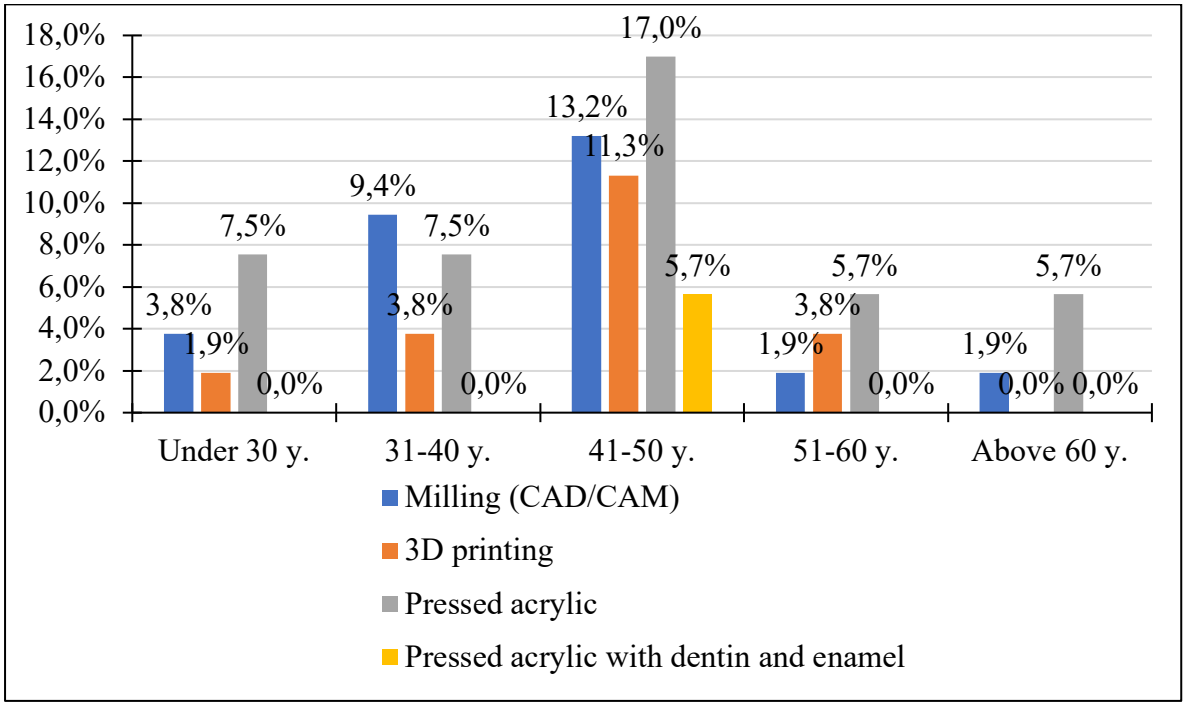
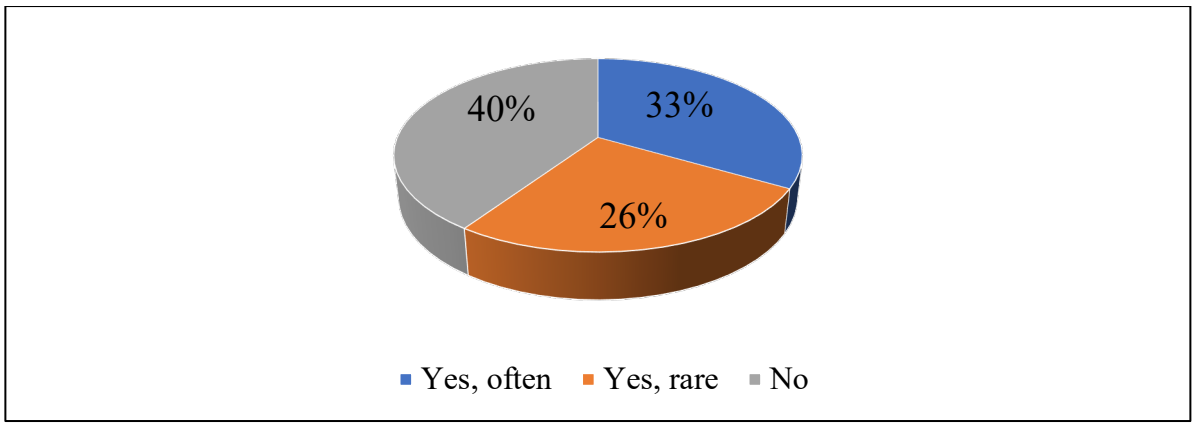


