MINISTRY OF HIGHER EDUCATION, SCIENCE AND INNOVATION OF THE REPUBLIC OF UZBEKISTAN MINISTRY OF HEALTH OF THE REPUBLIC OF UZBEKISTAN

TASHKENT STATE MEDICAL UNIVERSITY

"I CONFIRM"

Rector of Tashkent State Medical University

BOYMORODOV SH.A._____

"___" _____2025 year

_____

MELKUMYAN T.V. MUSASHAYKHOVA Sh.K. KAMILOV N.Kh.

SHERALIYEVA S.SH. DADAMOVA A.D.

TOOTH RESTORATION: CONTEMPORARY APPROACH AND TECHNOLOGIES

Textbook for masters of the dental faculty of medical higher educational institutions in the specialty:

Field of knowledge: 900000 – Social Security and Health

Field of education: 910000 – Healthcare

Direction of education: 70910101 – Dentistry

TASHKENT- 2025

UDC:616.311- 002-022-08

ISBN

BBK

M

Compiler:

Melkumyan T.V. - professor of the department of hospital therapeutic dentistry of the Tashkent State Medical University, DSc.

Musashaykhova Sh.K. - assistant of the department of Therapeutic Dentistry of the Tashkent State Medical University, PhD.

Kamilov N.Kh. – dentist, PhD.

Sheralieva S.Sh. - associate professor of the department of hospital therapeutic dentistry of the Tashkent State Medical University, PhD

Dadamova A.D. – assistant of the department of hospital therapeutic dentistry of the Tashkent State Medical University

Reviewers:

Kamilov Kh.P. – Head of the Department of Hospital Therapeutic Dentistry TSMU, MD, Professor

Gafforov S.A. – Head of department "Dentistry, pediatric dentistry and orthodontics" Center for the Development of Professional Qualifications of Medical Workers, Professor, DSc. CDPQMW

Doctor of Medical Sciences, Professor MD

The proposed teaching aid is based on the state educational standard for the specialty 70910101 - dentistry (in areas) of higher professional education and is intended for 5th-year students of the Faculty of Dentistry studying therapeutic dentistry. The textbook can also improve teaching methods in the master's degree program, clinical residency, and advanced training courses for doctors.

T.V. Melkumyan

Publishing house " ", Tashkent, 2025

Abstract

The proposed teaching aid is based on the acquired clinical experience and data from scientific research conducted at the Department of Therapeutic Dentistry in the period from 2000 to 2025.

The manual describes modern composite materials and adhesive systems, as well as available methods of isolation of teeth and air-abrasive powders for cleaning and preparation of adhesive surfaces before dental restoration. A new dental device for incremental heating of composite material for making dental restoration, developed by the staff of the Department of Hospital Therapeutic Dentistry of TSDI (patent for invention No. IAP 06189 dated 03/19/2020), is also presented, and the manual for working with heated composite is described.

The relevance of the proposed textbook is largely determined by the high requirements for aesthetic, functional and preventive goals that must be taken into account when restoring teeth with composite material using various restoration methods and adhesive concepts.

For better perception of the presented material the information on tooth restoration with composite materials was given in a common form. At the end of each section there are tests and control questions that will help focus the attention of students on the key issues of the subject and facilitate the teaching methodology.

Key words: Composite material, adhesive system, tooth isolation, heated composite, air-abrasive treatment, acid etching, adhesive surface, tooth restoration.

The aim of the tutorial: to study the features of the chemical composition of modern adhesive systems and composite material, to form a visual representation of the microstructure of the enamel and dentin surface depending on the selected preparation method, to acquaint with quantitative and qualitative methods for assessing the adhesion of composite restoratives to hard dental tissues.

INTRODUCTION

Restoration of teeth with contemporary composite materials allows with a high degree of success to restore the anatomical form, function and aesthetics, damaged due to carious and non-carious lesions of teeth.

One of the important tasks of dentistry is to extend the longevity of functional composite restorations and to entirely preserve the remaining dentin and enamel from secondary caries and fractures.

The commercialization and application of new adhesive systems and filled photopolymers is usually accompanied by clinical studies and laboratory tests. That is why the identification and elimination of drawbacks in composites, which can be associated with excessive wear and cracking of restorations, disruption of marginal integrity and micro-leakage, volumetric polymer shrinkage, color instability and many others are of paramount concern.

Progressive improvement and adjustment of the mechanical and aesthetic properties of materials have made modern composites acceptable for the restoration of not only the anterior group of teeth, but also the lateral ones, which experience the greatest occlusal load.

Preliminary testing of experimental compositions in vitro is essential for commercialization of a new filling material, but the final impression on quality of a composite or adhesive system in usage is formed after prolonged clinical observations.

Considering the wide variety of clinical situations in comparison to the narrow but precisely determined conditions of laboratory tests, the pinpointing and elimination of flaws in filling materials is possible only after a qualitative and quantitative analysis of laboratory and clinical test data.

Also, clinicians' awareness of laboratory testing methods and their participation in scientific projects will allow the formation of homogeneous study groups which is the core for reliable data collection.

Over the last few decades, the characteristics of composite materials and adhesive systems have been improved significantly. However, the control over a probable bleeding from traumatized gingiva and blocking of leakage of gingival fluid are the main prerequisites for conducting a quality adhesive protocol.

Leakage of blood and gingival fluid on adhesive surfaces negatively affects the quality of integration between the filling material and tooth, and is a strict contraindication for the application of adhesive resin or composite. Therefore, skillful and scientifically based approach to tissue management allows for the restoration of tooth defects located both at the level of margin of adjacent gum and below it.

The aim of this study was to develop effective and improved adhesive treatment protocols for composite tooth restorations and to evaluate the clinical performance of these restorations.

COMPOSITE MATERIALS, THEIR PROPERTIES, AND APPLICATIONS

At present, composite resins are the primary class of restorative materials in dentistry. Compared with other filling materials, composites offer several advantages: excellent aesthetics, high strength, reliable handling during restorative procedures, and relatively low polymerization shrinkage.

The introduction of composite materials has significantly expanded the indications for direct restorative treatments. Advances in dental chemistry have also led to the development of modern adhesive systems with strong bonding ability to tooth structures. Despite these improvements, composites still present certain disadvantages, such as polymerization shrinkage and a relatively high coefficient of thermal expansion. These limitations may result in the formation of marginal gaps between the restoration and the tooth surface, fluid penetration, and eventual loss of marginal seal.

The use of direct composite restorations in posterior teeth has gained wide acceptance. In particular, adhesive bonding with the acid-etching technique has been extensively studied and refined by researchers worldwide.

Dental composites consist of two main components: an organic matrix and an inorganic filler. The filler fraction is substantial, usually not less than 30% by volume. When the filler content is lower, the material is generally classified as a “low-filled polymer.”

The organic matrix of dental composites is primarily based on methacrylate monomers, often derived from epoxy resins containing two methacrylate groups. Methacrylic acid and its derivatives readily undergo polymerization reactions, leading to the formation of compounds such as polymethyl methacrylate (PMMA), commonly known as “organic glass.”

The first monomer of this class and its derivatives remain the foundation of nearly all modern dental composites and adhesive systems. Their continued

use can be attributed to several advantages: relatively low polymerization shrinkage (approximately 6% in pure form), rapid curing, low volatility, and favorable mechanical properties.

In addition to the base monomers, the organic matrix of dental composites contains several auxiliary components: a polymerization inhibitor (to prolong curing time and shelf life), a catalyst (for chemically cured composites), a photoinitiator (for light-cured composites), an ultraviolet light absorber (to enhance light stability), and coloring agents.

The typical fillers used in dental composites include quartz, barium glass, strontium glass, amorphous silica, titanium silicate, zirconium silicate, oxides and salts of various heavy metals, as well as polymer particles.

In recent years, both the clinical application techniques and the physical–mechanical properties of composite materials have been significantly improved. Modern composites allow for extensive reconstruction of the coronal portion of posterior teeth. Many manufacturers now produce composites specifically designed to replace dental amalgam. These newer materials use a mixture of filler particles of different sizes; smaller particles fill the spaces between larger ones, increasing the overall filler density. This structural arrangement provides composites with strength and resistance during condensation that are comparable to amalgam.

Classification of Composites by Filler Size

Composite materials are commonly classified according to the size of their filler particles, with three main groups:

Class I – Macrofilled Composites

These materials contain large inorganic filler particles ranging from 1 to 100 μm. They are mechanically strong, but their surface quality is poor: even after polishing, roughness remains, which favors microbial adhesion and can contribute to secondary caries or gingivitis. Due to their lack of color stability

and poor polishability, macrofills are unsuitable for aesthetic restorations of anterior teeth.

Class II – Microfilled Composites

Microfills contain filler particles smaller than 1 μm. Their main advantage is excellent polishability, although they are mechanically weaker than macrofills. For this reason, microfilled composites are mainly used in anterior restorations where aesthetics are critical.

Class III – Hybrid Composites

Developed in the 1980s, hybrid composites contain a mixture of filler particles of different sizes (0.004–50 μm). They are versatile materials suitable for a wide range of restorative procedures, including both functional and aesthetic corrections. Hybrids exhibit high flexural strength, abrasion resistance, and elasticity. The inclusion of dentin sealants in some hybrid systems eliminates the need for a separate insulating liner, which can otherwise negatively affect the color and translucency of restorations. Because of their mechanical performance, hybrid composites are widely used for restoring anterior anatomy and for extensive Class I and II cavities (according to Black's classification).

In the oral environment, composites are subject to wear through various mechanisms. At occlusal contact points, wear occurs due to the sliding movements of teeth during mastication, known as functional wear. In areas without antagonist contact, wear results from friction with the food bolus and is referred to as non-contact wear.

The performance of composite materials is commonly assessed by indicators such as compressive and flexural strength, resistance to abrasive wear, color stability, and polishability. However, studies on the wear resistance of different composites have yielded conflicting results.

ADHESIVE SISTEM

Modern adhesive systems play a crucial role in restorative dentistry. They improve stress distribution on occlusal surfaces, ensure reliable bonding to both enamel and dentin, and help prevent the penetration of microorganisms and harmful chemical substances into the pulp.

Modern restorative dentistry relies heavily on adhesive materials. These systems influence the formation of marginal gaps, the distribution of occlusal stresses, and the retention of restorations to enamel and dentin. They also play a crucial role in preventing the penetration of microorganisms and chemical substances harmful to the pulp. The longevity of restorations depends on several factors: adherence to the principles of adhesive preparation, effective isolation of the working field from oral moisture, controlled polymerization, and the use of soft-curing techniques.

The traditional classification of cavities by G.V. Black (1896) was originally developed for the preparation of cavities intended for amalgam restorations. In modern restorative practice, however, the choice of filling materials has expanded considerably, and restorations are guided more by the localization of lesions than by the type of cavity.

Despite this, Black’s classification remains relevant. It has proven reliable and universal for many decades, and some patients still present with cavities shaped according to those original principles.

Composite and adhesive materials have been widely available on the dental market for more than 30 years. The development of a new adhesive system, from initial research to clinical application, requires a long and rigorous process during which nearly all material properties are tested for compliance with established standards.

Producing a composite material with both sufficient mechanical strength and optimal optical and aesthetic properties demands considerable time and

resources. Today, adhesive systems must meet scientifically established requirements to achieve predictable clinical results.

The literature describes the historical development of adhesive systems, identifying seven distinct generations. Each generation differs in terms of chemical composition, curing mechanism, and application technique. Along with direct and indirect restorative protocols, clinical indications and contraindications, as well as advantages and disadvantages, are detailed for each. Nevertheless, the wide variety of systems and classifications poses challenges for clinicians when selecting the most appropriate adhesive protocol.

Generations of Adhesive Systems

First Generation

These adhesives showed low bond strength to composites due to their pronounced hydrophilic nature. They were unable to prevent moisture migration from the dentinal tubules through the adhesive layer, resulting in weak and unreliable bonding.

Second Generation

Adhesives of this group demonstrated approximately three times greater bond strength to dentin compared to the first generation. Their improved performance reflected stronger hydrophobic properties, although the adhesion was still clinically limited.

Third Generation

Representing a significant step forward, third-generation systems introduced two-component formulations, enabling bonding to both enamel and dentin. They reduced postoperative sensitivity and extended the service life of restorations compared with earlier generations.

Fourth Generation

Like their predecessors, these are two-component systems but with markedly improved adhesion, especially to dentin—approximately twice that of

the third generation. This breakthrough was made possible by the introduction of the total-etch technique and wet bonding. Fourth-generation adhesives are often regarded as the gold standard, providing durable and hermetic bonds to dental hard tissues. Their main drawback lies in their multi-step application, which increases chair time and operator sensitivity.

Fifth Generation

These are simplified “one-bottle” systems that combine the hydrophilic primer and hydrophobic bonding agent. While easier and faster to use, their chemical stability is limited. Their popularity, however, stems from their clinical convenience.

Sixth Generation

The first self-etching adhesives appeared in this generation. By eliminating the need for total etching, they minimized the risk of collapse of the collagen matrix in conditioned dentin. Many researchers consider them self-etching analogues of the fourth-generation systems.

Seventh Generation

These also belong to the self-etching category but are even more simplified, allowing quicker and more efficient clinical application. A major advantage of sixth- and seventh-generation adhesives over total-etch systems is their ability to create not only micromechanical retention with dental hard tissues but also chemical bonds with hydroxyapatite crystals, thanks to advanced functional monomers.

Studies have compared the characteristics of adhesive systems across seven generations, drawing specific conclusions for each. Among them, fifth-generation adhesives were found to be the most optimal and are most frequently used by dental practitioners.

Research on the effect of human blood plasma contamination on the adhesive bond strength between composites and dentin has shown that self-

etching adhesives are more sensitive to contamination than single-component systems.

In current dental practice, the polymerization of light-curing composites is carried out using different types of curing lamps. Light-emitting diode (LED) polymerizers are used most frequently, with an emission spectrum of 430–490 nm. This range corresponds to the absorption peak of camphorquinone, the most common photoinitiator, with a maximum at 470 nm. Halogen lamps, with a broader spectrum of 390–510 nm, also activate camphorquinone.

However, in cases where composites contain additional initiators besides camphorquinone, conventional LED lamps may not provide complete polymerization. As a result, residual unreacted monomers may be released into saliva, potentially causing complications and reducing the strength of restorations. To address this limitation, polywave LED lamps have been developed. Their emission spectrum (385–515 nm) combines the advantages of both halogen and LED sources, allowing more effective activation of different photoinitiators.

Long-term studies have evaluated the durability of composite restorations. The reported survival rates were as follows:

After 3 years – 90.7%

After 5 years – 89.5%

After 7–8 years – 89.3%

After 10 years – 75.6%

The main risk factors contributing to restoration failure include bruxism, frequent consumption of carbonated beverages, and smoking. Overall, these findings suggest that, when proper treatment protocols are followed, composite restorations can remain clinically acceptable for up to 15 years.

The continuous introduction of new composites and adhesive systems, along with the increasing aesthetic expectations of patients, underscores the need for objective evaluation criteria for restorations. Clinical assessment

provides valuable information for healthcare practice and is widely applied during the testing of new restorative materials. Such evaluations are often presented in clinical observations, professional training courses, master classes, and student education.

In 2017, the Department of Hospital Therapeutic Dentistry at TSDI established a laboratory for functional diagnostics and experimental research. Clinical, laboratory, and in vitro experiments are conducted there to assess the adhesive bond strength of composite materials to dental hard tissues. Bond strength testing is performed on extracted human teeth, specially prepared for analysis with the UltraTester device.

METHODS OF ISOLATION OF THE WORKING FIELD IN TEETH RESTORATION

Technological innovations in dentistry cover dental equipment, implantation, restoration, and reliable isolation of the oral cavity during treatment.

A cofferdam is a special system designed to protect the oral cavity and isolate teeth during dental procedures.

The first report on the use of a cofferdam was published in the United States in 1864. The New York dentist Sanford Barnum was the first to introduce it. In the same year, at a meeting of the Dental Society, he demonstrated the advantages of the cofferdam and by 1867 the technique had already become widespread in Western dentistry.

The rubber latex sheet (Fig. 1) is disposable, ensuring absolute sterility and safety for the patient. The device consists of a special frame (Fig. 2) onto which the latex sheet is stretched. A hole is made in the sheet using a punch (Fig. 3, Fig. 4), and one or more teeth requiring treatment are isolated with the help of a clamp (Fig. 6) placed using forceps (Fig. 5).

In this way, the patient’s oral cavity is reliably protected from possible complications during treatment, and the dentist can perform manipulations calmly, effectively, and with greater confidence.

Fig. 1. Rubber latex for cofferdam

Fig.2. Special frames for cofferdam

Fig. 3. Punch (perforator) for cofferdam

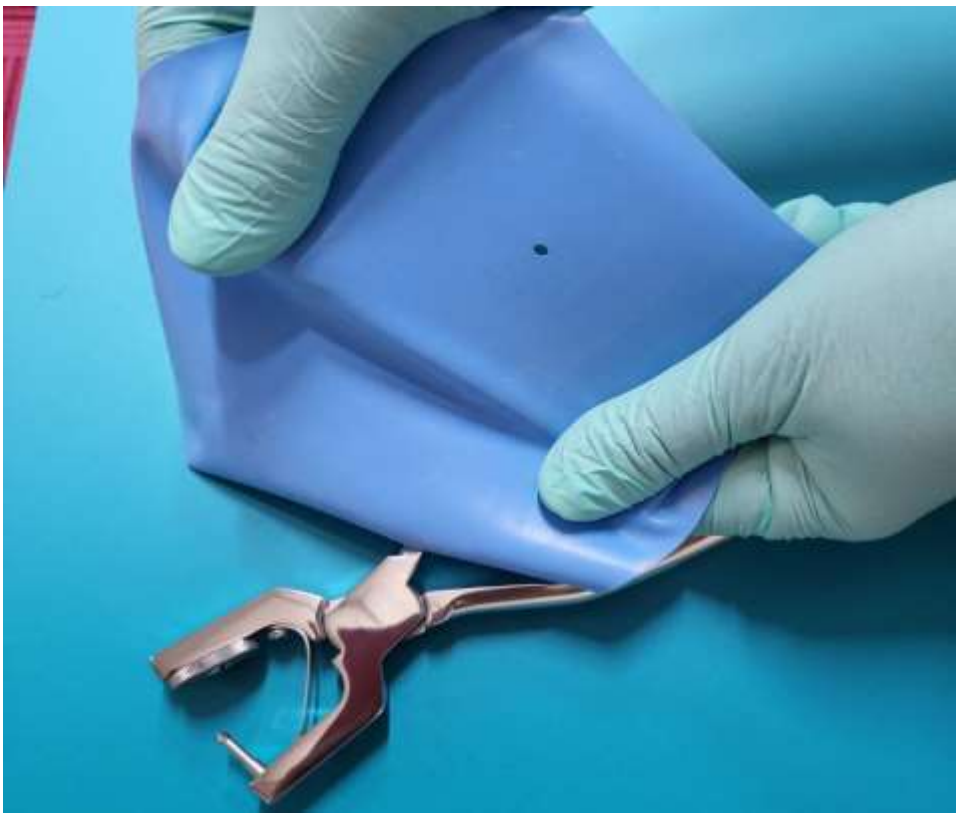


Fig.4. A perfectly round hole made with a puncher in latex

Fig. 5. Forceps with clamps for cofferdam

Fig.6. Clamps for cofferdam

The use of a cofferdam completely eliminates the risk of swallowing instruments, small fragments of hard dental tissues, and by-products of tooth preparation. Such incidents are extremely rare; however, if they do occur, they can cause significant difficulties for both the patient and the attending dentist. The cofferdam ensures that the operative field remains dry and clean, while simultaneously protecting the soft tissues of the oral cavity from accidental injury.

Owing to this system of oral protection and tooth isolation, patients do not experience discomfort or unpleasant sensations associated with the use of pharmacological agents, and therefore often consider the method appropriate for use in future treatments.

Since the cofferdam greatly facilitates clinical manipulations and enhances their effectiveness, it is routinely applied in complex dental procedures—most notably during root canal therapy and restorative interventions. In everyday dental practice, a dentist usually treats one or two teeth per visit, both of which must be isolated from the oral environment.

The cofferdam system isolates the tooth from the oral cavity and provides the following advantages:

A. Prevents the ingress of saliva into the operative field, thereby ensuring sterility.

B. Protects the oral mucosa from accidental contact with antiseptic solutions, many of which have an unpleasant taste.

C. Prevents the entry of small dental tissue particles generated during treatment into the oral cavity.

D. Reduces salivation by minimizing direct contact between the clinician’s hands and the oral mucosa.

E. Maintains a consistently dry operative field, significantly improving treatment quality and thus prolonging the functional longevity of restorations.

In addition to its clinical benefits, the use of a cofferdam may also serve as an effective marketing tool. At minimal cost and with little additional chairside time, it enhances the dentist's professional image and strengthens patient confidence.

This individualized system of oral cavity protection and tooth isolation during treatment provides the following benefits:

- protection of the tongue, cheeks, and other soft tissues;
- control of gingival bleeding;
- prevention of accidental introduction of sharp dental instruments into the oral cavity;
- elimination of the need for repeated rinsing and spitting;
- prevention of excessive drying of the oral mucosa;
- maintenance of the physiological swallowing of saliva;
- facilitation of monitoring the quality of restorations;
- maintenance of a consistently dry operative field;
- reduction of the risk of cross-infection associated with possible complications;
- prevention of chemical reagents from contacting the oral mucosa, thereby avoiding burns;
- reduction of the overall duration of complex restorative procedures and minimization of the need for re-interventions.

The use of a cofferdam allows the clinician to optimize working time. Even if the placement of the system requires additional minutes, its clinical expediency is beyond question. The only justified reason for not using a cofferdam is insufficient professional training, with the exception of rare cases where proper clamp application is technically impossible. In high-quality

restorative dentistry, the use of a is considered the standard of care whenever feasible.

As an individualized system of oral protection and tooth isolation, the cofferdam ensures complete control over the surgical field.

T***he relative disadvantages of the cofferdam include:***

• potential minor trauma to adjacent gingival tissues or the gingival sulcus during placement;

• latex hypersensitivity in some patients;

• the need for an assistant to ensure quick and efficient application.

Nevertheless, the indisputable advantages of the cofferdam—an essential component of modern dentistry—are as follows:

• improvement in the quality and predictability of treatment outcomes;

• facilitation of the dentist's work and reduction of chairside time, which positively influences both patient comfort and overall treatment efficiency.

Thus, it is evident that the advantages of the cofferdam far outweigh its relative limitations.

INDICATIONS FOR USE

At present, no absolute contraindications to the use of a cofferdam have been identified. With appropriate premedication and careful explanation of the procedure, it is possible to minimize discomfort during dental treatment in patients with a pronounced gag reflex or in those suffering from bronchial asthma.

The use of a cofferdam is indicated for:

Basic tools and materials

• restoration of teeth with the use of modern adhesive technologies;

• clinical and instrumental preparation of teeth for subsequent restorative procedures;

• traditional versus adhesive fixation methods for inlays;

• endodontic treatment as an integral stage of preserving tooth function;

• strict adherence to aseptic principles within the surgical field;

• prevention of risks associated with inhalation or ingestion of foreign particles and small dental instruments during intraoral procedures.

To correctly and efficiently apply a cofferdam and ensure its secure fixation in the oral cavity, the dentist requires a set of basic and auxiliary instruments and materials.

Basic tools and materials:

- cofferdam (latex scarves),
- cofferdam frames,
- cofferdam punch,
- clamps with different jaw angles,
- clamps (clamps).

Auxiliary materials and tools:

- paper napkins for the cofferdam;
- Heidemann spatula;
- waterproof markers and a corresponding template or a special stamp for marking the location of the teeth;
- wooden wedges;
- silk thread;
- microfilm, Vaseline lip lubricant, shaving foam;
- means for gluing the cofferdam in case of ruptures (adhesive glue, bonding);
- auxiliary means for fixing clamps (silicone from a cartridge, gutta-percha pins).

COFFERDAM

A cofferdam is a sheet made of natural latex. It is available either in rolls or as individual sheets measuring approximately 15 × 15 cm (Fig. 7). The material is characterized by high elasticity, which is essential for its clinical application. However, these optimal properties are not permanent: they usually persist for about nine months. After this period, the latex begins to deteriorate, becoming brittle, which leads to rapid tearing and insufficient adaptation. When stored in a refrigerator or another consistently cool environment, the material can retain its properties for up to one year. A practical criterion for usability is the ability to stretch the latex by hand until it becomes almost transparent — in this case, it can be considered suitable for use regardless of its shelf life.

Fig. 7. Napkins for cofferdam

One side of the cofferdam sheet is smooth, while the other is powdered. The smooth side is always directed toward the patient's oral cavity, and the powdered side faces the operator. This rule must be observed for two main reasons:

1. the smooth surface glides more easily over the teeth being isolated;

2. when the material comes into contact with the tongue or oral mucosa, no particles of rice or corn starch (used as a powder) remain.

Depending on thickness and quality, cofferdam sheets are classified into five types:

• thin (0.13–0.18 mm): easy to apply, but prone to tearing and provides less tight adaptation compared with thicker sheets;

• medium (0.18–0.23 mm): the most commonly used, easy to handle, convenient for stretching and placement;

• thick (0.23–0.29 mm): ensures effective gingival retraction and is practically tear-resistant;

• extra-thick (0.29–0.34 mm): highly resistant even under extreme conditions, provides maximum gingival retraction;

• special heavy (0.34–0.39 mm): used only when enhanced tissue protection is required.

Cofferdam sheets are manufactured in a variety of colors, including light beige, brown, dark gray, green, blue, light blue, pink, and lilac.

Cofferdam colors and indications

• Light beige: due to its partial transparency, it is mainly used in endodontic treatment. It is not recommended for work with composite filling materials, as it provides poor contour contrast.

• Brown or dark gray: ensures good color contrast and eliminates light reflection.

• Green: a pleasant, calming color that provides excellent contour contrast. Under fluorescent lighting, it prevents the “diaphragm effect” (absence of unwanted light reflection). Often produced with a mint scent, making it more comfortable for patients.

• Blue, light blue, pink, lilac: serve as alternatives to the above-mentioned light, dark, and green shades.

For long-term restorative procedures, it is advisable to use cofferdam sheets in deep green or blue shades, as they provide the best contrast and reduce visual fatigue.

Perforator for

The cofferdam punch is equipped with a rotating disk containing 5–6 holes of different diameters, which makes it possible to create precise perforations in the sheet.

Recommended hole sizes:

- **Hole No. 5 (largest): for molars (chewing teeth).**
- **Hole No. 4 (large): universal size for most molars.**
- **Hole No. 3 (medium): for canines and premolars of both jaws.**
- **Hole No. 2 (small): for anterior teeth of the upper jaw.**
- **Hole No. 1 (smallest): for narrow anterior teeth of the lower jaw.**

Fig. 8. Punch for a cofferdam with 5 through holes of different sizes

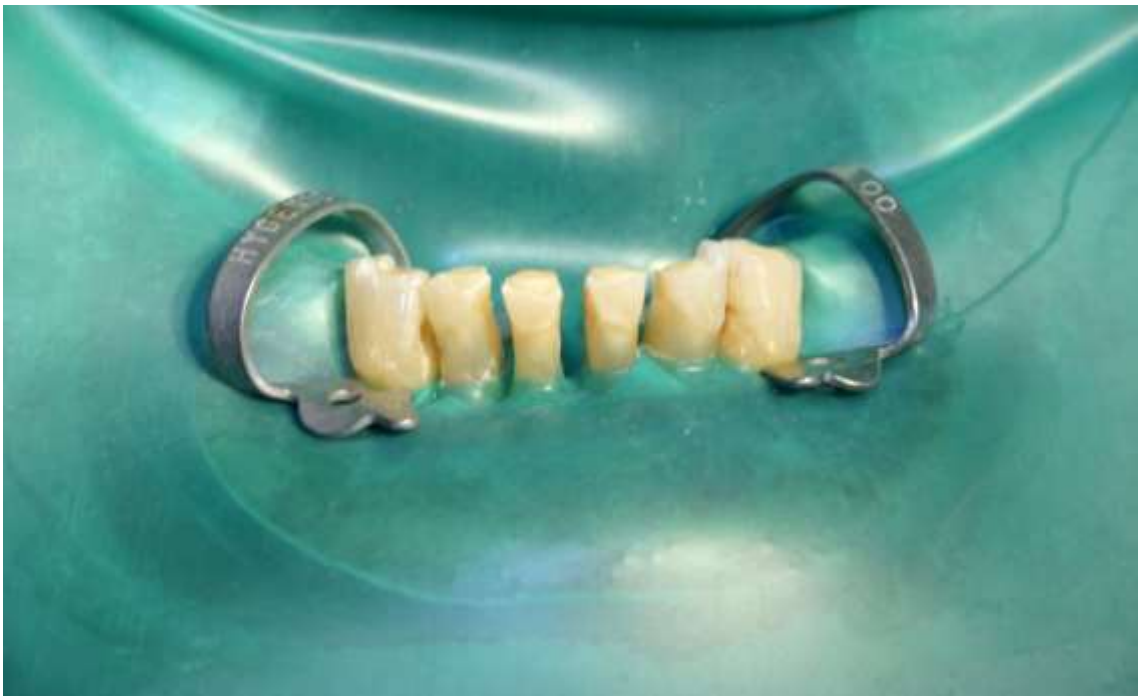


Fig. 9. Absolute adhesion of the cofferdam

Varying the hole sizes ensures a tight adaptation of the cofferdam around the tooth, preventing the penetration of moisture onto the working surface (Fig. 9).

To achieve a clean and precise perforation, the sheet must first be stretched between the thumb and ring finger, as well as the index and middle fingers of the left hand. This eliminates folds and minimizes the risk of accidental additional tearing. After that, the cofferdam sheet is placed onto the punch disk, the device is closed, and the spike is pressed firmly into the selected opening to create the perforation.

Template for marking perforation sites

To ensure accurate positioning of the perforations required for reliable isolation of the operating field, a special template is used (Fig. 10). The technique is straightforward: the cofferdam sheet is placed onto the template, and the future perforation points are marked with a waterproof marker or felt-tip pen.

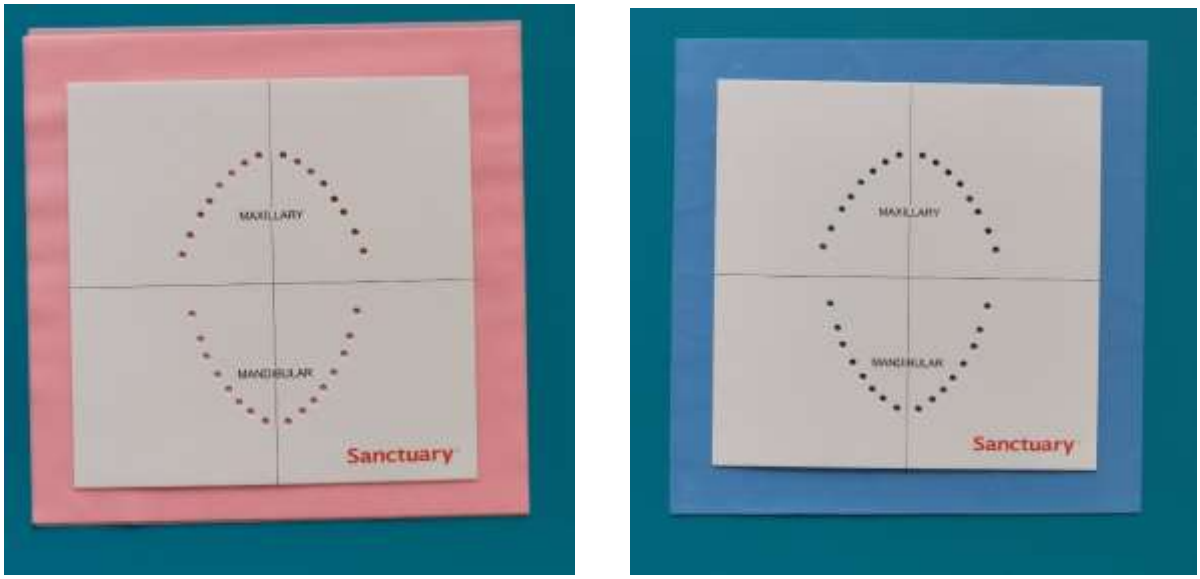


Fig. 10. Special template for cofferdam

In cases where the dental arch has individual anatomical features — such as wide interdental spaces, atypical tooth positions, or the presence of various prosthetic constructions — the use of a template may not be necessary.

Clamps (clasps)

There are two main types of clamps, corresponding to different methods of cofferdam application: wingless clamps and winged clamps (Fig. 11).

• Wingless clamps are characterized by short, rounded jaws. When using this type, the clamp is first positioned on the tooth, then the cofferdam is applied, and finally the frame is attached. The letter W preceding the clamp number indicates that it is wingless.

Fig.11. Wingless and winged clamps for cofferdam

• Winged clamps are equipped with lateral extensions (wings) that are inserted into the perforation in the cofferdam. In this case, the clamp and the cofferdam are positioned on the tooth simultaneously.

In clinical practice, the most commonly used clamps include No. 14A, No. 7, No. 2, No. 9, No. 00, No. 5, No. 8A, No. 212, and No. 214.

Each cofferdam clamp has a specific design adapted to the anatomical characteristics of certain groups of teeth and clinical situations.

• **Clamp No. 14A** – indicated for incompletely erupted, underdeveloped, or partially formed molars.

• **Clamp No. 7** – designed for mandibular molars. The flat lateral extensions prevent gingival injury.

• **Clamp No. 2** – standard clamp for large mandibular premolars. Flat sidewalls provide gingival protection.

• **Clamp No. 00** – intended for very small premolars and incisors of both jaws. Characterized by a high arch and shortened lateral extensions.

• **Clamp No. 9** – universal anterior clamp with double arches and wings, used for labial cavities in anterior teeth and premolars, particularly during endodontic procedures.

• **Clamp No. 5** – universal clamp for large maxillary molars, especially rounded crowns. Its deepened sidewalls ensure firm adaptation to the gingival margin and prevent rotation.

• **Clamp No. 8A** – designed for small molars of the maxilla and mandible that are incompletely erupted or underdeveloped.

• **Clamp No. 212** – cervical clamp for cavities located at the cervical margin of any tooth. Placement usually requires the use of an extra-thick cofferdam to achieve optimal gingival retraction.

• **Clamp No. 214** (Hatch cervical clamp) – equipped with two large movable arches forming short sidewalls. Applied vestibularly or labially to provide controlled gingival displacement.

• **Clamps No. 210 and No. 211** – belong to the group of labial clamps (double-arched design).

• **Clamp No. 210** – indicated for labial cavities in anterior teeth, as well as in premolars and mandibular second molars.

• **Clamp No. 211** – specialized clamp for labial cavities in mandibular anterior teeth.

Summary of Indications by Tooth Group:

• Anterior teeth: Clamps No. 9, 214 (Hatch).

• Premolars: Clamps No. 1, 2, 00.

• Molars: Clamps No. 7, 8, 8A, 14A.

• No. 7 – universal for mandibular molars.

• No. 8 – universal for maxillary molars.

• No. 8A – for small molars.

• **No. 14A** – for partially erupted or severely damaged molars.

Clamp forceps

For secure placement of clamps on different teeth, it is often necessary to use 2–3 types of forceps, which differ in the angle of the jaws relative to the handle (90° and 120°). The forceps are used to expand the clamp, apply it to the tooth, and subsequently remove it.

Method of application:

1. Insert the thin ends of the forceps into the corresponding holes in the clamp arms until they reach the special thickened stops.

2. Carefully spread the jaws of the clamp and release it from the holder.

3. After removal, turn the clamp with the handle facing downward. By moving the slider along the forceps handle, set the jaws at the optimal distance from each other.

4. Introduce the clamp into the oral cavity and position it on the target tooth. Move the slider forward until the clamp jaws come into contact with the cervical region of the tooth.

5. Compress the handle of the forceps and disengage the tips from the clamp holes. The clamp should remain firmly in place on the tooth.

Cofferdam frames

To maintain proper tension of the cofferdam, special frames are used. Owing to their rationally positioned pins, they provide quick and reliable fixation of the sheet. Frames are manufactured from metal or plastic.

Young frame: a classic U-shaped metal frame, stainless and flexible, equipped with small, strategically placed cylindrical pins for secure retention of the cofferdam. Its main advantage is easy orientation — the frame is always directed toward the chin.

Interdental wedges

Interdental wedges (Fig. 12), made of maple wood or nylon (plastic), are used both for securing matrices and for stabilizing the cofferdam in the patient's oral cavity. Their anatomically optimized shape ensures excellent adaptation to the tooth surface.

When it is necessary to press the gingival tissue and the cofferdam in an apical direction — as well as to prevent the dam from tearing and subsequently wrapping around the bur, particularly in cases of defects extending along the cervical region of the tooth — maple wedges are placed proximally.

Fig. 12. Interdental wedges for fixing matrices

Latex thread

Latex thread is used to stabilize the cofferdam. It is a cord made of natural rubber, supplied in lengths of approximately 2.14 m, and is intended for single use. There are two types available: a thin yellow thread and a thick orange thread.

Although many manufacturers offer complete kits containing the essential instruments (pliers, punch, frame, clamps, latex sheets, and accessories), all components can also be purchased separately.

Cofferdam pads

Cofferdam pads are used for patients with latex allergies. The pad is placed over the frame, and the cofferdam is applied through the opening in the pad. The pad additionally absorbs saliva, water, and perspiration, providing greater comfort during treatment.

Dental silk

Dental silk is the primary material for cleaning interdental spaces, but it also serves as an excellent auxiliary aid when applying the cofferdam to difficult-to-reach contact surfaces. A ligature made of dental silk often helps to secure the dam to the tooth, particularly in temporary molars and canines.

Ligatures are usually tied buccally with a surgical knot. It is recommended to use a longer length of silk, as it facilitates deep manipulation and simplifies removal. If the clamp does not adapt well, injures the gingiva, or allows leakage of gingival fluid, a single or double ligature made of silk can provide additional stabilization.

Most commonly, a silk loop is passed through the contact point and left in position. This allows compensation for weak dam tension: once introduced into the interdental space, the silk ensures reliable fixation of the cofferdam.

Heidemann spatula

The Heidemann spatula is an important instrument for short-term separation of contact points and for adapting the cofferdam around the cervical area of the tooth (“turning” technique). The procedure is facilitated by an additional, constant air flow directed toward the gingival sulcus, which allows manual adaptation of the dam with minimal effort.

Several methods for applying the cofferdam are described:

- **“Wings” technique**: convenient for molars and premolars;

• **“Cofferdam first” technique**: applicable to all groups of teeth in both jaws;

• **“Clamp first” technique**: used primarily for premolars and the first molar;

• **“Arch” technique**: suitable for mandibular molars.

The sequence of application is illustrated in Fig. 16-00.

During restorative procedures, a major difficulty is the treatment of gingival defects, as it is often technically challenging to ensure complete isolation of the operative field from gingival fluid. This is particularly evident in cases where application of the cofferdam — the most effective system for isolating teeth from oral moisture — is not feasible.

Such clinical situations are most commonly encountered in patients over 50 years of age with moderate to severe periodontitis, where pronounced gingival recession is present.

Restoration of cervical cavities also presents technical challenges, as these lesions are often located below the gingival margin and require subgingival preparation. In such cases, gingival retraction is essential. Retraction is most often performed with retraction cords, which displace the gingival margin laterally in a single stage, thereby widening the sulcus and providing improved visualization and surgical access.

Filling cervical defects is further complicated by the absence of conditions for macromechanical retention in this area. Fixation of composite materials relies primarily on the hybrid layer, which tends to degrade over time, reducing long-term adhesion.

When restoring root defects, where placement of a cofferdam is impossible, retraction cords remain the only reliable mechanical method of isolating the surgical field from gingival fluid. These cords are usually cotton threads with a special weave, impregnated with active components. The most

widely used are cords containing epinephrine hydrochloride or aluminum sulfate, which aid in hemostasis and tissue management.

The effectiveness of gingival retraction largely depends on the severity of tissue exudation and the uniformity of periodontal pocket depth. In cases of pronounced irregularities at the gingival margin — most commonly observed in patients with inflammatory-dystrophic periodontal diseases — uniform placement of the retraction cord along the entire circumference of the gingival sulcus becomes impossible, and control over gingival fluid is significantly reduced.

The composition of gingival exudate in periodontitis is notable for its high enzymatic activity, with many components capable of degrading the extracellular matrix. Of particular importance are neutrophil-derived metalloproteinases, the main source of which is the intracellular granules of polymorphonuclear neutrophils.

These collagenases demonstrate high substrate specificity for type I collagen, the principal component of the organic dentin framework. When collagen fibrils are exposed during acid etching, they become vulnerable to enzymatic degradation. The resulting weakening of the fibrillar structure reduces the resistance of the hybrid layer to polymerization stress during curing of restorative materials.

It has also been established that the adhesive strength of bonding agents to root dentin is significantly lower than to coronal dentin. The clinical situation is further complicated by the frequent impossibility of applying a cofferdam and of utilizing the method of directed polymerization shrinkage.

At the same time, the use of retraction cords in such cases is associated with a higher risk of trauma, which may predispose to recurrence of the underlying periodontal condition. Damage to the periodontal ligament, combined with reduced regenerative capacity and increased collagenase activity,

promotes deepening of periodontal pockets and progression of gingival recession.

Rehabilitation of inflamed periodontal tissues following retraction can proceed either through stimulation of reparative processes or through inhibition of further structural breakdown. Given the advanced age of most patients in this category, treatment strategies should prioritize approaches that slow destructive processes in periodontal tissues.

Currently, the number of drugs with inhibitory activity against collagenases is limited. Among them, tetracycline antibiotics are the most accessible. In addition to their primary antimicrobial effects, these drugs exhibit anti-collagenase activity, which is most pronounced in doxycycline hydrochloride.

Until recently, retraction cords containing collagenase inhibitors as active components have not been employed in dentistry. Staff from the Department of Hospital Therapeutic Dentistry (Melkumyan T.V., 2010) proposed a method for isolating the surgical field using a retraction cord impregnated with doxycycline hydrochloride (patent for invention**, IAP No. 04171 dated 11.05.2010,** Melkumyan T.V).

This method is applied during restoration of teeth in patients with periodontal disease (Fig. 17). The use of doxycycline-impregnated cords significantly reduces the level of active neutrophil-derived metalloproteinase in the gingival fluid. By controlling enzyme activity during gingival fluid leakage, this approach protects the organic dentin matrix exposed during acid etching.

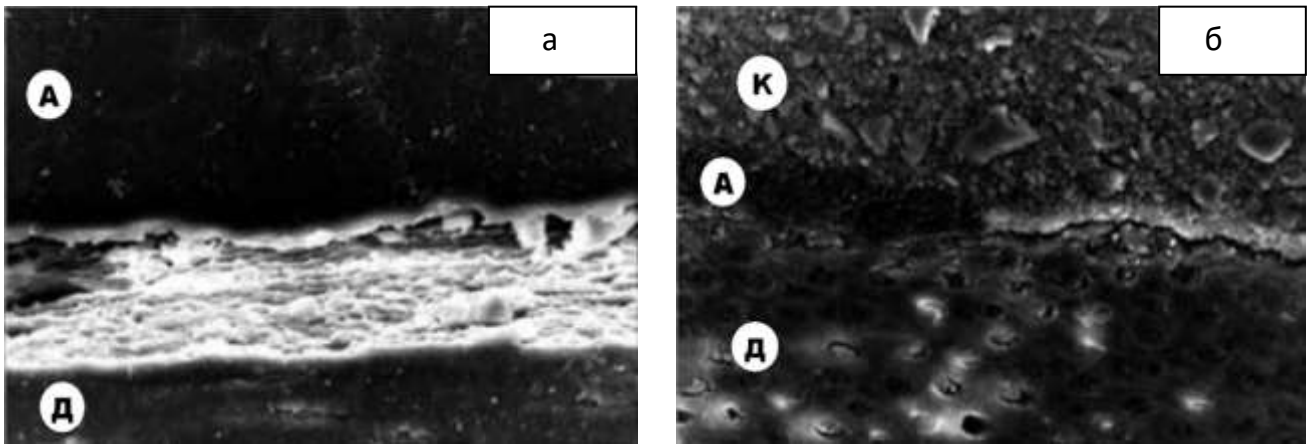
The effectiveness of this method has been confirmed through clinical, experimental, and laboratory studies. Two groups of patients were examined:

- Group 1: retraction cord without metalloproteinase inhibitors;
- Group 2: retraction cord impregnated with doxycycline hydrochloride.

Using scanning electron microscopy (SEM), the quality of the hybrid layer was evaluated by the number of zones with loose adhesion, expressed as a

percentage of the total length of the organosynthetic interface (OSI). In Group 1, disrupted zones were observed in 93.8% of cases, while in Group 2, they were noted in 82.4%.

In SEM analysis, zones of poor contact in Group 1 covered on average 50.9 ± 7.2% of the hybrid layer, with gap widths reaching 10 nm. In Group 2, the corresponding area averaged 24.3 ± 5.4%, significantly smaller (p = 0.000), with gaps up to 5 nm (Fig. 13).



.

Fig. 13. Organosynthetic interface (OSI) of tooth samples from patients from the first (a) and second (b) groups. A – adhesive, D – dentin, K – composite.

Collagenase activity (MMP-8) was measured in two stages:

1. Immediately before restoration of the root defect;
2. 24 hours after the procedure.

At the first stage, patients in Group 1 exhibited high MMP-8 levels, averaging 465.3 ± 89.8 ng/ml

Analysis of samples from patients in Group 2, in whom a retraction cord impregnated with doxycycline hydrochloride (0.7–0.8 mg/cm) was used for access and as an alternative method of surgical field isolation, demonstrated significantly lower levels of MMP-8, averaging 186.5 ± 84.7 ng/ml.

In contrast, analysis of gingival fluid from pathological periodontal pockets in Group 1 patients — who used retraction cords without metalloproteinase inhibitors — showed that MMP-8 levels exceeded the initial baseline, reaching 557.8 ± 98.6 ng/ml, indicating the traumatic effect of the manipulation on the gingival tissues.

In patients from Group 2, no significant increase in collagenase activity was observed. The average MMP-8 concentration was 203.8 ± 95.4 ng/ml, confirming the presence of an inhibitory effect on metalloproteinase activity within the periodontal pocket.