Fig.96 *Percentage distribution of the preferred method for fabricating temporary restorations by dental technicians based on their age.*

33% of the dental technicians participating in the survey indicate that they do not use the "shell" technique for fabricating temporary crowns, while 40% frequently apply it in their practices **(Fig.97)**.



Фиг.97 *Use of the "egg-shell" technique for fabricating temporary crowns (%)*

Analysis of the most commonly used finish lines by DMD highlights three types, as indicated by more than half of the dental technicians. At the forefront is the vertical (knife-edge) preparation margin (30%), followed by the chamfer (28%) and the biologically oriented preparation technique (28%). These results align with those obtained from the survey of DMD regarding the preferred finish line for the preparation of full coverage crowns **(Fig.98)**.

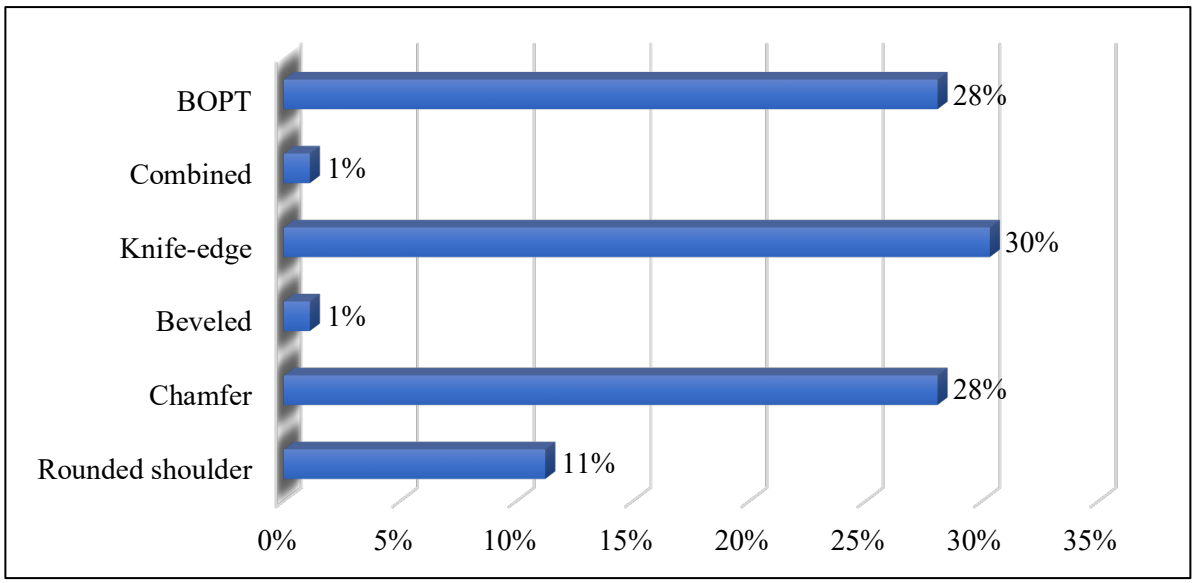


Fig.98 *The most commonly finish line by DMD according to dental technicians (%)*

The results of the analysis show that the biologically oriented preparation technique and the vertical preparation are the most commonly used according to both dentists and dental technicians. **(Fig.99)**.

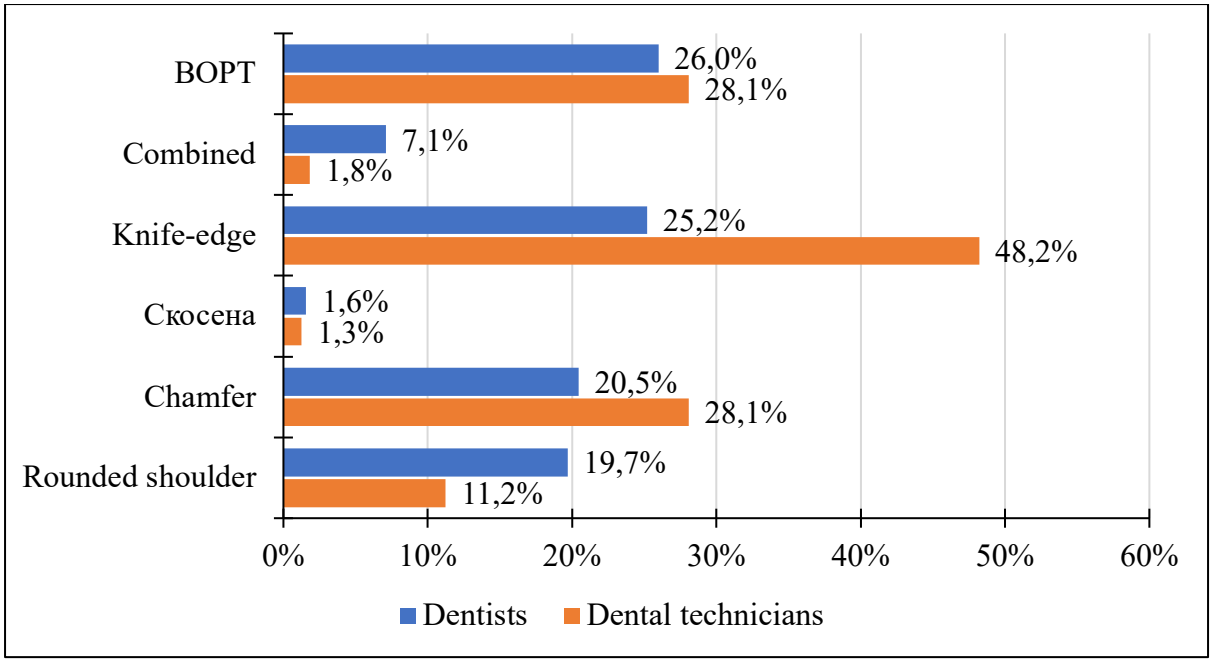


Fig.99 *The distribution of the most commonly used finish line according to dentists and dental technicians (%)*

65% of all surveyed specialists indicate that they are familiar with the method of fabricating FDP on natural teeth, prepared by biologically oriented preparation technique. Nearly 90% of them apply this method in their practices, with 57% using it frequently and 32% using it less frequently. **(Fig.100)**.