COFFERDAM SET

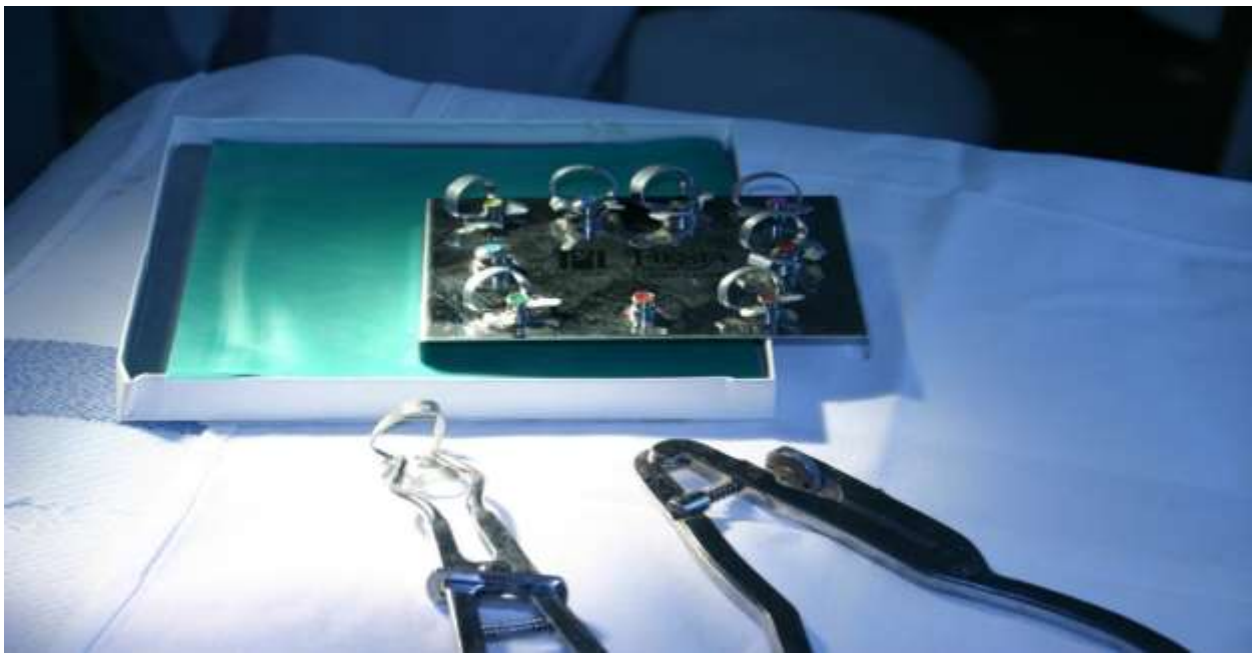
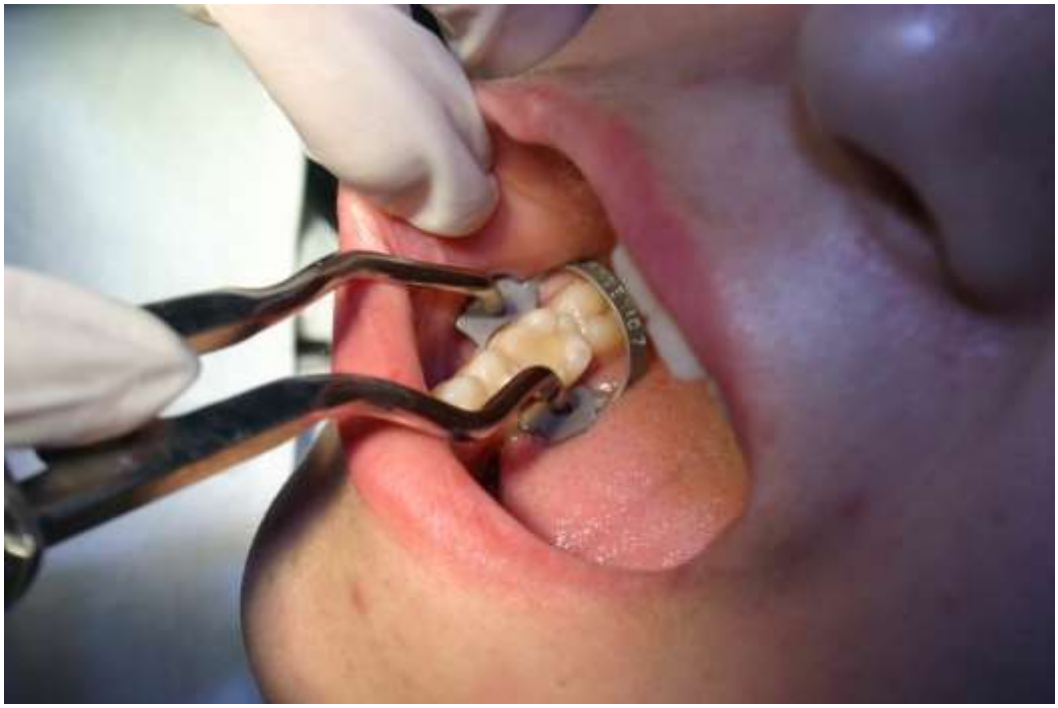


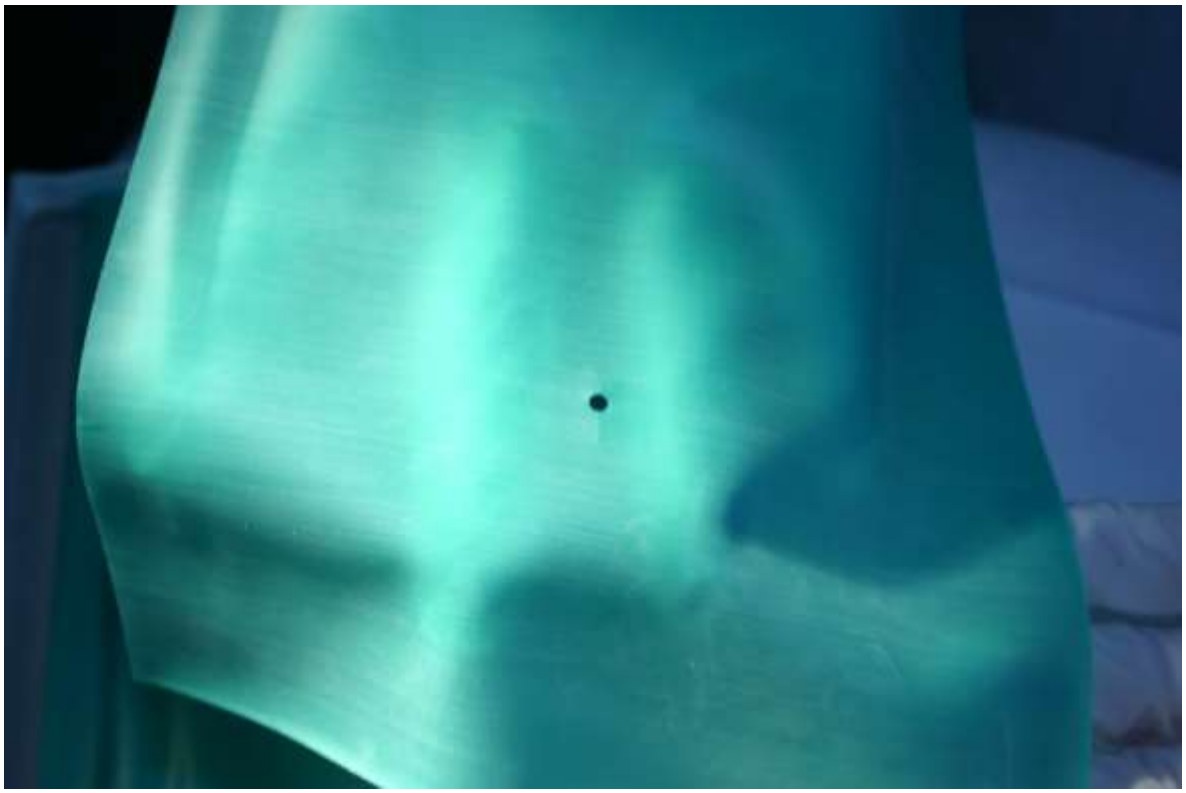
Fig.14. Cofferdam kit. Types of clamps, rubber scarves, pliers with a clamp, punch, frames, template

STEP-BY-STEP WORK WITH COFFERDAM

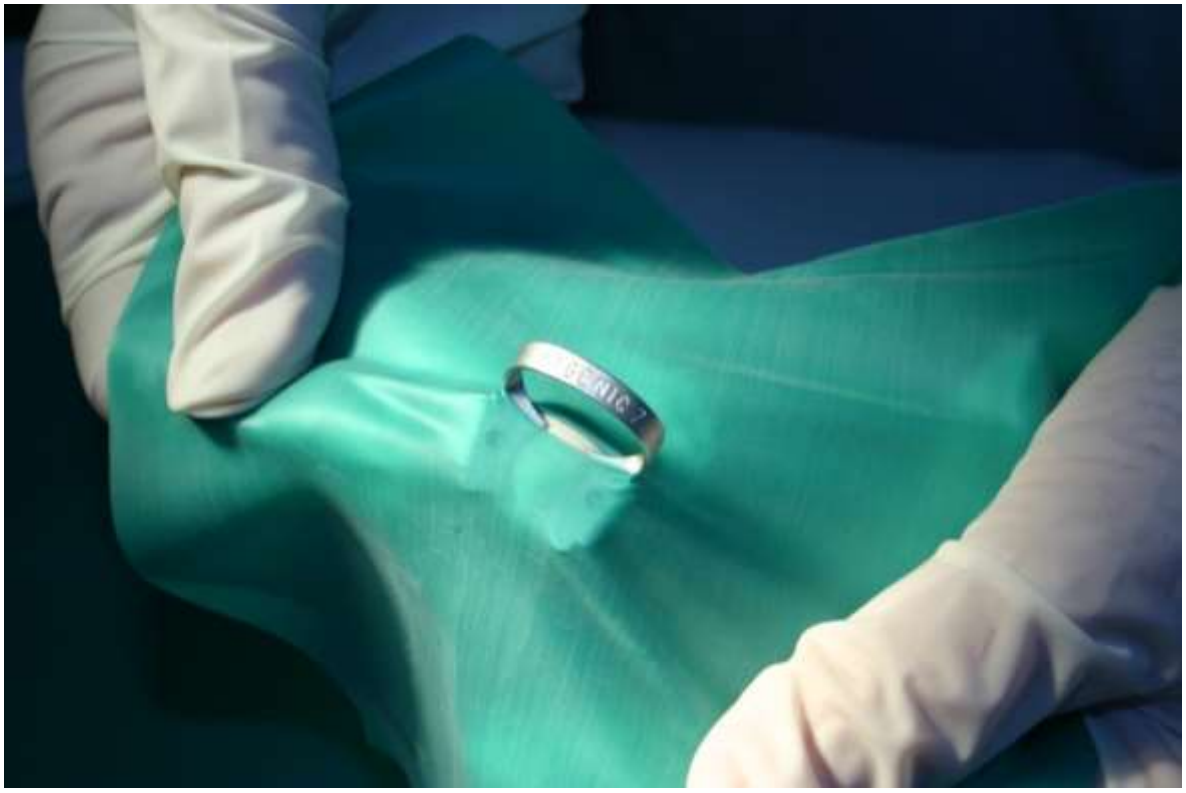
Stage 1. Selecting a clamp



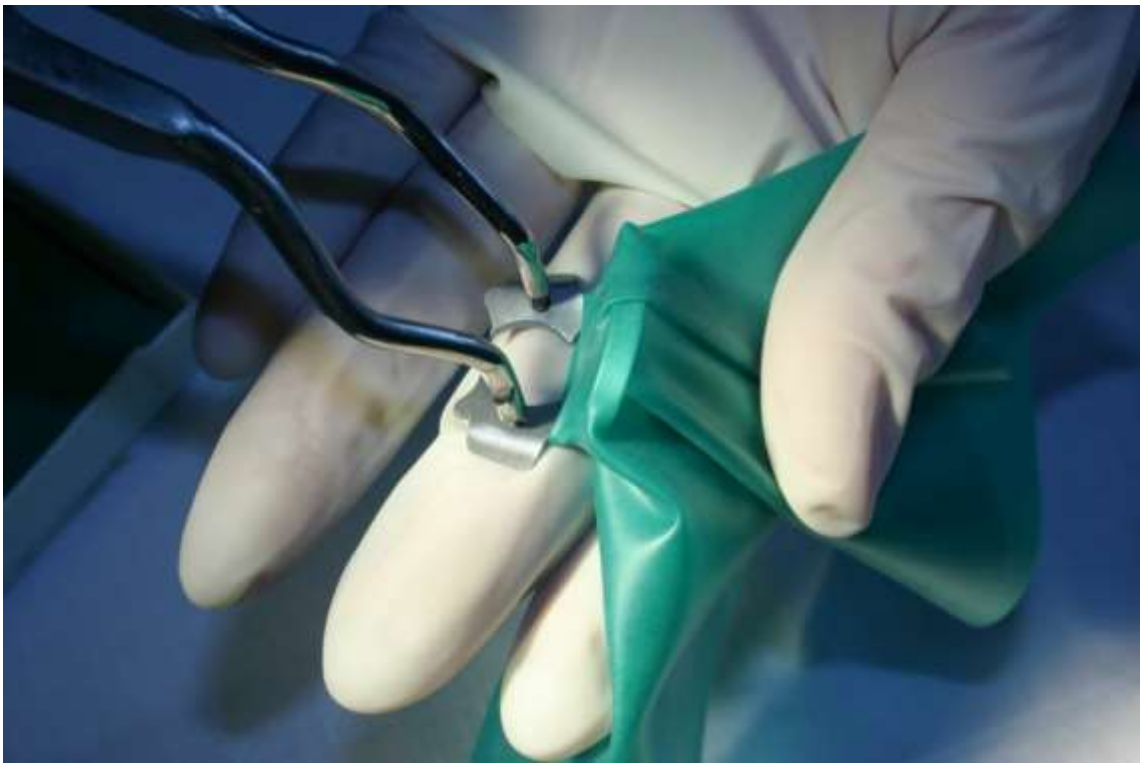
Stage 2. Trying on the selected clamp



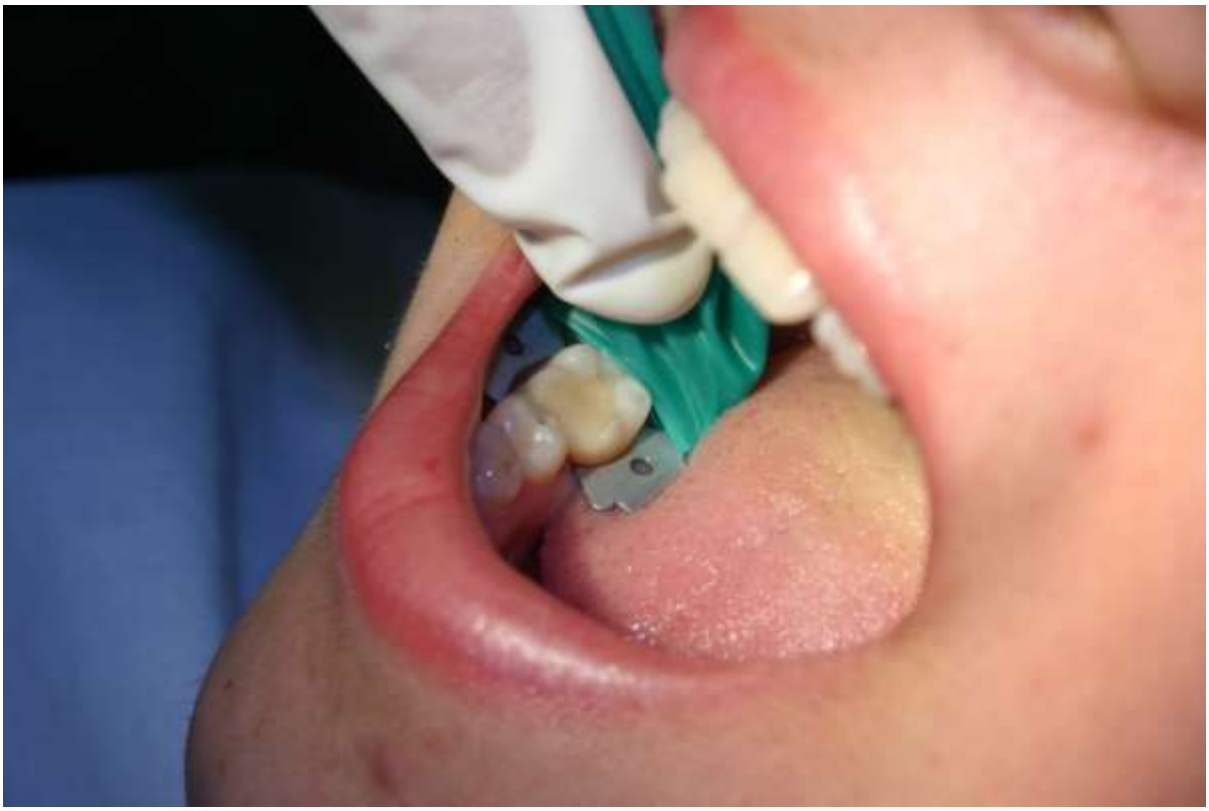
Stage 3. Perforation in a rubber scarf



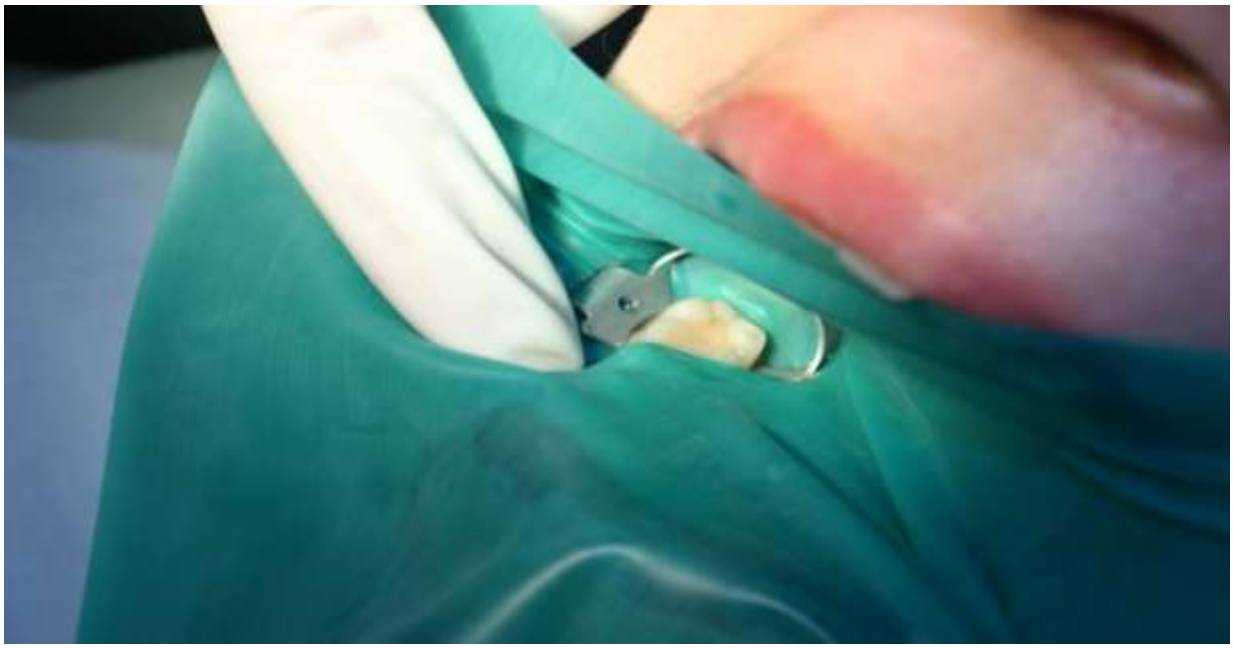
Step 4. The rubber scarf is put on the clamp.



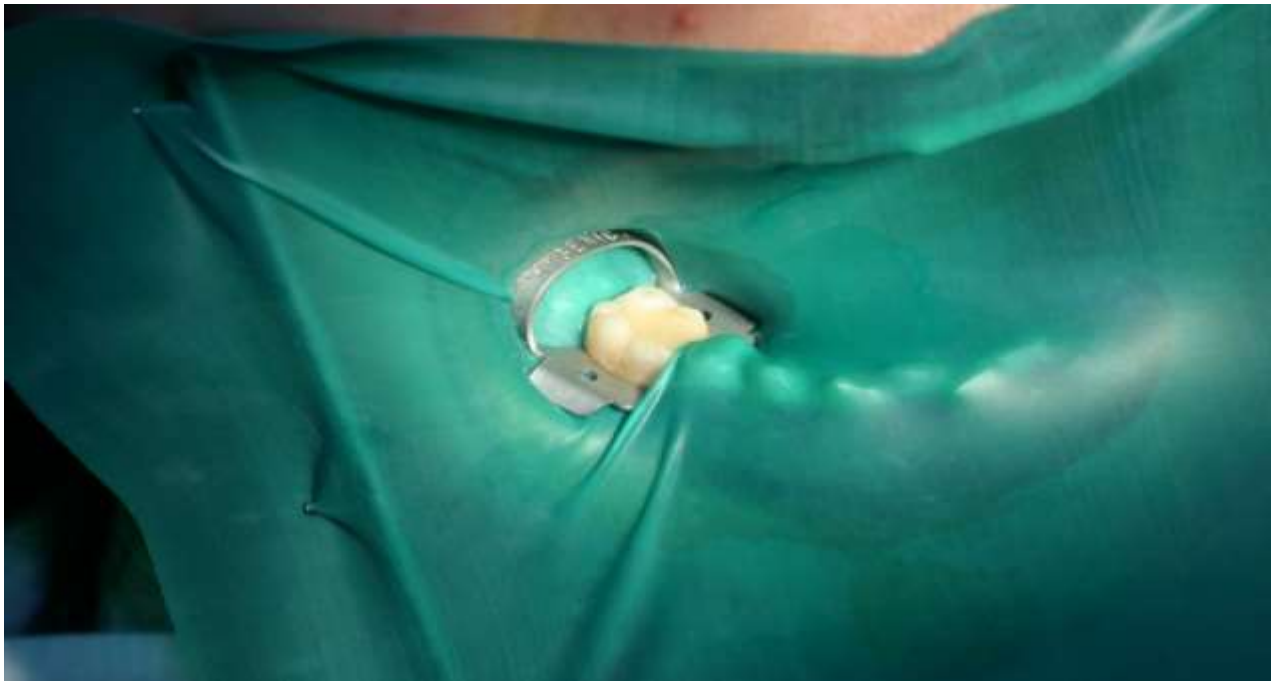
Step 5. The pliers are inserted into the clamp holes.



Stage 6. Applying a clamp with a rubber bandage to the tooth



Stage 7. The cofferdam (rubber scarf) is straightened in the oral cavity



Stage 8. External view of the applied cofferdam with a frame

There is no doubt that today the cofferdam remains the most effective method for isolation of the oral cavity. Although a wide range of isolation systems exists, the “OptiDam” system, developed by the well-known company Kerr, deserves special attention (Fig. 15).

OPTIDAM - OPTIMAL ISOLATION OF THE ORAL CAVITY

Fig.15. Set for optimal isolation of the oral cavity.

LATEX PLATES FOR ISOLATION OF DIFFERENT GROUPS OF TEETH:

Two types of latex plates have been designed to isolate different groups of teeth: OptiDam Anterior, intended for incisors and canines, and OptiDam Posterior, intended for premolars and molars (Fig. 16).

Fig.16. Latex plates for isolating different groups of teeth

Three-dimensional cofferdam sheets and anatomically designed frames (Fig. 17).

• The three-dimensional structure of the cofferdam sheet, characterized by mamelons, eliminates the need for a template or punch.

• To prepare an opening for a tooth, it is sufficient to trim the mamelon with scissors. The sheet is then placed onto a specially designed anatomical frame.

• The combination of the three-dimensional cofferdam sheet and the anatomical frame offers several clinical advantages.

Fig.17. Three-dimensional latex and frame with anatomical design

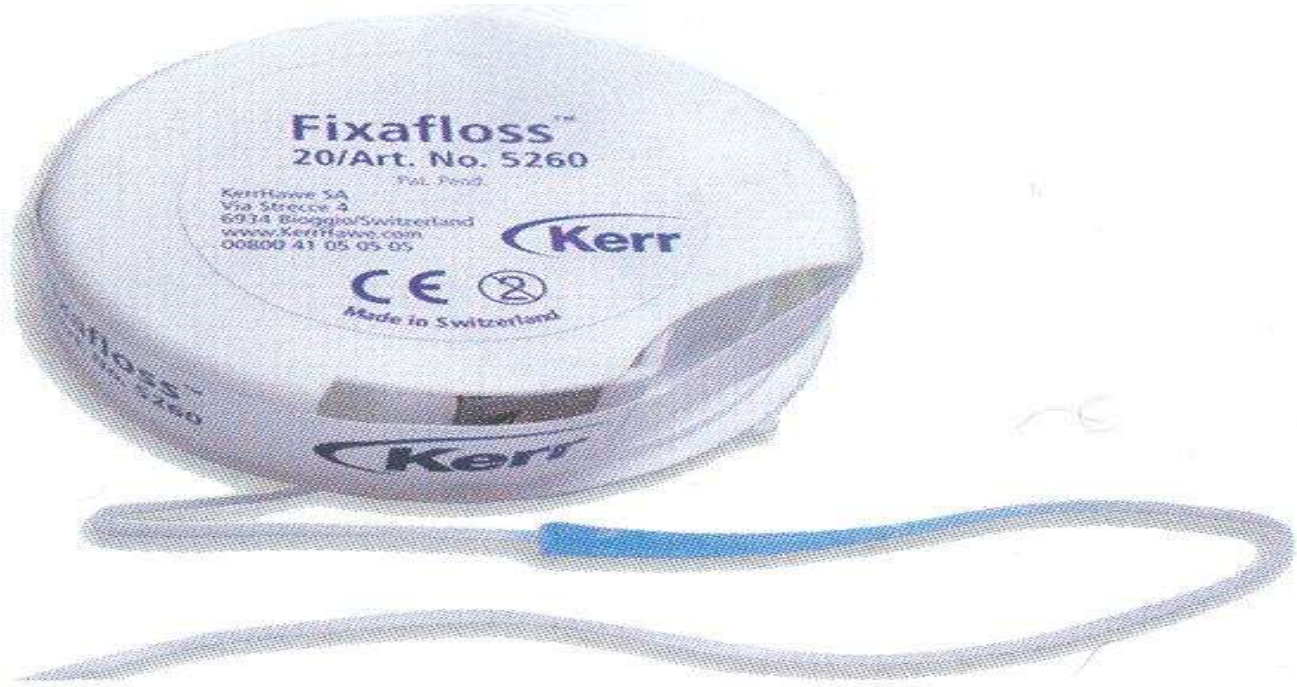


Fig. 18. Fixafloss - a thread with a silicone wedge for introducing latex between teeth

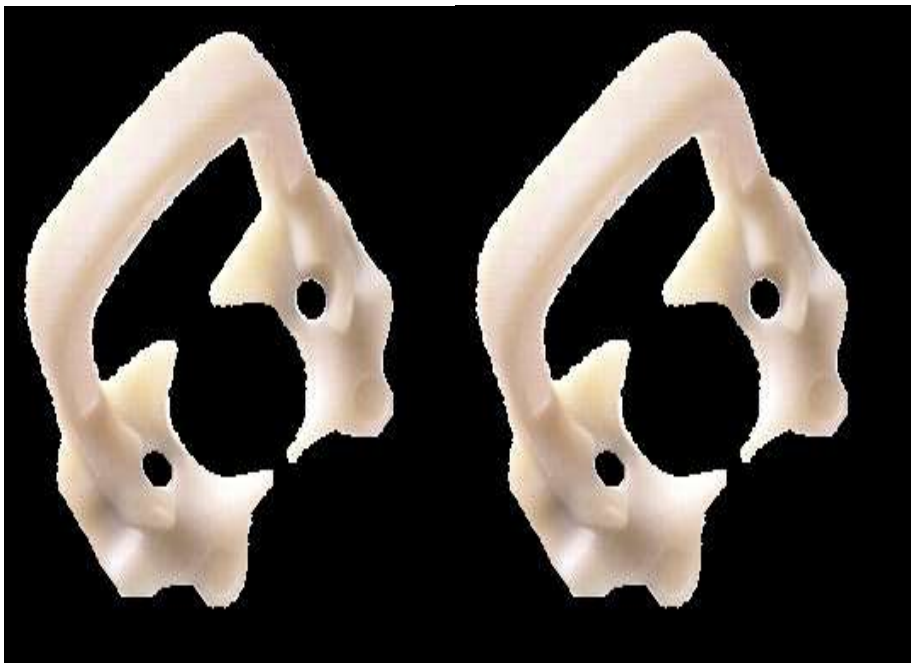


Fig.19. SOFTCLAMP – plastic clamps

Advantages of the OptiDam Isolation System

1. The operative field remains consistently dry and clean.

2. Effective isolation of oral soft tissues ensures that the tongue, cheeks, and lips do not interfere with the procedure.

3. Dental materials are fully protected from contamination by oral fluids.

4. The patient is safeguarded from accidental exposure to various solutions and from the risk of aspiration.

5. Dental professionals are protected from potential infection.

Protocol for Application of OptiDam Anterior

1. Stretch the cofferdam sheet over the anatomical frame.

2. Trim the mamelon corresponding to the tooth to be treated with scissors.

3. Insert the frame with the mounted sheet into the oral cavity.

4. Adapt the cofferdam sheet to the teeth undergoing treatment.

5. Secure the sheet on the central incisors using Fixafloss®.

6. Clinical view of a patient with isolated teeth using the OptiDam Anterior system.

Fig. 20. STRETCHING LATEX ONTO THE FRAME (STEP 1A)

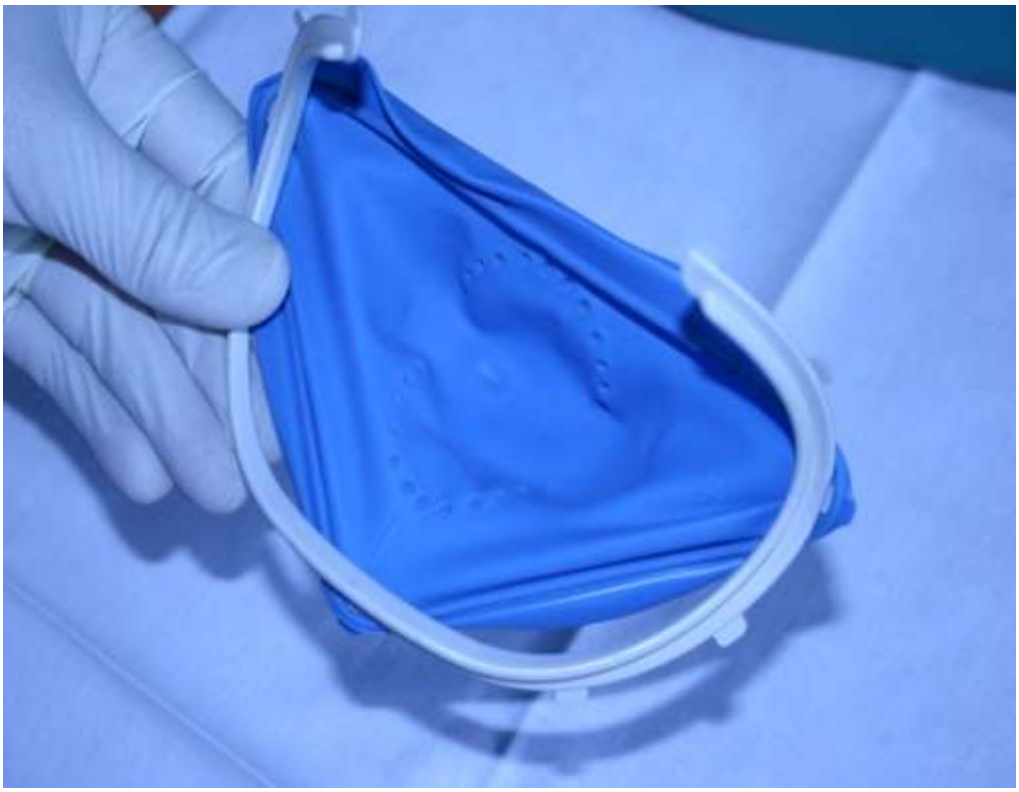


Fig. 21. STRETCHING LATEX ONTO THE FRAME (STEP 1 B)

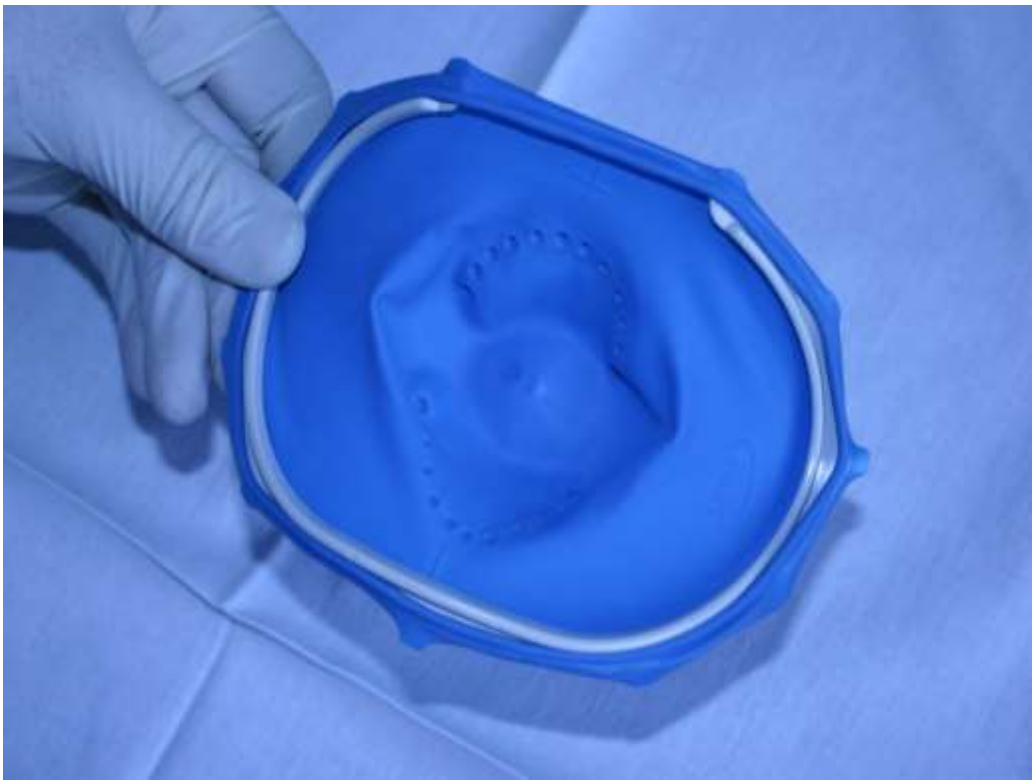


Fig.22. STRETCHING LATEX ONTO THE FRAME (STEP 1B)

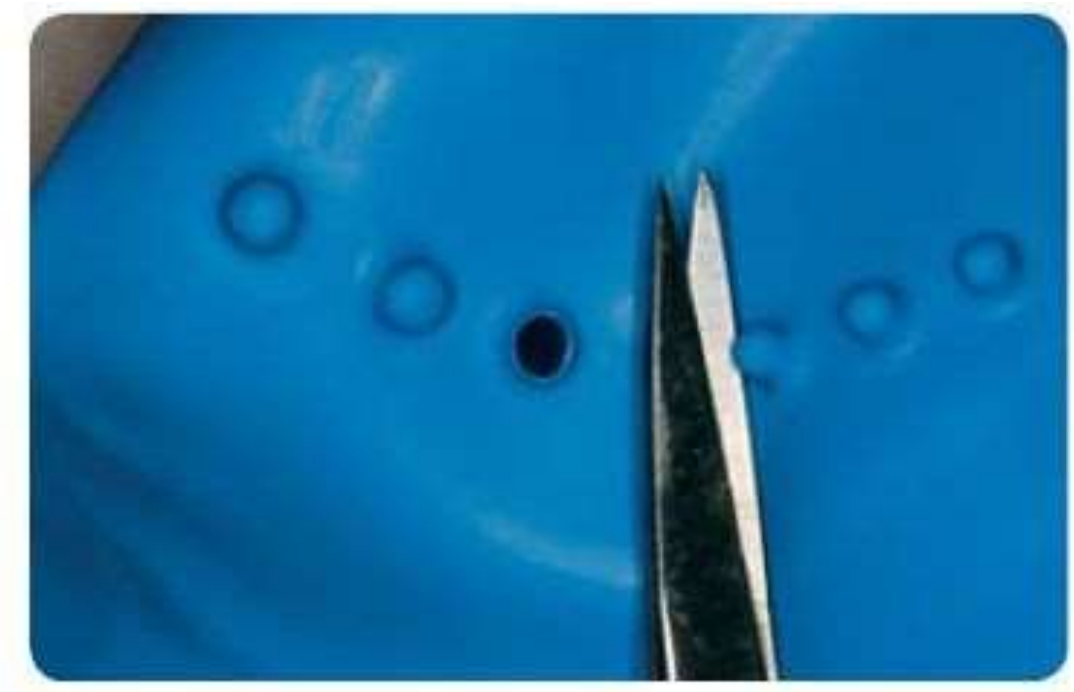


Fig.23. CUTTING WITH SCISSORS THE MASTOID TUBE CORRESPONDING TO THE TEETH TO BE TREATED

(STEP 2)

Fig.24. INTRODUCING A FRAME WITH LATEX

INTO THE ORAL CAVITY (STEP 3)

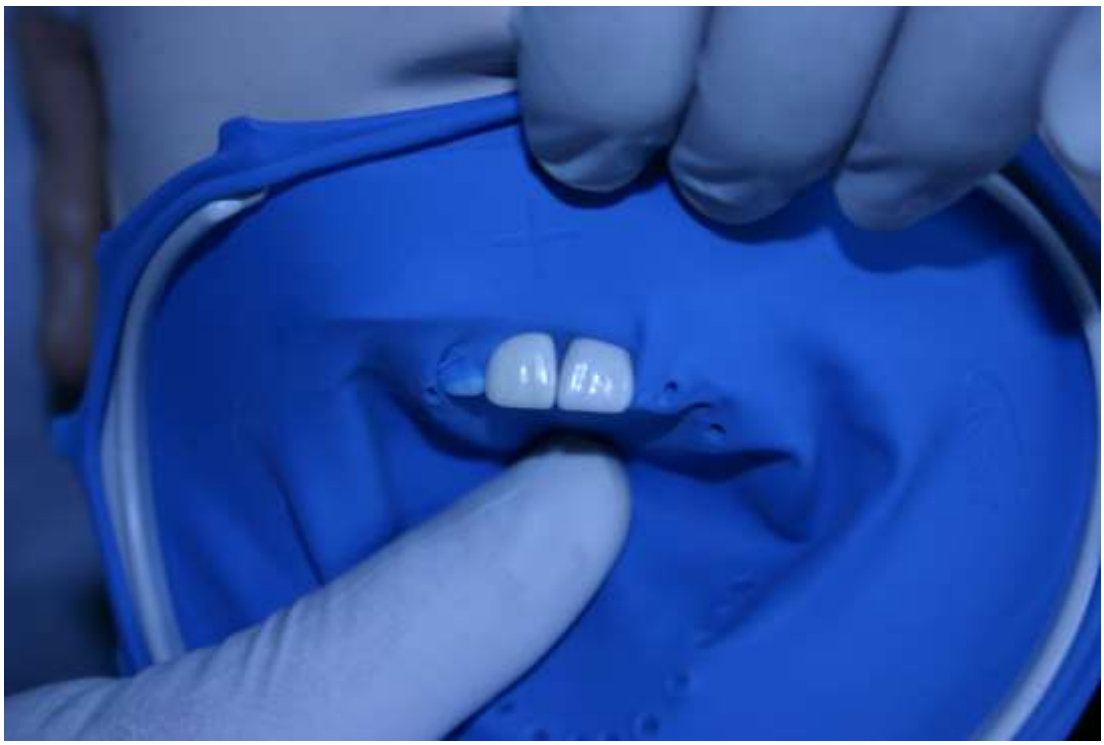


Fig.25. PUTTING LATEX ON THE TEETH TO BE

TREATED (STEP 4)

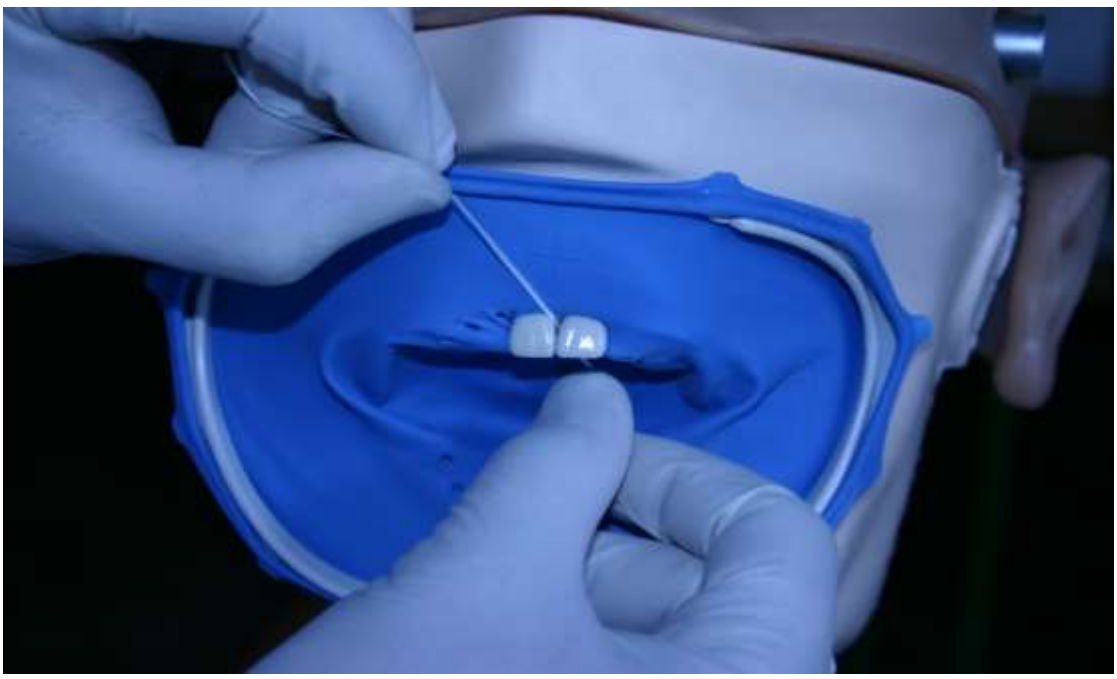


Fig.26. LATEX FIXATION ON CENTRAL INCISORS

USING FIXAFLOSS (STEP 5)

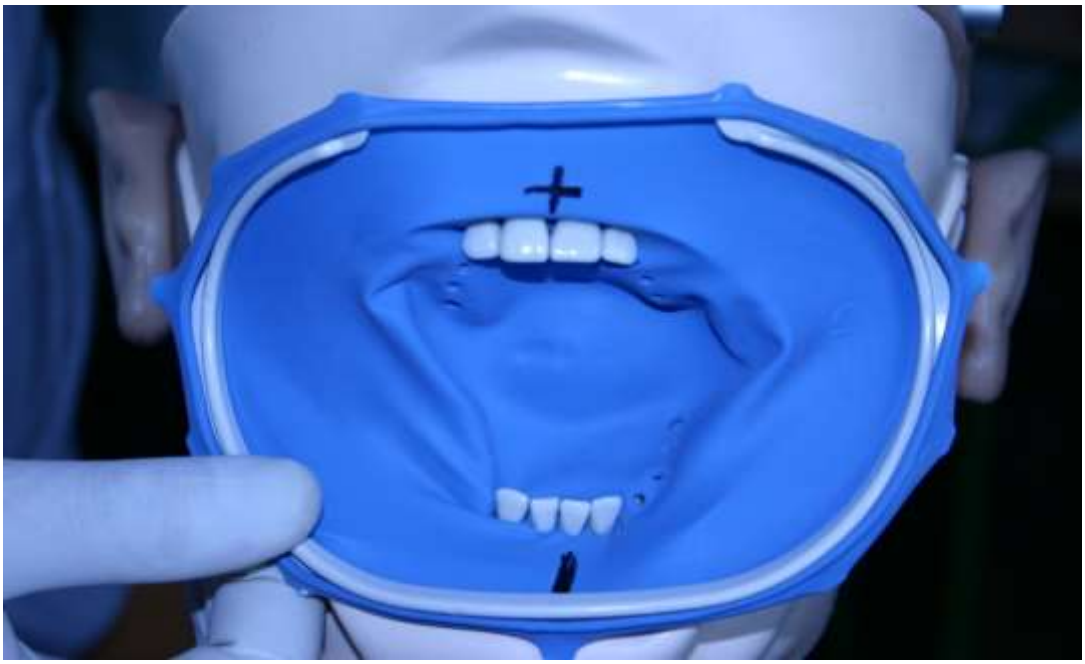


Fig.27. APPEARANCE OF A PATIENT WITH ISOLATED TEETH

USING OPTIDAM ANTERIOR

It should be noted that the application of OptiDam Anterior is carried out using the markings in the form of the signs “+” (upper jaw) and “-” (lower jaw)