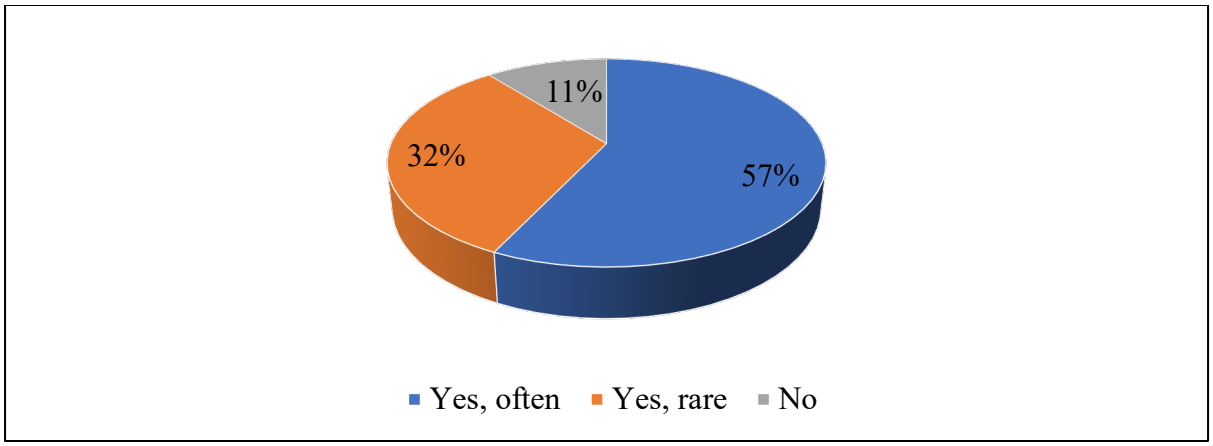


Fig.100 *Do you fabricate restorations using biologically oriented preparation technique? (%)*

When examining the relationship between age and awareness of the biologically oriented preparation technique (BOPT), it is observed that 32.6% of dental technicians who are familiar with the technique are in the age group of 41-50 years, while 18.6% are in the age range of 31-40 years **(Fig.101).**

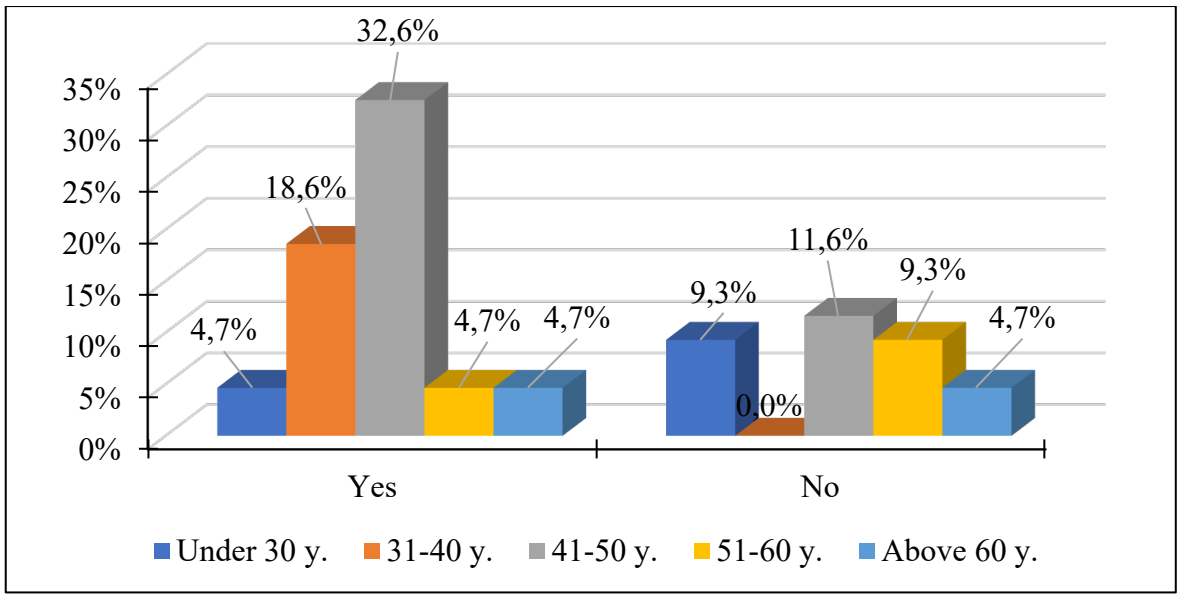


Fig.101 *Percentage distribution of awareness regarding BOPT based on the age of the surveyed dental technicians.*

The majority of surveyed dental technicians who fabricate FDPs using the biologically oriented preparation technique indicate encountering difficulties during the execution of this method. The two most frequently mentioned challenges, cited in 26% and 24% of cases, respectively, are "more difficult determination of the position of the crown margin" and "difficulty in creating the emergence profile" **(Fig.102)**.