SEQUENCE OF APPLICATION

Protocol for Application of OptiDam Posterior

1. Stretch the cofferdam sheet over the anatomical frame.

2. Trim the mamelon corresponding to the tooth to be treated with scissors.

3. Insert the clamp arch into the prepared opening of the sheet.

4. Secure the clamp onto the tooth using dental forceps.

5. Clinical view of a patient with teeth isolated using the OptiDam Posterior system.

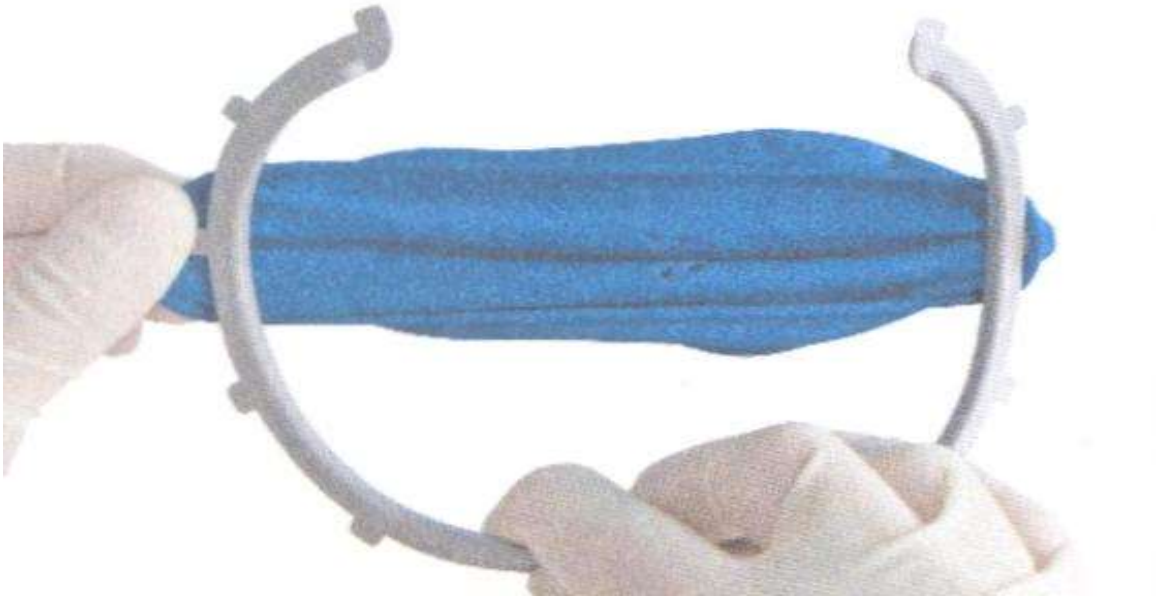


Fig.28. STRETCHING LATEX ONTO THE FRAME (STEP 1A)

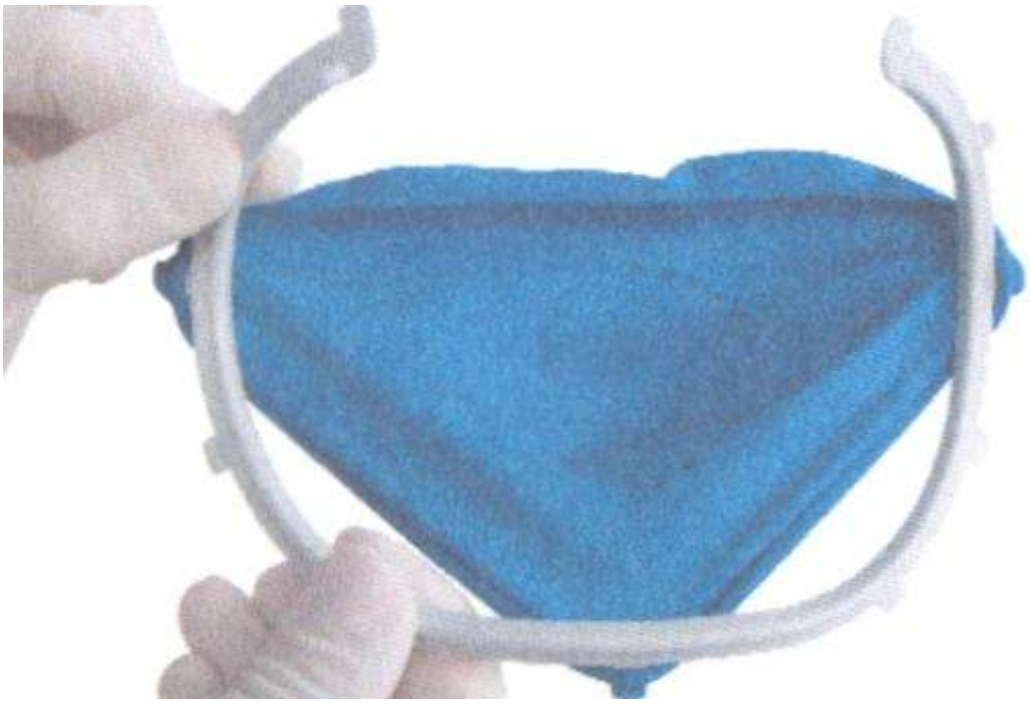


Fig.29. STRETCHING LATEX ONTO THE FRAME

(STEP 1B)

Fig.30. STRETCHING LATEX ONTO THE FRAME

(STEP 1B)

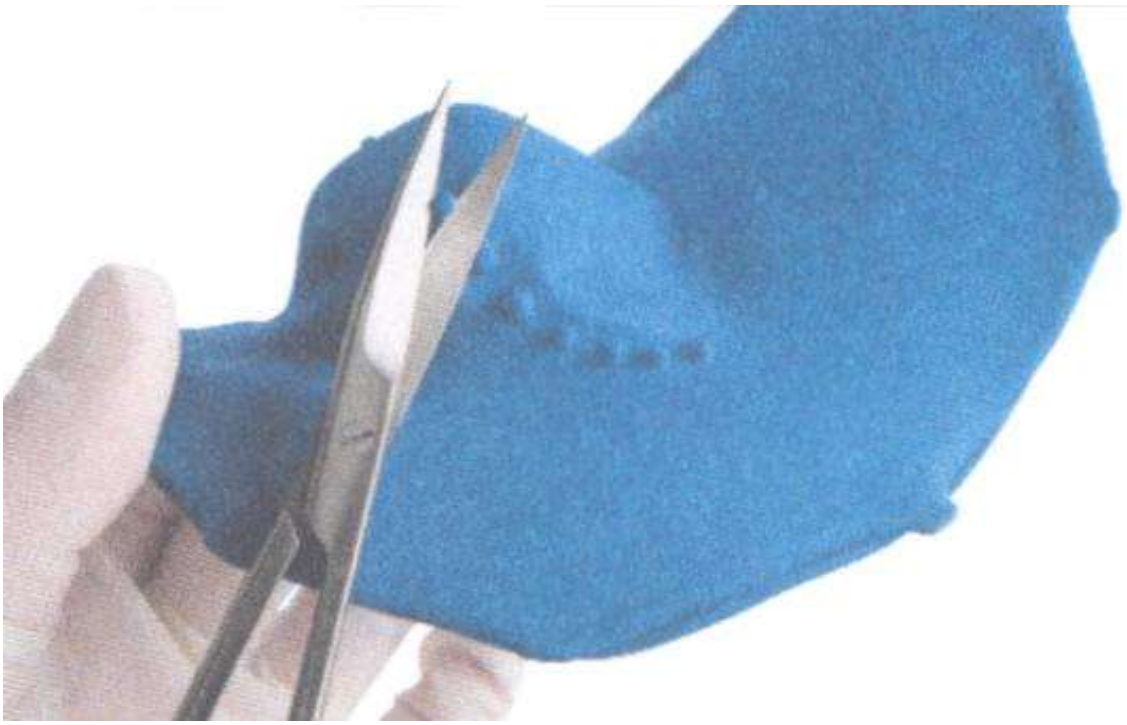


Fig. 31. CUTTING WITH SCISSORS THE MASTOID TUBE CORRESPONDING TO THE TEETH TO BE TREATED

(STEP 2)

Fig. 32. THE CLAMP ARCH IS INSERTED INTO THE LATEX HOLE

(STEP 3)

Fig. 33. USING TONGS, THE CLAMP IS FIXED ON THE TOOTH (STEP 4)

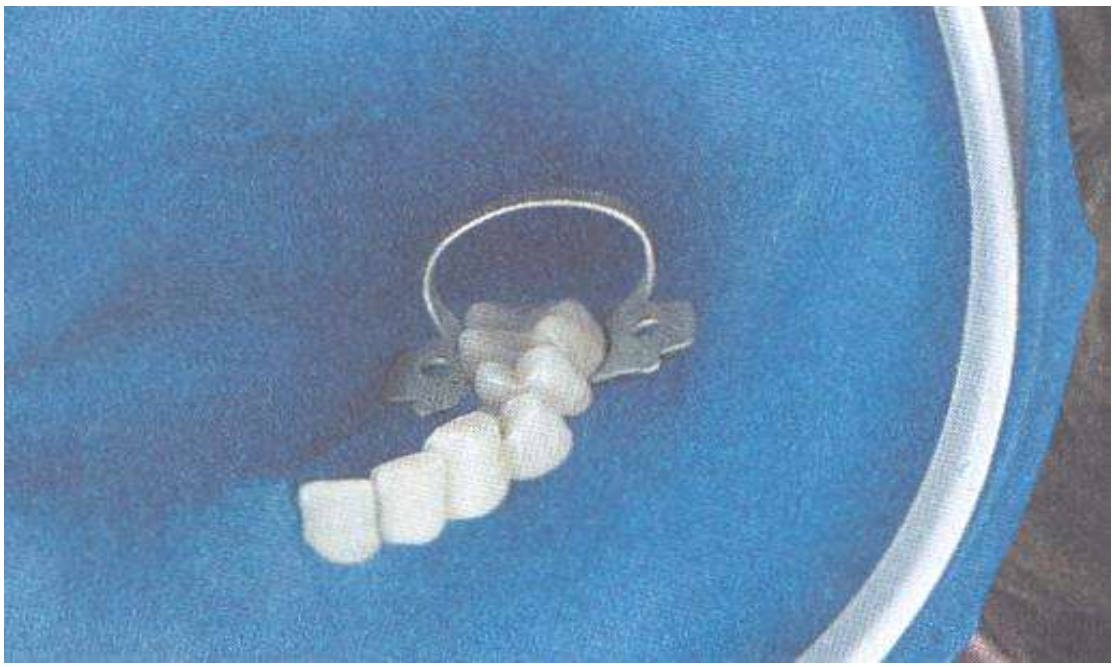
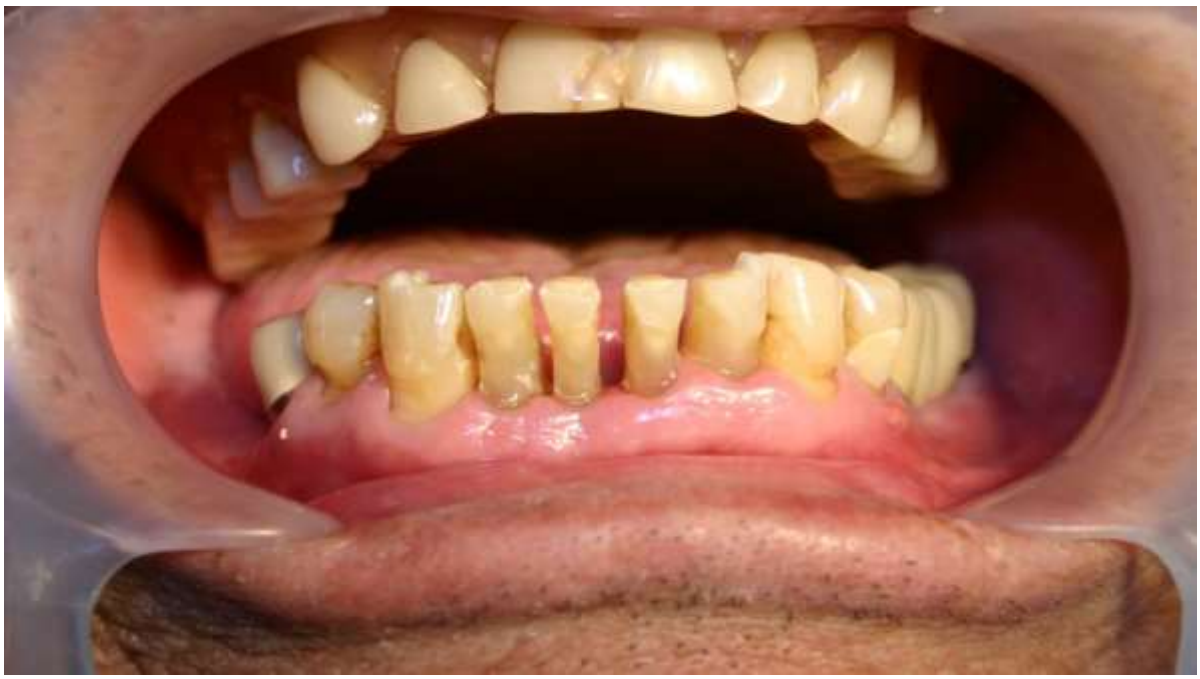


Fig.34. APPEARANCE OF A PATIENT WITH TEETH ISOLATED WITH OPTIDAM POSTERIOR

It is important to emphasize that OptiDam is predominantly described in the literature in positive terms. However, clinical observations indicate certain limitations. Specifically, the perforations in the OptiDam sheet intended for the mandibular central incisors do not always correspond to the actual tooth dimensions. A clinical case using OptiDam Anterior demonstrates that the cofferdam sheet fails to achieve adequate marginal adaptation to the cervical region of the tooth, thereby compromising the quality of isolation (Fig. 46). In this respect, OptiDam is considerably less effective than the conventional cofferdam.

CLINICAL SITUATION



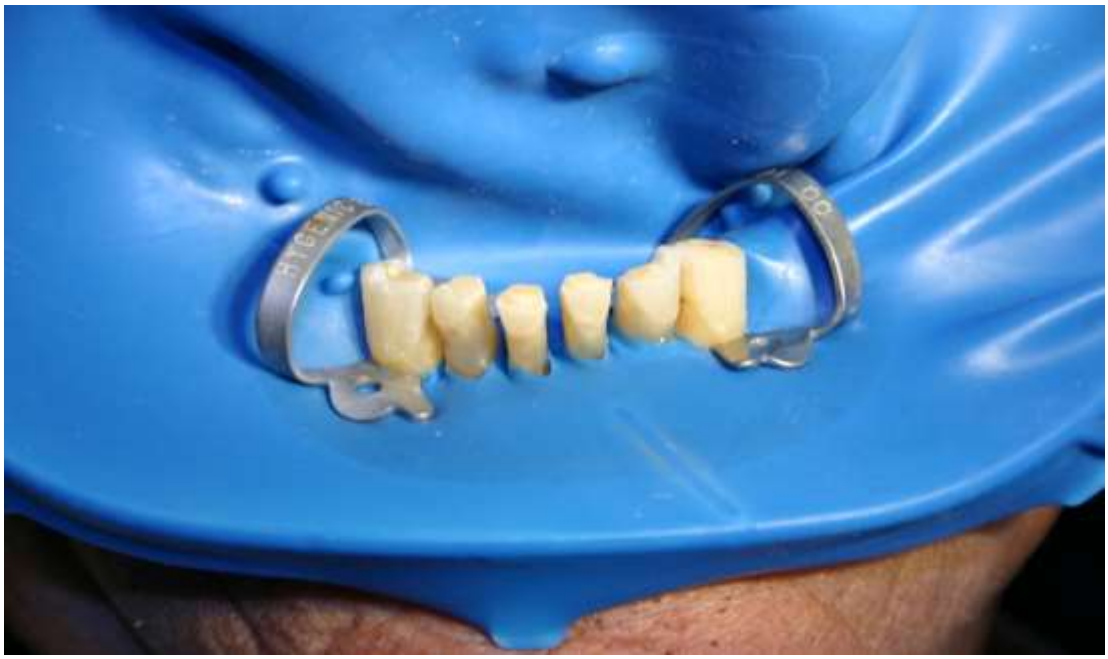
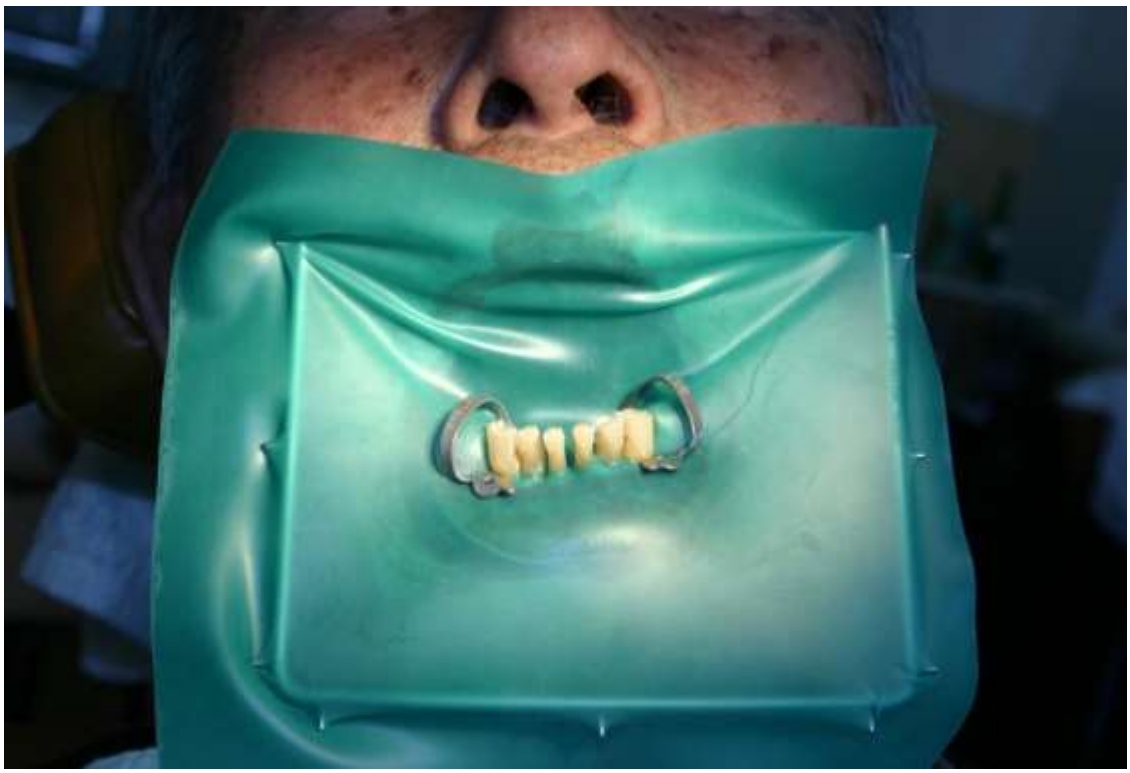