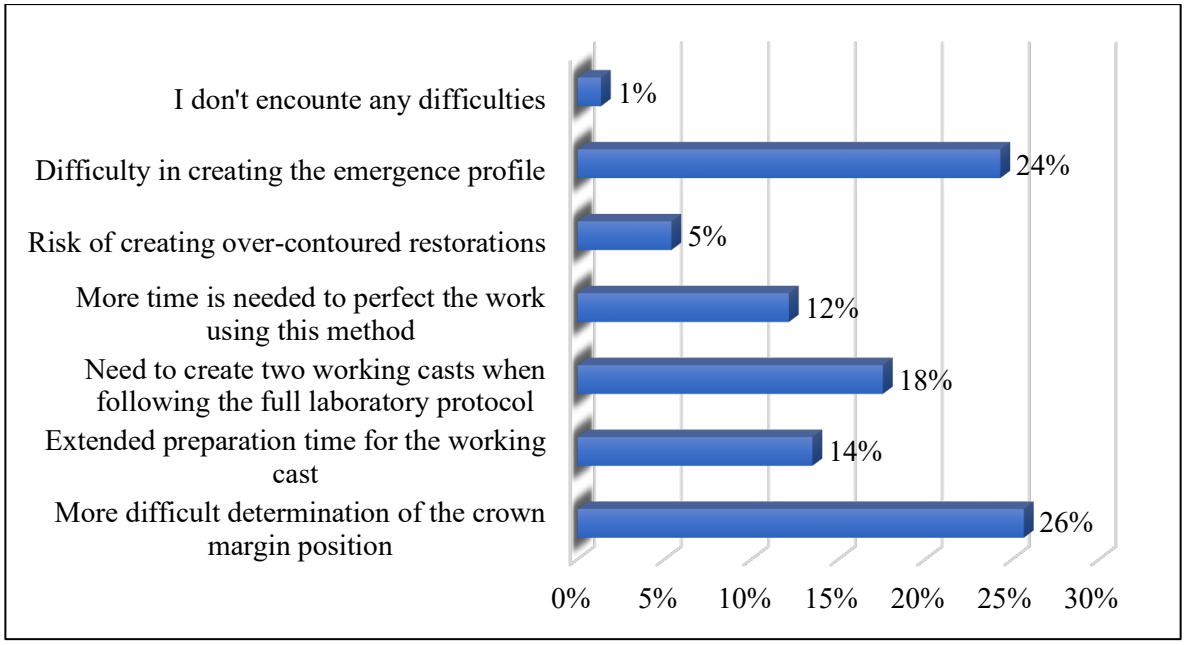


Fig.102 *Challenges in implementing the method of creating FDP using BOPT (%).*

Approximately 74% of dental technicians indicate that they would implement this method for the fabrication of permanent FDP in their practices **(Fig.103)**.