Fig. 35. Optidam insulation system does not provide optimal insulation



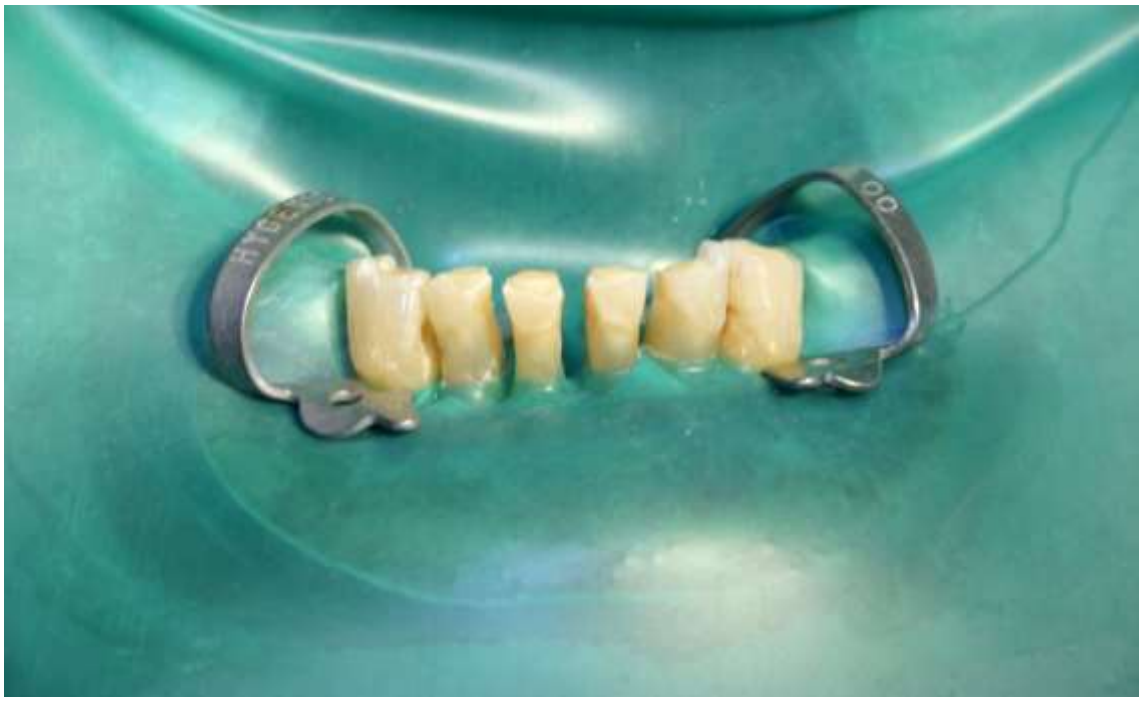


Fig. 36. The cofferdam insulation system provides

optimal insulation

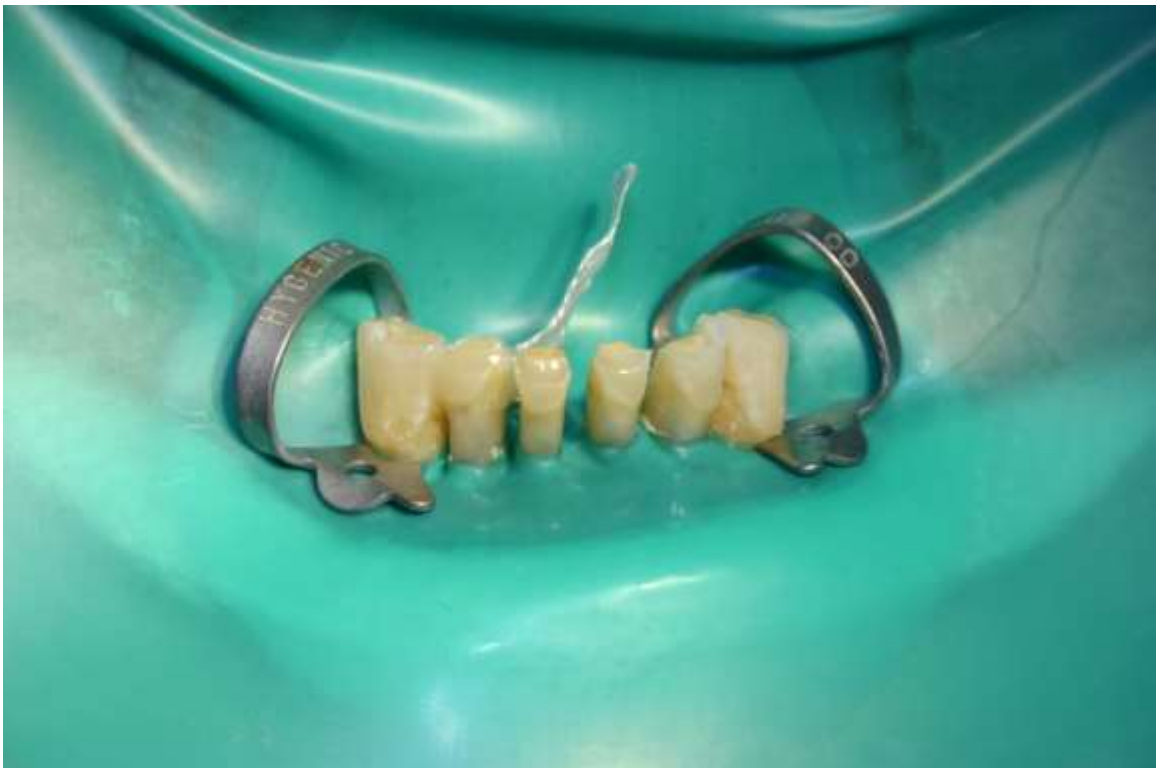


Fig. 37. The cofferdam insulation system provides optimal insulation

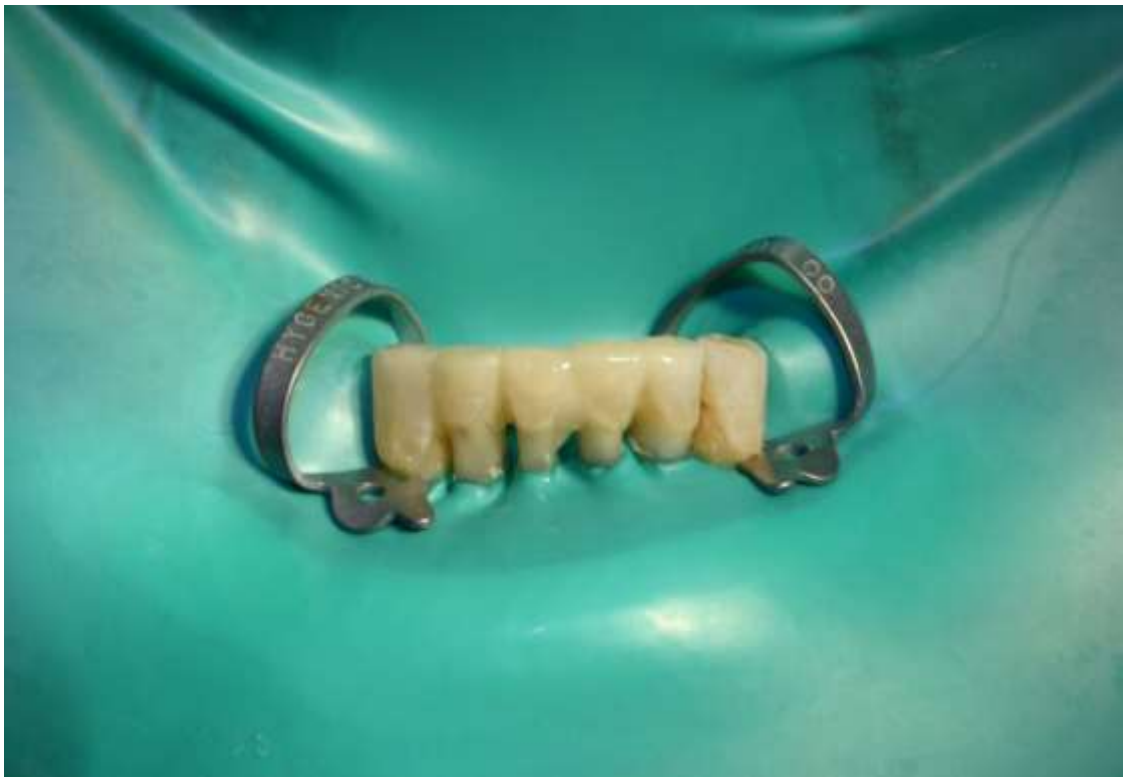


Fig. 38. The cofferdam insulation system provides

optimal insulation

During endodontic treatment, the three-dimensional design of the cofferdam sheet facilitates unrestricted hand movement during root canal procedures. Clinical practice demonstrates that it is advisable for contemporary dentists to have access to both OptiDam and the conventional cofferdam for optimal isolation.

Local infiltration anesthesia is considered the most effective, accessible, and widely used method of pain control in therapeutic dentistry. Its extensive application in clinical practice is attributed to relative safety and rapid onset of

Several types of local anesthesia are employed in dental practice, including infiltration anesthesia (submucosal, periosteal, intraligamentary, papillary, intrapulpal), conduction anesthesia, and topical application. Under infiltration and conduction anesthesia, most procedures on the maxilla can be performed

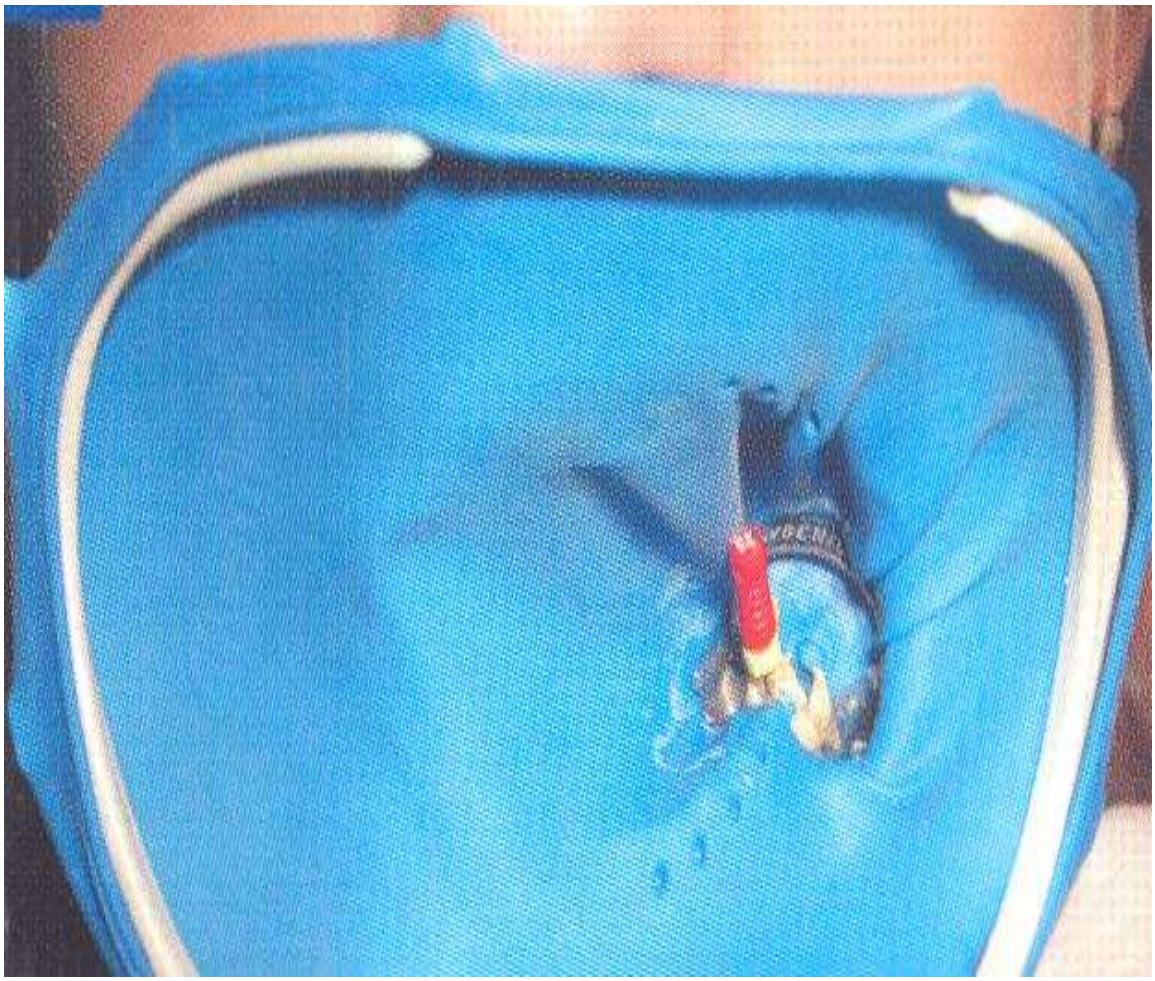
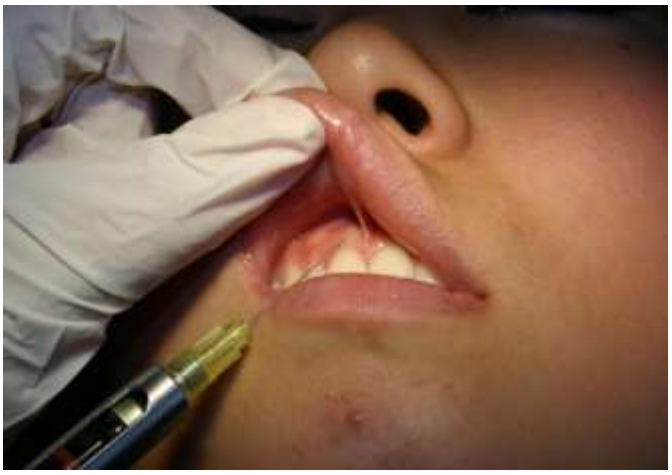


Fig. 39. OptiDam isolation system provides optimal

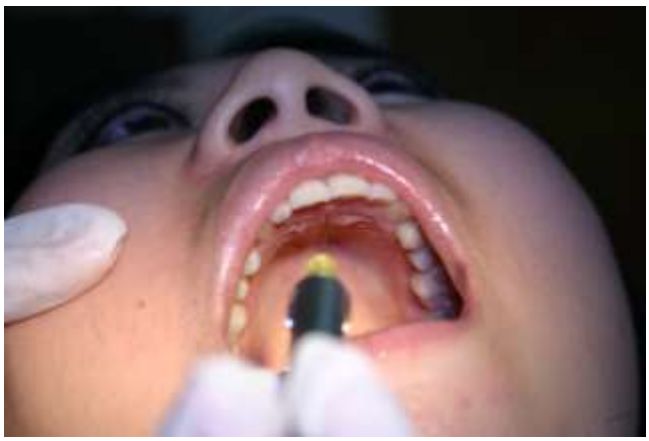
access during endodontic procedures

without pain (Fig. 40). For the mandibular posterior teeth, similar manipulations require conduction anesthesia to ensure effective analgesia (Fig. 41).action. The technique involves the administration of small volumes of concentrated local anesthetic solutions with precise delivery to specific anatomical sites.

Several types of local anesthesia are employed in dental practice, including infiltration anesthesia (submucosal, periosteal, intraligamentary, papillary, intrapulpal), conduction anesthesia, and topical application. Under infiltration and conduction anesthesia, most procedures on the maxilla can be performed without pain (Fig. 40). For the mandibular posterior teeth, similar manipulations require conduction anesthesia to ensure effective analgesia (Fig. 41).

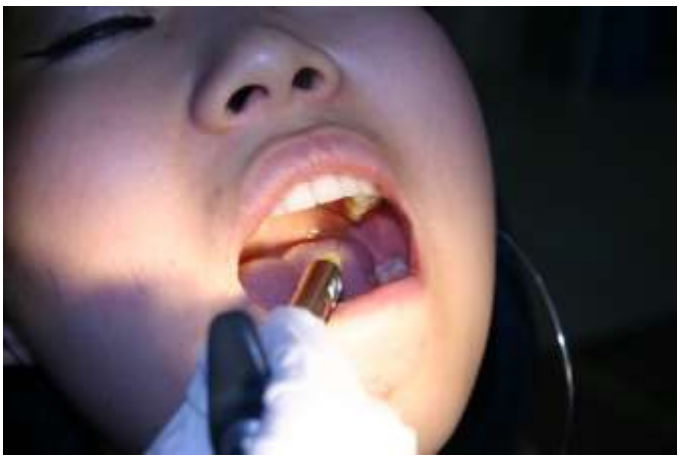


Infiltration anesthesia of the upper jaw



Conduction (incisor) anesthesia on the upper jaw

Fig. 40. Infiltration and conduction anesthesia in the upper jaw



Conduction (mandibular) anesthesia on the lower jaw

Fig. 41. Conduction anesthesia on the lower jaw

Application anesthesia is effective only for superficial anesthesia of the oral mucosa and gums. In recent years, various gels have been used to anesthetize the needle puncture site (Fig. 42).

«LIDOXOR» (15% gel)

A) Ingredients: chamomile extract, lidocaine, aromatic additives, sorbitol, stabilizer.

Manufacturer: «Omega»

B) «Gingicaine» (gel)

Ingredients: 20% benzocaine N.F. in a flavored P.E.G. base with saccharin.

Manufacturer: « Gingi-pak»

C) «Topicale TM Xtra» (gel)

Ingredients: 20% benzocaine, aromatic additives, stabilizer.

Manufacturer: «Stone Pharmaceuticals»

Fig. 42. Application gels (A, B, C)

A good knowledge of the topography of the nerve trunks and the spaces surrounding them is a guarantee of the correct performance of anesthesia and eliminates the possibility of developing complications associated with trauma when advancing the needle to the branches of the trigeminal nerve.

V. HEATED COMPOSITE MATERIALS

The primary causes of failure in composite restorations are secondary caries and fracture. To address these challenges, considerable attention has been given to methods that enhance the degree of monomer conversion. One of the earliest approaches was the so-called Soft-Start polymerization technique.

Composite materials with a high filler load exhibit an increased modulus of elasticity and flexural strength. However, such materials are characterized by higher viscosity and are generally classified as packable or condensable composites. Preheating has been shown to temporarily reduce viscosity, thereby improving handling properties and enhancing the mechanical performance of the final restoration.

Recent studies have demonstrated that preheating filled composite materials reduces viscosity, improves adaptation to cavity walls, and decreases microleakage. Insufficient conversion is a major factor leading to compromised restoration quality. A higher conversion rate correlates with greater material strength and modulus of elasticity. It has also been established that the modulus of elasticity of contemporary composites approaches that of dental enamel, further supporting the rationale for preheating.

Experimental data indicate that chemical reaction rates in composites increase upon heating. For example, composites preheated to 40 °C exhibit approximately twice the strength compared with those at 5 °C. Preheating has

additionally been shown to increase curing depth and reduce polymerization time. Moreover, the maximum degree of conversion may already be achieved during restoration placement, which shortens the post-polymerization phase. Importantly, each heated composite increment polymerizes to near-maximum conversion, limiting polymerization shrinkage to the individual layer rather than the entire bulk restoration.

Clinical and laboratory investigations have evaluated the effect of preheating on marginal adaptation, polymerization degree, flexural strength, and polymer network structure. In one study, cavities were prepared on extracted teeth and restored using the Adper Single Bond 2 adhesive system (3M/ESPE). Composites were applied either at room temperature (25 °C) or after preheating to 68 °C. Scanning electron microscopy was employed to analyze porosity, photoelectron spectroscopy to assess polymerization degree, and a three-point bending test to determine flexural strength. Preheated composites demonstrated superior marginal adaptation, reduced porosity, and higher polymerization values compared with those used at ambient temperature.

Although indirect metal–composite restorations have long involved polymerization at elevated temperatures in laboratory conditions, direct restorative composites have been continuously modified in recent years, resulting in denser consistencies and higher viscosity. Earlier generations of composites had more manageable consistencies but were limited by insufficient hardness and increased wear. As filled composites gained wider clinical acceptance, specialized heating devices were developed to improve their handling characteristics during direct restorations. It has been confirmed that composites of medium to high viscosity become more flowable at elevated temperatures (54–60 °C).

At the Department of Hospital Therapeutic Dentistry of the Tashkent State Dental Institute, a novel device was designed for heating packable composites, offering improved clinical convenience compared with existing analogues. This device was tested with the composite material Filtek P60 (3M/ESPE) (Fig. 43). A patent has been granted for this invention ("Dental device for preparing filling material," Patent No. IAP 06189, 19.03.2020, published in Rasmiy Axborotnoma, 2020, No. 4, pp. 54–55. Authors: Melkumyan T.V., Dadamova A.D., Sheralieva S.Sh., Kakhkharova D.Zh.).

Fig. 43. Device for heating composite filling material

The device is designed for heating a dosed (portioned) amount of composite material during restorations. The device consists of a power supply unit (220 V/19 V) and an electronic control unit with a table for heating the composite material. The table heating temperature is from 45^0 to 95^0 C.

The prototype of the developed device for heating composite material during dental restorations was a furnace (Fig. 44, 45).

Fig.44. Furnace for heating composite material

Fig.45. Furnace for heating composite material

It should be emphasized that when using conventional syringe heating, the entire material portion is warmed and subsequently returned to refrigeration for storage, a process that may compromise the integrity of the composite. In contrast, the device developed at our department allows heating only the required portion of material, thereby reducing the risk of deterioration.

At present, composite resins are available in various viscosity grades. Flowable composites represent the most fluid formulations, while packable composites are characterized by minimal flow. Flow is generally achieved by reducing the filler fraction, which in turn decreases polymerization stress in the restoration as well as in adjacent adhesive and hybrid layers.

Despite numerous protocols proposed for restoring hard dental tissues, evaluating their comparative effectiveness remains difficult due to variations in study design. Differences in bond strength and microleakage outcomes are primarily related to methodological inconsistencies.

At the Department of Hospital Therapeutic Dentistry of the Tashkent State Dental Institute, an experimental study was conducted to assess the need for preheating three widely used high-viscosity composites: Te Econom Plus (Ivoclar Vivadent), Synergy D6 (Coltene), and Premice (Kerr).

SHEAR BOND STRENGTH (SBS)

Sixty tooth specimens were prepared according to the Ultratest Machine (Ultradent Inc.) protocol. Samples were randomly assigned to six groups:

- Group 1A (n=10): Te Econom Plus at room temperature (24–26 °C)
- Group 1B (n=10): Te Econom Plus preheated to 70 °C
- Group 2A (n=10) and 2B (n=10): Synergy D6 at room and preheated conditions
- Group 3A (n=10) and 3B (n=10): Premice at room and preheated conditions

The departmental heating device was used for composite preheating.

Thirty intact premolars extracted for orthodontic purposes were used. Two standardized approximal cavities (1 × 3 mm) were prepared on each tooth, with the mesial cavity filled at room temperature and the distal cavity with preheated material (70 °C). Groups were divided according to the composite used: Te Econom Plus (n=10), Synergy D6 (n=10), and Premice (n=10).

Following restoration, samples underwent thermal cycling according to established protocols. Apices were sealed with sticky wax, teeth coated with varnish except for a 1 mm margin around the restorations, and then immersed in 2% methylene blue for 24 hours. After rinsing, teeth were sectioned longitudinally. Dye penetration depth was assessed using a Canon EOS 5D Mark III with a 100 mm macro lens and scored from 0 to 4.

The adhesive protocol was identical for all groups, employing the fifth-generation adhesive system Peak Universal (Ultradent Inc.) with polymerization by Bluephase 20i (Ivoclar Vivadent) in “High” mode.

SBS: No significant differences were detected between preheated and room-temperature composites, possibly due to the limited bonding surface of class V cavity designs. C-factor considerations were therefore critical in interpreting the data.

Microleakage: Preheated composites demonstrated improved marginal sealing without increasing residual stress, likely due to incremental layering during polymerization. Thermal cycling further highlighted compatibility between thermal expansion coefficients of biomaterials and tooth tissues.

For Te Econom Plus, preheating improved marginal integrity and reduced microleakage. For Synergy D6, differences suggested a potential mismatch in

thermal expansion between composite and tooth structure. Premice results were not significantly influenced by preheating, possibly due to its inherent thixotropy and biocompatibility.

Preheating effects vary depending on the composite formulation. Experimental validation is required for each material before routine clinical application.

VI. AIR-ABRASIVE TREATMENT OF ADHESIVE TOOTH SURFACES

The restoration of cervical defects with composite resins is considered a universal and minimally invasive therapeutic approach. The long-term clinical success of such restorations depends not only on reliable isolation of the operative field but also on the cleanliness of the dental substrate. Within the adhesive protocol, the tooth surface must be free from dental plaque and microbial biofilm.

Traditionally, surface decontamination prior to cavity preparation has been achieved through mechanical methods such as abrasive polishing pastes, brushes, and rubber cups. However, displacement of the gingiva during the use of retraction cords and cofferdam frequently results in the exposure of cervical tooth surfaces, which require meticulous cleaning. Access to these areas is often restricted, complicating the use of conventional rotary instruments. Consequently, the application of alternative cleaning methods has become clinically relevant.

Air-abrasive technology has gained wide acceptance in restorative dentistry as an effective technique for removing dental plaque and preparing tooth surfaces

for adhesive procedures. Its popularity is attributed to several advantages over traditional mechanical approaches, including enhanced cleaning efficiency and minimally invasive action.

In this context, a study was conducted at the Department of Hospital Therapeutic Dentistry of the Tashkent State Dental Institute to evaluate the bond strength between composite materials and dentin surfaces treated with an aqueous air-abrasive mixture. A combination of laboratory, experimental, and statistical methods was employed for data collection and analysis. Laboratory investigations were carried out at the Center for Advanced Technologies under the Ministry of Higher Education, Science, and Innovation of the Republic of Uzbekistan.

Fig. 46. Scanning electron microscope

(EVOMA10(Oxford), Karl Zeiss)

Fig.47. Ultratest Machine

Scanning electron microscopy was performed using an EVOMA10 scanning electron microscope (Oxford, Karl Zeiss) (Fig. 46). This instrument is designed to obtain high-resolution surface images of specimens.

The principle of SEM operation is based on directing an electron beam, emitted by an electron probe, onto the surface of the analyzed object. Interaction of the electron beam with the sample produces low-energy secondary electrons, which are captured by a secondary electron detector. The intensity of the detected signal depends on both the properties of the sample and its surface topography.

This makes it possible to generate a detailed topographic map of the scanned region.

The microscope is equipped with an energy-dispersive spectrometer (EDS), which enables elemental analysis of the material. In addition, an electron backscatter diffraction (EBSD) detector provides complete crystallographic information, including the crystallographic orientation of grains, unit cell parameters, and orientation maps of grains within the crystal structure.

The adhesive bond strength was tested on 10 extracted human teeth, prepared for use with the UltraTester device (Ultradent, USA) (Fig. 47). Each specimen was subjected to three repeated measurements.

- Series 1 (control, n=10): dentin surface treated only with fine-grained sandpaper.
- Series 2 (n=10): after mechanical sanding, dentin was additionally treated for 20 seconds with an aqueous air-abrasive mixture containing sodium bicarbonate particles.
- Series 3 (n=10): after the same mechanical sanding, dentin was treated for 20 seconds with an aqueous air-abrasive mixture containing erythritol particles.

Accordingly, three groups were formed:

1. Control group (Series 1)
2. Experimental group with sodium bicarbonate (Series 2)
3. Experimental group with erythritol (Series 3)

Air-abrasive treatment was performed with an Air-Flow device (EMS, Switzerland), using Classic powder (sodium bicarbonate, 40 μm) and Plus

powder (erythritol, 14 μm). The nozzle was positioned at a distance of 1 cm from the dentin surface and at an angle of 45°.

The OptiBond FL adhesive system was applied in combination with the Herculite XRV composite (Kerr, Italy). A wet bonding protocol was followed. Polymerization was carried out with a Valo light-curing unit (Ultradent, USA) under standard operating conditions.

Bond strength was measured immediately after placement of the restoration, and the results were expressed in pounds (lb).

Data were analyzed using Student's t-test, with calculation of the mean (M) and standard deviation (SD). Differences were considered statistically significant at $p < 0.05$.