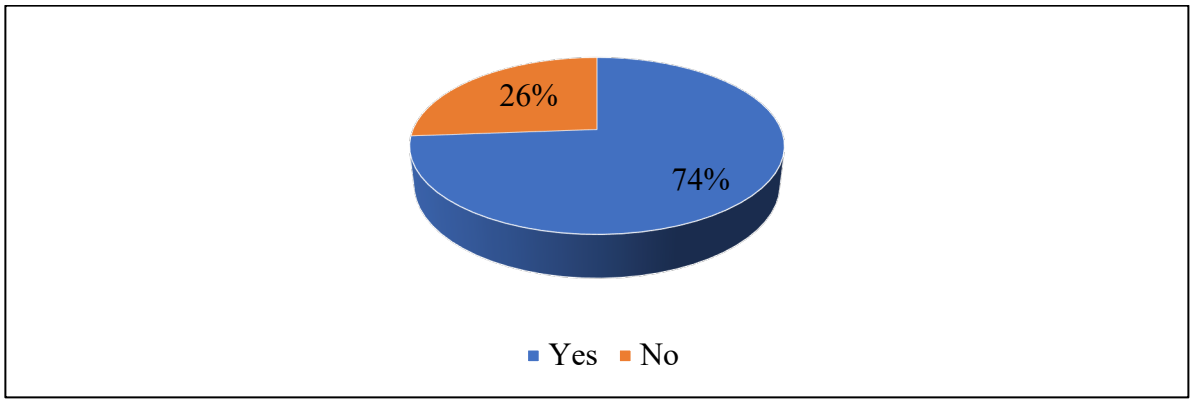


Fig.103 *Attitudes toward the implementation of the protocol for the fabrication of fixed dental prostheses using BOPT (%).*

IV.4.3. Discussion on Task 4

Analysis of the opinions of doctors of dental medicine and dental technicians regarding the clinical and laboratory protocol for work on biologically oriented preparation yechnique.

Based on the obtained results from the survey of DMD, it was found that they most commonly use the vertical (knife-edge) preparation margin and the biologically oriented preparation technique when preparing teeth for full coverage crowns. It is important to note that almost all surveyed DMD who are familiar with and utilize the biologically oriented preparation technique individualize the crown margins of temporary structures to achieve stable results.

The most common situations in which dentists apply the biologically oriented preparation technique are during prosthetics in the visible area of the dentition, as an alternative to the vertical finish line, and when replacing FDP with cleary defined finish line. Comparative analysis of the survey results shows that the most commonly cited advantages of this technique align with data from scientific literature: more conservative preparation of hard dental tissues, a fast and easy method, simplified impression technique, increased thickness and volume of gingival tissues, and achieving long-term stability of the gingival margin.

More than half of the dentists indicate that they are most challenged by the clinical relining of temporary crowns when using BOPT. This is one of the most critical clinical stages, especially when aiming to change the emergence profile of the future restoration and achieve stable gingival tissues. The obtained results make it clear that nearly 32% of surveyed professionals using this technique do not stick to the protocol for creating temporary structures.

Both dentists and a majority of dental technicians state that they are familiar with the method for fabricating FDP on natural teeth prepared according to the biologically oriented preparation technique. Nearly 65% of dental technicians state that they often stick to the laboratory protocol for manufacturing restorations using this technique. In our opinion, this is crucial for achieving a definitive prosthetic restoration with the desired emergence profile, as it is created in the dental laboratory and would impact the final treatment result.

V. CONCLUSIONS

1. Around both temporary and permanent restorations on teeth prepared by BOPT, less plaque accumulation is observed compared to the initial stage.
2. A significant percentage (approximately 87%) of examined teeth do not present bleeding on probing after a period of two months with temporary restorations.
3. In prosthetic treatment with BOPT, an increase in the thickness of the free gingival margin is observed, averaging 0.128 ± 0.027 mm.
4. When comparing the results of monitoring the periodontal response to temporary restorations made by direct-indirect and indirect methods, it is observed that the fabrication method does not influence the degree of thickening of the marginal gingiva.
5. The method of fabricating temporary restorations does not affect the thickness, but the specific and individually shaped margin of the temporary restorations is the tool for achieving a stable and aesthetic tooth surrounding gingival contour.
6. By using BOPT and specific shaping and contouring of the crown margin of temporary restorations, remodeling of the gingival contour is achieved.
7. BOPT is a preferred alternative when replacing prosthetic structures with clearly defined finish lines in the visible area of the dentition.
8. According to the conducted survey, 39% of dentists and 35% of dental technicians report that they are not familiar with the technique.

VI. CONCLUSION

The modern prosthetic practice applies various well-established preparation techniques for fixed dental prostheses.