Efficiency of Using Total-Etch and Self-Etching Adhesive Systems after Air-Abrasive Treatment of Dentin

The effectiveness of self-etching adhesive systems after air-abrasive treatment of dentin was investigated by the staff of the Department of Hospital Therapeutic Dentistry (Melkumyan T.V., Musashaykhova Sh.K., Kamilov N.Kh., Dadamova A.D., 2022). Modern trends in minimally invasive cavity preparation, combined with the development of self-etching adhesives, have significantly changed the protocols for the surgical treatment of dental caries. Alternative preparation methods now allow clinicians to perform interventions with greater consideration of the microstructure of enamel and dentin.

The removal of biofilm and the smear layer without causing clinically significant damage to hard tissues has become possible due to the introduction of low-abrasive powders (glycine, erythritol, etc.) into clinical practice. Nevertheless, due to the wide variety of clinical situations and the complexity of

some restorative procedures, the use of more abrasive powders (aluminum oxide, sodium bicarbonate, calcium carbonate, and others) cannot be completely abandoned.

In addition to surface cleaning, current approaches aim to create a bioactive surface layer that promotes accelerated remineralization of enamel and dentin compromised by caries. Thus, methods of preparing adhesive surfaces may contribute to the long-term success of restorations, provided that the properties of the adhesive systems used are carefully considered.

The concept of simultaneous etching and hybridization of dental hard tissues, implemented in sixth- and seventh-generation adhesive systems, represents an important step toward minimally invasive adhesive dentistry. However, a key drawback of total-etch (etch-and-rinse) adhesives is the incomplete infiltration of monomers into the microporosities formed in enamel and dentin after conditioning with phosphoric acid gels. Furthermore, the moisture retained in the demineralized dentin matrix may lead to gel polymerization of adhesive monomers, producing hydrolytically unstable polymers.

Many of these shortcomings of fourth- and fifth-generation systems were addressed in the development of self-etching adhesives, which are based on acidic monomers. Their advantages include the elimination of separate dentin etching and the ability to form a chemical bond between adhesive monomers and hydroxyapatite crystals. A specific feature of self-etching adhesives is the integration of the smear layer into the adhesive interface.

It follows that the quality and thickness of the smear layer can significantly influence the bond strength of self-etching adhesives to dentin. Air-abrasive treatment of dentin is known to open numerous dentinal tubules and reduce smear layer thickness. However, previous studies suggest that this method can

also alter the elemental composition of dentin surfaces, potentially affecting the adhesive bond strength of composite restorations.

These considerations defined the objectives of the present study, which aimed to evaluate the effect of air-abrasive dentin treatment on both the elemental composition of the dentin surface and the bond strength of two self-etching adhesive systems.

In this study, powders based on aluminum oxide (27 μm), sodium bicarbonate (40 μm), and erythritol (14 μm) were used for air-abrasive treatment of adhesive surfaces. The adhesive protocol was performed with two single-component self-etching systems: Single Bond Universal and Bond Force 2.

The adhesive bond strength between composite material and dentin was evaluated on 80 extracted human teeth, prepared according to the Ultratest method (Ultradent). To create a standardized smear layer, the exposed dentin surfaces were prepared with carbide burs under constant water cooling, rinsed with distilled water, and dried with an air–water syringe.

The samples were randomly divided into four groups (n=20 each), with subgroups A and B depending on the adhesive system used:

- Group 1 (n=20): dentin surface treated with aluminum oxide powder.
- Group 2 (n=20): dentin surface treated with sodium bicarbonate powder.
- Group 3 (n=20): dentin surface treated with erythritol powder.
- Group 4 (control, n=20): dentin surface left untreated after preparation with carbide burs.

Air-abrasive treatment was performed with a constant particle flow under a pressure of 0.25 MPa for 30 seconds. The nozzle was positioned at a distance of 5 mm from the dentin surface, at an angle of 45° (Fig. 48).

Fig. 48. Air-abrasive treatment of the adhesive surface of the tooth

After air-abrasive treatment, the dentin surface was thoroughly rinsed with an air–water spray for 30 seconds. The adhesive protocol was then initiated.

- Subgroup A: treated with Single Bond Universal (3M ESPE, USA).
- Subgroup B: treated with Bond Force 2 (Tokuyama, Japan).

Application and polymerization of the adhesive resins were performed strictly in accordance with the manufacturers' instructions. As a restorative material, the composite Herculite XRV (Kerr, Italy) was used.

Polymerization was carried out using a VALO LED curing light (Ultradent Products Inc., USA) in standard operating mode (Fig. 49).

Fig.49. Photopolymerizing lamp VALO.

The adhesive strength of the bonded interfaces was assessed on the same day using an UltraTester (Ultradent Products Inc., USA) without simulating the aging process. The lifting speed of the test clamp with the specimen installed was set at 1 mm/min. The maximum value of the joint break was recorded in pounds (lb).

Scanning electron microscopy and determination of the elemental composition of the sample surfaces were performed on a SEM EVO MA 10 microscope (Carl Zeiss) with an EDS AztecEnergy Advanced X-Act energy-dispersive X-ray spectrometer (Oxford Instruments). For this purpose, 12 additional samples were prepared, each of which had two areas identified on the dentin surface. In this case, one area was treated in accordance with the methods used in the study,

while the other, after preparation with carbide burs, was not subjected to air-abrasive treatment.

Thus, three groups of samples were formed: in group (A/M), Al_2O_3 powder was used for air-abrasive treatment; in group B/M – Air-Flow Classic; in group E/M (n=4) – Air-Flow Plus.

Statistical analysis was performed using the StatSoft Statistica v6.0 software package. The mean (M) and standard deviation (SD) were calculated. Multiple comparisons were made using one-way analysis of variance and Tukey's HSD post hoc test. A probability value of $p<0.05$ was considered statistically significant.

The obtained results showed that the adhesion force of the composite material to the tooth dentin depends not only on the type of powder used for air-abrasive treatment, but also on the type of adhesive system used (Table 1).

A decrease in the strength of the studied interface was observed in tooth specimens where SBU was used after air-abrasive treatment of dentin with sodium bicarbonate (2A). However, the detected difference of 1.1 times ($p=0.042$) appeared clinically insignificant due to the relatively high mean value in this subgroup.

Air-abrasive treatment of the dentin surface with powders based on erythritol (3A) and aluminum oxide (1A) did not negatively affect the adhesive bond strength in the remaining subgroups when using SBU, as their results did not significantly differ from the control value in subgroup 4A.

Regarding the performance of BF2, no statistical difference was found between the control subgroup (4B) and the experimental group (1B), where the dentin

Table 1.

Groups / Subgroups	1	2	3	4
A	24,57±4,72	21,42±2,03	21,82±4,7	23,53±2,27
B	15,56±1,72	13,57±2,3	9,9±2,96	16,47±2,35
Statistics (P)	4A-1A=0,538: 4A-2A=0,042: 4A-3A=0,314: 1A-2A=0,068: 1A-3A=0.208: 2A-3A=0.808: 4B-1B=0,336: 4B-2B=0,012: 4B-3B=0,000: 1B-2B0,042: 1B-3B=0,000: 2B-3B=0,006: 1A-1B=0,000: 2A-2B=0,000: 3A-3B=0,000: 4A-4B=0,000: 1A-2B=0,000: 1A-3B=0,000: 1A-4B=0,000: 1B-2A=0,000: 1B-3A=0,000:1B-4A=0,000			

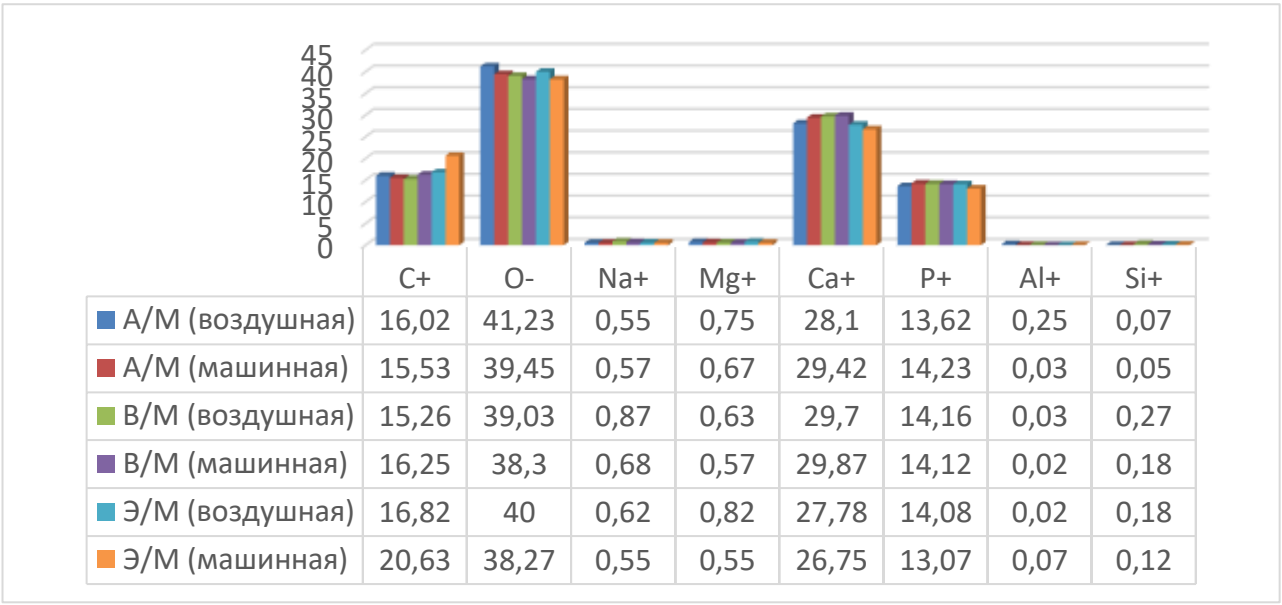
surface was treated with aluminum oxide before the application of the adhesive resin.

In contrast, similar surface treatment with abrasive mixtures based on sodium bicarbonate (2B) and erythritol (3B) led to a reduction in the adhesive bond strength between the composite and dentin by 1.2 (p=0.012) and 1.7 times (p=0.000), respectively, compared with the control subgroup (4B).

Changes in the elemental composition of the dentin surface after treatment with various air-abrasive mixtures were largely predictable (Fig. 50). Alongside fluctuations in the levels of major elements composing dentin, the presence of aluminum and silicon ions was detected following exposure to powders based on aluminum oxide, sodium bicarbonate, and erythritol. Specifically, in samples

of group A/M, the Al^+ content increased 8.3-fold (p=0.000). In the W/M group, the Na^+ level rose by 1.28 times ($p<0.05$). A 1.5-fold increase in Si^+ was observed in the W/M and E/M samples; however, these differences were not statistically significant ($p>0.05$).

Additionally, a 1.5-fold increase in Mg^+ ($p<0.05$) was recorded on dentin surfaces treated with erythritol-based powder, though this value did not significantly differ from that of surfaces treated with Al_2O_3 powder. In E/M group samples, a 1.23-fold ($p<0.05$) increase in the average C^+ level after carbide bur treatment was attributed to contamination of the scanning area.



	C+	O-	Na+	Mg+	Ca+	P+	Al+	Si+
А/М (воздушная)	16,02	41,23	0,55	0,75	28,1	13,62	0,25	0,07
А/М (машинная)	15,53	39,45	0,57	0,67	29,42	14,23	0,03	0,05
В/М (воздушная)	15,26	39,03	0,87	0,63	29,7	14,16	0,03	0,27
В/М (машинная)	16,25	38,3	0,68	0,57	29,87	14,12	0,02	0,18
Э/М (воздушная)	16,82	40	0,62	0,82	27,78	14,08	0,02	0,18
Э/М (машинная)	20,63	38,27	0,55	0,55	26,75	13,07	0,07	0,12

Fig. 50. Elemental composition of the dentin surface after air-abrasive treatment with various mixtures

A large number of studies have been devoted to the problem of integrating composite material with tooth dentin, which is directly related to numerous controlled and uncontrolled factors influencing the quality of adhesion and the longevity of restorations. At the same time, the complex ultrastructure of adhesive surfaces and technical difficulties associated with the use of 4th and

5th generation adhesive systems may negatively affect the quality of dental treatment with composite materials. In this context, the use of self-etching adhesive monomers on dentin appears to be the most promising approach. However, considering the mechanism of interaction of this group of materials with dental hard tissues and the specifics of their application, the presence of a smear layer—characterized by its amorphous structure and weak adhesion to the underlying tissue—remains a critical concern.

There is sufficient evidence in the literature supporting the effectiveness of air-abrasive methods for cleaning the tooth surface from dentin and enamel fragments generated during conventional preparation with diamond and carbide burs. Nevertheless, the results of studies evaluating the improvement of adhesion strength of composite materials to dentin after air-abrasive treatment remain inconclusive.

In this regard, the primary aim of this study was to assess the effect of different air-abrasive mixtures on the adhesion strength of composite material to tooth dentin when using self-etching adhesive systems. To further explore possible mechanisms underlying the strengthening or weakening of adhesion between resin composites and dentin, a comparative analysis of the elemental composition of the dentin surface at the tooth–filling interface was also conducted. Previous findings indicate that self-etching adhesive systems vary in their acidity levels and are classified into ultra-mild (pH $\geq$ 2.5), mild (pH $\approx$ 2), intermediate (pH $\approx$ 1.5), and strong (pH $\leq$ 1). The depth of enamel and dentin demineralization caused by self-etch adhesives is known to depend strongly on these pH values.

To minimize subjectivity, this study employed single-component adhesive systems Single Bond Universal and Bond Force 2, which differ slightly in acidity, with pH values of 2.7 and 2.8, respectively. The results demonstrated

that, when using SBU, air-abrasive preparation of the dentin surface with Al_2O_3 powder (27 μm), Air-Flow Classic, and Air-Flow Plus did not lead to clinically significant changes in the adhesion strength of the composite material to dentin. However, similar surface preparation produced a significant decrease in adhesive bond strength when BF2 was used, with notable differences following exposure to sodium bicarbonate- and erythritol-based powders.

Regarding the elemental composition of the dentin surface after treatment with Al_2O_3 powder (27 μm), a marked increase in Al^+ levels and a decrease in Ca^+ and P^+ were observed, likely reflecting a reduction in the amount of hydroxyapatite crystals in the tested areas. These changes, however, did not cause significant fluctuations in adhesive strength, regardless of whether SBU or BF2 was applied.

Accumulation of Na^+ on the dentin surface after treatment with Air-Flow Classic powder could be one of the probable reasons for the deterioration of composite adhesion when using BF2.

The most pronounced decrease in the adhesive strength of the photopolymer with BF2 was observed after dentin treatment with Air-Flow Plus powder, despite the relative increase in Ca^+ and P^+.

Thus, based on the obtained data, it was concluded that air-abrasive treatment of the dentin surface does not improve the adhesion of composite material when using self-etching adhesive systems. It was also noted that the pH level of self-etch adhesives is not the fundamental factor determining the durability of the tooth–filling interface. The observed alterations in the chemical composition of dentin after air-abrasive treatment with different powders, as well as their influence on the performance of adhesive systems, require further in vitro investigation.

Analysis of the data revealed that the highest adhesive bond strength was achieved in the 2nd study group, where air-abrasive treatment with Classic powder based on sodium bicarbonate was performed. The obtained value was 20.9 ± 3.3. In the 1st and 3rd groups, this indicator was 18.25 ± 5.65 and 17.2 ± 3.36, respectively. Statistically significant differences were found between the 2nd and 3rd groups ($p=0.023$), whereas the differences between the 1st and 2nd, as well as the 1st and 3rd groups, were not significant ($p>0.05$).

Therefore, based on the results of this experimental study, it can be concluded that the use of an aqueous air-abrasive mixture with sodium bicarbonate powder (particle size 40 μm), applied for plaque removal from the tooth surface prior to the adhesive protocol, significantly enhances the adhesion strength of composite material to dentin.

TESTS

No	TESTS	No	TESTS
1	The purpose of the clinical examination: Determine the patient's diagnosis * Determine the patient's age Determine the place of residence Determine the place of work Collect anamnesis	7	Additional examination methods include: X-ray examination * Collection of anamnesis Interviewing the patient Percussion of teeth Probing of teeth
2	The purpose of the clinical examination: Determine the patient's diagnosis * Determine the patient's age Determine the place of residence Determine the place of work Collect anamnesis	8	Additional examination methods include: Electroodontodiagnostics* Percussion Probing Palpation Inspection
3	The main methods of examining a patient include: Interviewing the patient *	9	Additional examination methods include: All answers are correct *

	X-ray examination Thermodiagnostics Biochemical examination Microbiological examination		Biochemical studies Immunological studies Cytological studies Blood analysis
4	The main methods of examination included: Patent examination* EDI Cytological examination Biochemical examination Nystamine test	10	A method in which a beam of light is directed onto the cleaned surface of a tooth. The results allow one to judge the condition of the hard tissues of the tooth. Luminescent diagnostics * EOD Thermometry X-ray Enamel staining
5	The main research methods include: Probing of teeth * Histological examination EOD Allergological research methods Thermodiagnostics	11	To determine the electrical excitability of a tooth, the following method is used: EOD * X-ray Cytological Biochemical Thermodiagnostics
6	The main examination	12	According to the localization

	methods include: Percussion of teeth * Immunological examination Electrometric examination Blood analysis Urine analysis		of the lesion, caries is divided into: Fissure * Superficial Medium Deep Peripulpal
13	According to the localization of the lesion, caries is divided into: Cervical * Intrapulpal Peripulpal In the spot stage Medium	20	Caries in the spot stage is differentiated: Hypoplasia * Erosion Wedge-shaped defect Hyperesthesia Enamel necrosis
14	Accordion to the localization of the forest, caries is divided into: Approximal * Dep Medium Superficial Secondaries	21	Caries eun the spot stage is differentiated: Fluorosis * Superficial caries Erosion Pulpitis Wedge-shaped defect
15	According to the topographic classification,	22	Caries in the spot stage proceeds:

	caries is divided into: At the spot stage * Acute Chronic Primary Secondary		Asymptomatically * With paroxysmal pain With night pain With the appearance of a defect With pain from thermal irritants
16	According to the topographic classification, caries is divided into: Superficial * Chronic Recurrent Secondary Circular	23	In order to diagnose caries at the spot stage, the vital staining method is used: Methylene blue * Iodine Alcohol Brilliant green Potassium permanganate
17	According to the topographic classification, caries is divided into: Medium * Acute Flourishing Secondary Circular	24	In case of caries in the spot stage, the dental pulp reacts to the current strength: 2-6 μA * 12-20 μA 20-40 μA 40-60 μA Over 100 μA

18	Complicated caries is: Periodontitis * Erosion Necrosis Hypoplasia Hyperplasia	25	Main locations of carious spots: Fissure area* Lingual surface Vestibular surface Palatal surface Cutting edge
19	Main locations of carious spots: approximal surface * tubercles area cutting edge lingual surface vestibular surface	26	Main locations of carious spots: Cervical area * Equator area Cutting edge Palatal surface Vestibular surface
27	Remineralizing therapy is used for: Caries in the spot stage * Medium caries Deep caries Alveolitis Chronic fibrous pulpitis	34	Median caries in Latin: Caries media * Macula cariosa Pulpitis acuta focalis Caries profunda Caries superficialis

28	All measures for the prevention of dental caries can be divided into: all answers are correct * state social hygienic educational	35	Deep caries in Latin: Caries profunda * Macula cariosa Pulpitis acuta focalis Caries media Caries superficialis
29	The course of remineralizing therapy consists of: 15-20 applications* 2-6 applications 5-10 applications 1-3 applications 10-15 applications	36	The dental pulp with superficial caries reacts to current with a strength of: 2-6 mkA * Over 100 mkA Over 60 mkA Over 40 mkA 10-12 mkA
30	For remineralization of carious spots we use: 3% remodent solution * 10% remodent solution 6% remodent solution 20% remodent solution	37	Superficial caries is differentiated: Hypoplasia * Acute focal pulpitis Medium caries Caries in the spot stage

	5% remodent solution		Deep caries
31	Superficial caries in Latin: Caries superficialis * Macula cariosa Pulpitis acuta focalis Caries profunda Caries media	38	Superficial caries is differentiated: Erosion of hard dental tissues * Acute diffuse pulpitis Chronic fibrous periodontitis Chronic fibrous pulpitis Deep caries
32	Caries in the stage of the spot in Latin: Macula cariosa * Caries superficialis Pulpitis acuta focalis Caries profunda Caries media	39	Superficial caries is differentiated: Wedge-shaped defect * Chronic fibrous pulpitis Acute focal pulpitis Chronic fibrous periodontitis Deep caries
33	The wedge-shaped defect is localized: In the cervical region * On the approximal surfaces In the tubercle region	40	Moderate caries is characterized by: Asymptomatic course * Night pain Painful attacks

	On the chewing surface On the cutting edge		Spontaneous pain Pain when biting
41	For superficial caries (class 1), for permanent filling use: Tetric-Ceram * Adgezor Belatsin Unifas Dentin-paste	47	When treating superficial caries (class 3), the following are used for the insulating lining: Adgesor * Cresopat Beladont Uni-Fill Abscess remedi
42	For superficial caries (class 2), for permanent filling use: Herculite * Adgezor Belatsin Tenet Dentin paste	48	With moderate caries there is: A medium-depth carious cavity * Intact tooth Pigmented spot Deep carious cavity Smooth enamel surface
43	In case of superficial caries (class 2), for permanent filling use:	49	The dental pulp with moderate caries reacts to current of: 2-6 μA *

	Lux * Adgezor Iodent Tenet Kresodent		Over 100 μA Over 60 μA Over 40 μA 10-15 μA
44	For superficial caries (class 3), for permanent filling use: Crystalline * Amalgam Adgezor Foredent Beladont	50	Medium caries is differentiated: Wedge-shaped defect * Trauma Marble disease Acute focal pulpitis Tetracycline teeth
45	For superficial caries (class 3), for permanent filling use: Charisma * Amalgam Abscess remedi Tenet Silidont	51	Medium caries is differentiated: Deep caries * Pathological abrasion Hyperesthesia Fournier tooth Acute focal pulpitis
46	For superficial caries (class 3), the following are used for	52	With average caries differentiate:

	the insulating lining: Unifas * Dentin paste Iodent Composite Foredent		Chronic fibrous periodontium * Caries in the spot stage Superficial caries Chronic fibrous pulpitis Acute focal pulpitis
53	In chronic course of medium caries the following is observed: All answers are correct * Dense walls of the cavity Dense bottom of the cavity Wide entrance opening Defect of enamel and dentin	60	Deep caries is differentiated: Acute focal pulpitis * Caries in the spot stage Fournier tooth Superficial caries Pathological abrasion
54	Deep caries is characterized by complaints: Short-term pain from mechanical irritants * Night pain Patient pain Spontaneous pain Radiating pain	61	Deep caries is differentiated: Chronic fibrous pulpitis * Chronic fibrous periodontitis Erosion Hyperplasia Necrosis

55	In case of deep caries, the patient complains of: Pain from thermal irritants * Night pain Radiating pain Spontaneous pain Painful attacks	62	In acute deep caries, the following is noted: All answers are correct * A cavity of significant size Uneven overhanging edges Fragile enamel edges Pliable dentin of the cavity walls
56	With deep caries, the patient complains of: Pain from chemical irritants * Night pain Radiating pain Spontaneous pain Painful attacks	63	When treating acute deep caries, it is necessary to take into account: Close location of the pulp * Duration of the disease Sex of the patient Number of roots Number of teeth in the oral cavity
57	The dental pulp with deep caries reacts to current of: 10-12 μA * Over 100 μA Over 60 μA 40-60 μA	64	In chronic deep caries, the following is observed: All answers are correct * A cavity of significant size Dense cavity walls Dense cavity bottom