To achieve "red" aesthetics in the frontal segment of the dentition, the biologically oriented preparation technique (BOPT) has gained increasing popularity in recent years. This technique provides increased volume and long-lasting stability of the margo gingivalis, as well as coronal migration in the presence of recession.

Despite the proven advantages of BOPT over traditional preparation techniques for fixed prosthetic restorations in the aesthetic zone, the method is not yet well-known or routinely applied in clinical practice. The specific nature of the method and the associated clinical and laboratory stages require additional knowledge and awareness from both doctors of dental medicine and dental technicians.

The promising results published by foreign authors and the need to popularize this preparation technique motivated the present scientific research. In additional studies, the periodontal response of the soft tissues after prosthetic treatment with FDP on teeth prepared using the specified technique was monitored.

The results are recorded using three parameters at different stages of treatment and are compared with the initial clinical condition. Two different methods for fabrication temporary restorations are used since they are a key step towards achieving a long-lasting aesthetic effect of BOPT. The obtained data are compared and analyzed among themselves, as well as with the data after cementation of the definitive restorations.

Both the direct-indirect and direct methods for fabrication temporary restorations provide a similar periodontal response and can be equally effective.

The application of BOPT improves the condition of the gingival tissues and leads to an increase in the thickness of the free gingival margin. Both temporary and permanent restorations show a tendency towards reduced plaque accumulation and bleeding on probing.

The results of this dissertation work confirm that the described and researched technique has a beneficial effect on periodontal health and can be an alternative to techniques for preparing teeth for full coverage crowns, achieving stability of soft tissues and stable, long-lasting clinical results. The observed coronal migration of the free gingival margin makes BOPT the first choice in

treating recessions around existing prosthetic restorations in the frontal area of the dentition.

The created algorithm for clinical relining of temporary crowns is believed to facilitate and encourage dental practitioners, students, and specialists to apply BOPT in their patients.

VII. CONTRIBUTIONS

Scientific and applied contributions

Original contributions:

1. For the first time in Bulgaria, the periodontal response of soft tissues after prosthetic treatment with fixed prosthetic restorations on teeth prepared using a biologically oriented preparation technique has been investigated and clinically evaluated.

2. For the first time in Bulgaria, the periodontal response after applying two different methods for babrication temporary restorations has been compared.

3. For the first time in Bulgaria, an alternative to vertical preparation margins technique has been presented.

Confirming contributions:

1. It has been confirmed that the application of a biologically oriented preparation technique results in a biotolerant behavior of the teeth-surrounding soft tissues towards fixed prosthetic restorations.

2. It has been confirmed that after preparation using the biologically oriented preparation technique around the crown margins of fixed prosthetic restorations, there is reduced plaque retention.

3. It has been confirmed that the application of a biologically oriented preparation technique results in reduced bleeding on probing around the permanent fixed prosthetic restorations.

4. It has been confirmed that the biologically oriented preparation technique leads to an increase the thickness of the free gingival margin.

Applicable contributions:

1.An algorithm is developed for fabrication of temporary constructions by direct-indirect method with the "egg-shell" technique using biologically oriented preparation technique.

VIII. PUBLICATIONS RELATED TO THE DISSERTATION

1. Delyan Georgiev, Magdalena Gugleva, "Elaboration of Recipes for 3D - Printing Resins, Reproducing Proportionally and Properly the Color Standards", International Journal of Science and Research (IJSR), Volume 10, Issue 10, October 2021, 284 – 28

2. Magdalena Gugleva, “Gingival Contour in BOPT: A Review of Provisional Crown Guidance”, International Journal of Science and Research (IJSR), Volume 12, Issue 7, July 2023, 292 – 296

3. Magdalena Gugleva, Mihail Bachvarov, „Vertical preparation for fixed prosthehic restorations in anterior region: a case report”, International Journal of Science and Research (IJSR), Volume 12, Issue 9, September 2023, 1899-1903