	2-6 μA		Pigmented dentin
58	Which of the diseases differentiates deep caries: Medium caries * Fluorosis Hutchinson's tooth Erosion Caries in the spot stage	65	Deep caries in Latin: Caries profunda * Macula cariosa Pulpitis acuta focalis Caries superficialis Caries media
59	Medium caries is differentiated: Erosion * Hyperesthesia Acute diffuse pulpitis Fournier tooth Acute focal pulpitis	66	Erosion is often accompanied by: Hyperesthesia * Night pain Pain attacks Spontaneous pain Deep carious cavity
67	The initial stage of pulp inflammation is: acute focal pulpitis* exacerbation of chronic pulpitis chronic fibrous pulpitis	74	Chronic hypertrophic pulpitis is characterized by: all answers are correct* the presence of "wild meat" in the cavity of the tooth pain from chemical irritants

	chronic gangrenous pulpitis chronic hypertrophic pulpitis		the presence of a carious cavity bleeding of the pulp
68	Acute focal pulpitis is differentiated from: deep caries* chronic gangrenous P chronic hypertrophic P chronic granulating Pt chronic granulomatous Pt	75	In the stage of acute inflammation of the pulp, the following signs are distinguished: all answers are correct* alteration exudation hyperemia metabolic disorder
69	Acute focal pulpitis is differentiated from: acute diffuse pulpitis* medium caries exacerbation of chronic pulpitis exacerbation of chronic periodontitis superficial caries	76	Chronic fibrous pulpitis is characterized by: pain from strong irritants* night pain paroxysmal pain radiating pain asymptomatic course

70	Acute focal pulpitis is characterized by: pain from all irritants* asymptomatic course pain when biting radiating pain presence of a fistula	77	Electrical excitability of pulp in chronic fibrous pulpitis: 20-40 μA* 2-15 μA 2-6 μA over 100 μA 60-80 μA
71	Chronic hypertrophic P is characterized by: all answers are correct* the presence of "wild meat" in the cavity pain from chemical irritants the presence of a carious cavity pulp bleeding	78	Differential diagnostics of chronic hypertrophic P is carried out with: proliferation of the gingival papilla* chronic fibrous P chronic fibrous Pt chronic gangrenous P chronic granulomatous Pt
72	EDI for gangrenous pulpitis: 50-60 μA* 2-15uA 20-40 μA 20-30 μA 2-6 μA	79	By location, denticles are: interstitial* fibrous acute chronic recurrent

73	The nature of pain in chronic gangrenous pulpitis: all answers are correct* spontaneous pain pain from hot paroxysmal pain pain when biting	80	Denticles are deposited: in the coronal part of the pulp* in the cement in the periodontium in the enamel in the dentin
81	The process of deposition of mineral salts in the pulp is preceded by: degenerative changes in the main substance of the pulp with the release of mucopolysaccharides and proteins* all answers are correct all answers are incorrect young age open bite	87	Denticles are deposited: in the root part of the pulp* in the cement in the periodontium in the enamel in the dentin
82	Focal or diffuse deposits of mineral salts in the pulp are:	88	Topical anesthesia is used for: pain relief of the oral cavity*

	petrifications* no correct answers all answers are correct fluorosis hyperesthesia		removal of lower incisors removal of wisdom teeth removal of upper molars resection of the root apex
83	Dentin-like formations that are deposited in the pulp are: denticles* hyperplasia all answers are correct fluorosis hypoplasia	89	Application anesthesia can be performed: all answers are correct* 1-2% lidocaine solution 1-2% pyromecaine solution 0.5-2% dicaine solution 10% lidocaine aerosol
84	According to their location in the tooth cavity, denticles are classified as: parietal* gangrenous diffuse recurrent all answers are correct	90	Indications for anesthesia: large volume of manipulations* lack of a disposable syringe young age of the patient all answers are correct cardiovascular diseases
85	To stop bleeding after vital amputation, the following is	91	Pain relief allows you to: all answers are correct*

	used as a hemostatic agent: caprofer* all answers are correct iodine furacilin alcohol		increase work efficiency raise the doctor's reputation reduce the patient's fear reduce the doctor's stress
86	In case of bleeding during vital extirpation it is necessary to use: 3% sodium hypochlorite solution * chlorhexidine furacilin saline solution trypsin, chymotrypsin	92	The temperature of the anesthetic should be: closer to the temperature of the human body* 10-15 0 C 15-20 0 C 5-10 0 C no correct answers
93	With conduction anesthesia: anesthetic is injected into the nerve area* anesthetic is injected into the tissue all answers are incorrect anesthetic is injected submucosally anesthetic is injected intravenously	100	The anesthetic solution can be administered: all answers are correct* perineurally endoneurally intravenously intramuscularly

94	Duration of anesthesia with novocaine: 30 minutes* 3 hours 6 hours 2 hours 7 hours	101	Chronic fibrous pulpitis is characterized by: pain from strong irritants* night pain paroxysmal pain radiating pain asymptomatic course
95	The adrenaline hydrochloride solution is added to the anesthetic solution in the form of: 0.1% solution * 0.3% solution 0.5% solution 0.2% solution 10% solution	102	Composite material is: Filtek Ultimate* AH Plus Ultracal Foredent Ionotite F
96	Lidocaine has a pain-relieving effect superior to novocaine: 2-3 times* 10 times no correct answers	103	Composite material is: Estelite Asteria* AH Plus Ultracal Dentine paste Adhesor

	all answers are correct 8 times		
97	Articaine is superior to novocaine in its analgesic effect: 6 times* 10 times 2 times No correct answers 8 times	104	Composite material is: Enamel Plus* AH Plus Ultracal Dentine paste GC Fuji I
98	Articaine is superior to lidocaine in its analgesic effect by: 2 times* 10 times no correct answers all answers are correct 8 times	105	Composite material is: Filtek Z 550* AH Plus Ultracal Adhesor Vitremer
99	Indications for the vital extirpation method are: all answers are correct*	106	Composite material is: Esthet X HD* AH Plus

	chronic fibrous pulpitis chronic gangrenous pulpitis acute diffuse pulpitis chronic hypertrophic pulpitis		Ultracal GC Fuji Plus Ionotite F

References

1. Borisova Z.G., Idris A.Ya. Comparative characteristics of adhesive systems in modern dentistry // J. Dentist-practitioner. 2019; 1: 6-7.

2. Bocharov V.S. Criteria for choosing a method for restoring chewing teeth//New in Dentistry. 2018; 3: 102-104.

3. Butova V.G., Zuev M.V., Smirnova L.E. Medical and socio-economic significance of oral sanitation / Dentistry. 2020; 1: 86-88.4. Daurova F.Yu., Vaits T.V., Kodzaeva Z.S. Current level of development and production of dental restorations//Ros.stom.journal. 2014; 3: 53-55.

5. Ivashov A.S., Zaitsev D.V., Mandra Yu.V. Dependence of strength properties of modern composite materials under compression on polymerization temperature//Problems of Dentistry. 2011; 5: 30-34.

6. Iyashvili L.V., Vinnichenko Yu.A., Vinnichenko A.V. Comparative assessment of the degree of influence of human blood plasma on the properties of various adhesive systems//Dentistry. 2020; 2: 17-20.

7. Kabak D.S. General idea of quality of life, quality of life in dentistry // Clinical dentistry.2018; 1: 76-79.

8. Kamilov H.P., Bekzhanova O.E., Azimova N.N. Condition of fillings in the adult population of Tashkent // DentalForum. 2004; 1: 39-44.

9. Kamilov H.P., Zoyirov T.E., Sadikova Sh.A., Absalamova N.F., Kakhkharova D.Zh. Clinical evaluation and improvement of the quality of filling fit under various conditions of dental caries treatment// J. Stomatologiya. 2017; 1(66): 10-12.

10. Kodzaeva Z.S., Turkina A.Yu., Doroshina V.Yu. Remote results of dental restoration with light-cured composite materials: a literature review // Dentistry. 2019; 3: 117-122.

11. Kolodkina V.I., Arutyunov A.V., Doeva E.T. Microbiological assessment of bacterial adhesion on the surface of composite restorations before and after bacterial colonization “in vitro” // Dentistry for all. 2018; 4(85): 36-40.

18. Kondratieva V.S. Simple methods of restoration of teeth of the anterior group with nanohybrid composite material FiltekTMZ 550//New in dentistry. 2014; 3: 85-90.

19. Kuzin A.V. On the mechanism of occurrence, prevention and treatment of local complications of injection anesthesia// New in Dentistry. 2018; 1: 82-85.

20. Lipetskaya E.A. Experimental study of the depth of penetration of the adhesive into dentinal tubules using the marking method and scanning electron microscopy depending on the method of antibacterial treatment and the technique of total etching// Russian Dental Journal. 2013; 6: 12-15.

21. Lobovkina L.A. Nanocomposites - strength and aesthetics of restorations// DentalMagazine. 2017; 5(161): 10-14.

22. Lukoyanova T.V. Ideal balance between strength and aesthetics in the restoration of teeth with class IV and III defects//New in Dentistry. 2019; 6: 72-74.

23. Lutskaya I.K. Criteria for evaluation of aesthetic restorations. Instructions for use//Approved by the Ministry of Health of the Republic of Belarus on 27.06.07. Minsk: BelMAPO; 2007.

24. Makeeva I.M., Voronkova V.V. Justification for the choice of the method of isolation of the surgical field when filling subgingival defects//Clinical Dentistry. 2011; 1: 19-21.

25. Malykhina I.E., Andreeva E.A., Kaverina E.Yu., Pozdnyakov S.N., Chuev V.P. Experience of clinical application of the Air-flow air-abrasive system using the AER-Cleans-prof material during professional oral hygiene// Clinical Dentistry. 2018; 2: 26-30.

26. Melkumyan T.V., Kakhkharova D.Zh., Dadamova A.D., Kamilov N.Kh. Integration of composite material to hard dental tissues under different photopolymerization modes// Collection of scientific articles based on the results of the international scientific conference. - St. Petersburg. 2016; 38-41.

27. Melkumyan T.V., Dadamova A.D.,Sheraliyeva S.Sh.,Kamilov N.Kh.,Daurova F.U. Treatment of class II caries lesions with application of packable and conventional resin composites: clinical and experimental study// Int J Biomed. 2020; 10(1): 66-69.

28. Muradov M.A., Ryakhovsky A.N., Sorokina D.R., Chkalin V.A., Poyurovskaya I.Ya. Study of the film thickness of composites after their heating / Dentistry. 2019; 6: 96-101.

29. Murashkin A.S. Adhesive dentistry. A generalist's view // New in dentistry. 2018; 5: 88-90.

30. Nikolaev A.I., Nakonechny D.A., Nikolaev D.A. Unification of cavity preparation and restoration processing techniques for dental restoration with composites. Part IV. A set of burs and abrasive instruments for aesthetic

restoration of chewing teeth with composites // New in Dentistry. 2008; 3: 42-45.

31. Nikolaev A.I., Tsepov L.M., Makeeva I.M., Vedyaeva A.P. Professional and individual oral hygiene in adults//M.:MEDpress-inform;2018;192.

32. Ovchinnikov I.V. Comparative assessment of the effectiveness of clinical use of standard and hybrid diamond burs//Clinical Dentistry. 2019; 2/90/: 23-25.

33. Patent for the invention “Dental device for preparing filling material” (UZ IAP No. 06189 dated 03/19/2020).

34. Rabinovich S.A., Zoryan E.V. Criteria for a justified choice of local anesthetic drugs in dentistry// Clinical Dentistry. 2012; 4: 32-35.

35. Rozhkova K.I., Slabkovskaya A.B., Persin L.S., Zakharov A.N., Avetisyan K.K. Evaluation of the perception of the shape of the central incisors of the upper jaw as an important element of smile microaesthetics//Clinical Dentistry. 2019; 1(89):16-19.

36. Rusanov F.S., Poyurovskaya I.Ya., Krechina E.K., Sogachev G.V. Adhesion as a criterion for choosing a material for the restoration of teeth with defects in the cervical region / J. Dentistry. 2015; 4: 29-34.

37. Sadovsky V.V., Shumilovich B.R., Sushchenko A.V., Morozov A.N., Leshcheva E.A. Clinical effectiveness of modern direct composite restoration with a combination of standard and prepolymerized forms of composite/Ros.stom.journal. 2016; 4: 194-198.

38. Saleev R.A., Fedorova N.S., Saleeva L.R. Dental health and quality of life: historical milestones and development prospects (literature review) // Clinical dentistry. 2020; 4 (96): 92-98.

39. Samedova S.I. Quality of life indicators in patients with caries and periodontal diseases of varying intensity and severity//Clinical Dentistry. 2020; 1: 94-98.

40. Chertovskikh A.V. Achieving quality and reliability in the creation of direct restorations using new generation adhesive systems Kuraray (Japan)// DentalMarket. 2014; .6: 33-37.

41. Chistyakova G.G., Sakhar G.G. Method of thermogravimetric analysis for determining the conversion of monomers in composite materials/ Dental Journal. 2015; 3: 213-216.

42. Chudinov K.V., Lavrov A.A. Finishing of aesthetic restorations // New in Dentistry. 2005; 2: 102 – 105.

43. Yudina N.A. Adhesive technologies in general dentistry // Minsk: BelMAPO; 2015; 189.

44. Arora P., Arora V., Shamrani A., Fahmi M.K. Innovatively Modified Glass bead Sterilizer for Pre-heating / Pre warming of Dental Composite Resins// Int J Oral Res. Dent. Sci. 2017; 1(1): 19.

45. Asmussen E., Peutzfeldt A. Temperature rise induced by some light emitting diode and quartz-tungsten-halogen curing units//Eur J Oral Sci. 2005; 113: 96–98.

46. Ausiello P., Cassese A., Miele C., Beguinot F., Garcia-Godoy F., Di Jeso B. Cytotoxicity of dental resin composites: an in vitro evaluation// J ApplToxicol. 2013; 6: 451-457.

47. Ayar MK. A review of ethanol wet-bonding: Principles and techniques//Eur J Dent. 2016; 10(1):155-159.

48. Baroudi K.,SilikasN.,Watts D.C. Edge-Strength of flovable resin-composites//J Dent. 2008; 36(1): 63-68.

49. Bertolotto, Krejci. The effect of temperature on hard-ness of a light-curing Composite// J Dent Res. 2003; 82: (special inssue A): abstr.

50. Burke F. J. T., Louis Mackenzie, Adrian CC Shortall. Survival rates of resin composite restorations in load- bearing situations in posterior teeth// Dent Update. 2019; 46(6): 524.

51. Cabral D.L.,Laurentino G.E.,Damascena C.G.,Faria C.D., Melo P.G.,Teixeira-Salmela L.F. Comparisons of the Nottingham Health Profile and the SF-36 health survey for the assessment of quality of life in individuals with chronic stroke//Rev Bras Fisioter. 2012; 16(4): 301-308.

52. Clelland N.L., Pagnotto M.P., Kerby R.E., Seghi R.R. Relative wear of flowable and highly filled composite// J Prosthet Dent. 2005; 93(2): 153-157.

53. Conditt M., Leinfelder K. Improving the polymerization of composite resins//PractProcedAesthet Dent. 2006; 18(3): 169-171.

54. Da Costa J., McPharlin R., Hilton T., Ferracane J. Effect of heat on the flow of commercial composites//Am J Dent. 2009; 22: 92-96.

55. Daronch M., Rueggeberg F.A,, De Goes M.F., Giudici R. Polymerization kinetics of pre-heated composite// J Dent Res. 2006; 85: 38–43.

56. DaronchM.,RueggebergF.A.,Hall G. ,De Goes M.F. Effect of composite temperature on in vitro intrapulpal temperaturerise// Dent.mater. 2007; 23: 1283-1288.

57. De Souza FB, Guimaraes RP, Silva CH. A clinical evaluation of packable and microhybrid resin composite restorations: one-year report// Quintessence Int. 2005; 36(1): 41.

58. Dionysopoulos D., Papadopoulos K., Koliniotou-Koumpia E. Effect of temperature, curing time and filler composition on surface microhardness of composite resins// Journal of Conservative Dentistry. 2015; 18(2): 114-118.

59. Ernst C.P., Brand N., Frommator U. et al. Reduction of polymerization shrinkage stress and marginal microleakage using Soft-Start polymerization// J EsthetRestor Dent. 2003; 15: 93–103.

60. Fossdal P. Реставрация в целом //Новое в стоматологии. 2008; 7: 50 -66.

61. FrancescoDeFngelis. Современные достижения в механических свойствах композитной смолы. Расширение показаний к применению от минимально-инвазивных реставраций зуба до обширных окклюзионных реконструкций//Новое в стоматологии.-2018.-№3.-С.98-100.

62. Frankenberger R., ReineltCh., Taschner M., Kramer N. Минимальнаяинвазивность// Новое в стоматологии. 2014; 1: 10-15.

63. Freedman G. Клинические преимущества предврительно нагретых композитов// ДентАрт. 2007; 4: 30-34.

64. Fried l. K.H., Schmalz G., Hiller K..A., Mark l. A. Marginal adaptation of Class V restorations with and without "soft-start-polymerization" //Oper Dent. 2000; 25: 26-32.

65. Froes-Salgado N.R., Silva L.M., Kawano Y., Francci C,, Reis A., Loguercio AD. Composite pre-heating: effects on marginal adaptation, degree of conversion and mechanical properties// Dent Mater. 2010; 26(9): 908-914.

66. Goulart M., Damin D.F., Melara R. Effect of pre-heating composites on film thickness//J Res Dentistry. 2013; 4: 274-280.

67. Heba A. EL-Deeb, Sara Abd El-Aziz, Enas H. Mobarak Effect of preheating 0f low shrinking resin composite on intrapulpal temperature and microtensile bond strength to dentin//J of Advanced Research. 2015; 6(3): 471-478.

68. Hervas –Garcia A., Martinez-Lozano M.A., Cabanes –Vila J., Barjau-Escribano A., Fos-Galve P. Composite resins: a review of the materials and clinical indications//Med Oral Patol Oral Cir Bucal. 2006; 11: 215-220.

69. Hickel R., Roulet J.F., Bayne S.,Heintze S.D., Mjor I.A., Peters M., Rousson V., Randall R., Schmalz G., Tyas M., Vanherle G.//Recommendations for conducting controlled clinical studies of dental restorative materials//Int Dental J. 2007; 57: 300-302.

70. Krebs H. Чистая эстетика// Новое в стоматологии. 2014; 1: 82-86.

71. Lohbauer U., Zinelis S., Rahiotis C., Petschelt A., Eliades G. The effect of resin composite preheating on monomer conversion and polymerization shrinkage// Dent Mater. 2009; 25 (4): 514-519.

72. Manhart J.,SchenkH. Эстетический вызов// Новое в стоматологии. 2014; 2: 38-45.

73. Masood M., Masood Y.,SaubR.,Newton J.T. Need of minimal important difference for oral health- related quality of life measures//J Public Health Dent. 2014; 74(1): 13-20.

74. Muangmingsuk A, Senawongse P, Yudhasaraprasithi S. Influence of different Soft- Start polymerization techniques on marginal adaptation of Class V restorations //Am J Dent. 2003; 16: 117-119.

75. Nagpal R, Manuja N, Pandit IK. Effect of ethanol wet bonding technique on the durability of resin- dentin bond with contemporary adhesive systems// J Clin Pediatr Dent. 2015; 9(2):133-42.

76. Pfeifer C.S., Shelton Z.R., Braga R. R., Windmoller D., Machado J.C., Stansburi J.W. Characterization of dimethacrylate polymeric networks: a study of the crosslinked structure formed by monomers used in dental composites//European polymer journal. 2010; 2(47): 162-170.

77. Pokorny A.,Wagner W.C., Neme A.L. Effect of multiple preheating cycles on hardness of composite materials//J. Dent Res.2005;84. Available at: //www. Dental research.org.

78. Prasanna N., Pallavi Reddy Y., Kavitha S., Lakshmi Narayanan L. Degree of conversion and residual stress of preheated and room-temperature composites//Indian J Dent Res. 2007; 18: 173-176.

79. Ryge G.,Cvar J. Reprint of Criteria for the clinical evaluation of dental restorative materials//Clin Oral Invest. 2006; 10: 92.

80. Sahafi A, Peutzfeldt A, Asmussen E. Soft-Start polymerization and marginal gap formation in vitro //Amer J Dent. 2001; 14: 145-147.

81. ShumanIan E. Упрощенное выполнение прямых и композитных реставраций в эстетической зоне//Новое в стоматологии.2014; 5: 26-28.

82. Silva J.C., Rogerio Vieira R., Rege I.C., Cruz C.A., Vaz L.G., Estrela C., Castro F.L. Pre-heating mitigates composite degradation// J Appl Oral Sci.2015; 23: 571-579.

83. Trujillo Marionela, Newman S.M., Stransbury J.W. Use of near-IR to monitor the influense of external heating on dental composite photopolymerization//Dent Mater. 2004; 20: 766-777.

84. Uctasli M.B., Arisu H.D., Lasilla L.V., Valittu P.K. Effect of Preheating on the Mechanical Properties of Resin Composites// Eur J Dent. 2008; 2: 263-268.

85. Vipin Arora, Pooja Arora, Ammar Al Shammrani, Mohammed Khalil Fahmi. A new, simple and innovative technique for pre-heating/pre-warming of dental composite resins in thermal assisted light polymerization technique is presented// Journal of Dentistry and Oral Biology. 2017; 2 (9): 1061.

86. Wagner W.C., Aksu M.N., Neme A.M., Linger J.B., Pink F.E., Walker S. Effect of pre-heating resin composite on restoration microleakage// Oper Dent. 2008; 33(1): 72-78.

87. Walter R., Swift E., Heikh H., Ferracane J.L. Effects of temperature on composite resin shrinkage//Quintessence int. 2009; 40: 843-847.

88. Zhao S., Qian Y., Liu H., Jiang L., Zhou L. The effect of Preheating on Light Cured Resin Composites//J Hard Tissue Biol. 2012; 1: 273-278.

O'QUV ADABIYOTINING

NASHR RUXSATNOMASI

O'zbekiston Respublikasi Sog'liqni saqlash vazirligi Toshkent davlat stomatologiya institutining 20 24 yil " 02 " may dagi "AR177" – sonli buyrug'iga asosan

Dadamova A.D.

(mualliflning familiyasi, ismi-sharifi)

7091001-Magistratura (Stomatologiya)

(o'quv yo'nalishi (mutaxassisligi))

ning

talabalari (o'quvchilari) uchun tavsiya etilgan

Современные подходы к реставрации зубов

(o'quv adabiyotining nomi va turi: darslik, o'quv qo'llanma)

O'quv qo'llanma

O'zbekiston Respublikasi Vazirlar Mahkamasi tomonidan litsenziya berilgan nashriyotlarda nashr etishga ruxsat berildi.

Rektor _____ **N. Xaydarov**

(imzo)

M.O'

Ro'yhatga olish raqami

177-4

TABLE OF CONTENTS