

МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ
БЕЛОРУССКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ
КАФЕДРА ЭНДОДОНТИИ

А. В. Бутвиловский, Л. Н. Полянская

**МЕТОДЫ ИЗОЛЯЦИИ
ОПЕРАЦИОННОГО ПОЛЯ
В ЭНДОДОНТИИ**

**OPERATING FIELD
ISOLATION METHODS
IN ENDODONTICS**

Учебно-методическое пособие



Минск БГМУ 2025

УДК 615.471:616.314(075.8)-054.6

ББК 56.6я73

Б93

Рекомендовано Научно-методическим советом университета в качестве учебно-методического пособия 21.05.2025 г., протокол № 9

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Бутвиловский, А. В.

Б93 Методы изоляции операционного поля в эндодонтии = Operating field isolation methods in endodontics : учебно-методическое пособие / А. В. Бутвиловский, Л. Н. Полянская. – Минск : БГМУ, 2025. – 19 с.

ISBN 978-985-21-1998-6.

Рассмотрены методы, этапы и особенности изоляции операционного поля в эндодонтии.

Предназначено для студентов 4–5-го курсов медицинского факультета иностранных учащихся, обучающихся на английском языке по специальности «Стоматология».

УДК 615.471:616.314(075.8)-054.6

ББК 56.6я73

ISBN 978-985-21-1998-6

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MOTIVATIONAL CHARACTERISTIC OF THE TOPIC

Total time: 120 minutes.

The complexities of oral environment present obstacles to the endodontic procedures starting from diagnosis till the final treatment is done. In order to minimize the trauma to these surrounding structures, to provide comfort to the patient and to prevent microbial contamination of the root canal system the clinician needs to control that field. These challenges are solved by proper operating area isolation. The rubber dam is the only device capable of preventing contamination of the root canal system with oral flora during treatment. Furthermore, the rubber dam also aids in visualization during treatment and reduces the risk of aspiration of irrigants or instruments. Lastly, survival of endodontically treated teeth appears to be influenced by the use of rubber dam isolation during treatment.

The goal: to provide proper work field isolation during root canal treatment of the tooth.

Objectives:

- 1) to know the methods of operating field isolation in dentistry;
- 2) to be able to choose the proper isolating method for endodontic treatment in different clinical situations;
- 3) to develop practical skills in isolating the operating field during endodontic manipulations.

Requirements for the initial level of knowledge. For full understanding of the topic the student must revise:

- from human anatomy: anatomical features of oral cavity;
- from microbiology: the concept of “biofilm,” the structure, and the nature of interactions among microbial colonies in the biofilm;
- from propaedeutics of dentistry and materials science: methods of moisture control in dentistry.

Control questions from related disciplines:

1. Oral and dental anatomy.
2. Microbiology of endodontic infections.
3. Rubber dam: basic instruments and techniques.

Control questions for the seminar:

1. Methods of partial and complete isolation of the operating field.
2. Advantages and disadvantages of using isolation systems, indications for use.
3. Selection of methods for isolating the operating field during endodontic manipulations.
4. The method of application a rubber dam system depending on the clinical situation during endodontic manipulations.

RATIONAL FOR OPERATING FIELD ISOLATION IN ENDODONTICS

Comprehensive operative field isolation is considered as one of the key steps for a predictable clinical result. The operative procedures that are performed in the patient's mouth must be seen as larger or smaller surgical procedures. In endodontics, as in general surgery, isolation of the operative field is imperative. It has some objectives, which can be listed as follows:

- safety: isolation should provide the best protection for the oropharynx and the soft tissues of the mouth from the potentially caustic effects of any instruments or medicaments;
- prevention of cross-infection: most importantly, the barrier should prevent salivary microorganisms from entering the root canal environment. Also, isolation of work field prevents aerosol formation from the mouth when air-driven or ultrasonically activated instruments are used;
- comfort: proper isolation confers a comfortable working environment for the patient, dentist and dental assistant;
- controlled operating field simplifies procedures: it contributes to an improvement in overall efficiency of treatment.

RUBBER DAM

The purpose of the isolation is the creation of an operative field with the following characteristics:

- stable;
- leakage-free;
- made to last for the whole treatment time.

Rubber dam isolation is the single most useful procedure for making dentistry and in particular endodontics easier. The Quality Assurance Guidelines of the American Associations of Endodontists says that “cleaning, shaping, disinfection and obturation of all canals are accomplished using an aseptic technique with dental dam isolation whenever possible”.

ADVANTAGES OF THE RUBBER DAM IN ENDODONTICS

In Endodontics, use of the rubber dam confers the following advantages:

1. The patients are protected from the ingestion or, worse, the aspiration of small instruments, dental fragments, irrigating solutions, or irritant substances.
2. The opportunity to operate in a clean surgical field. From a microbiological point of view, root canal contamination during orthograde treatment is the reason

why the microbiological composition found in retreatment cases is different from the one in primary root canal infections. Thanks to the use of the rubber dam, the irrigants can work properly as their action is not compromised by the contamination arising from saliva and bacteria of the oral mouth, so basically we can conclude that the disinfection of the root canal system begins with a non-contamination, that means with the proper application of the dam.

3. Retraction (very important for working in the posterior areas) and protection of the soft tissues (gums, tongue, lips, and cheeks), which are sheltered from the cutting action of the bur.

4. Better visibility in the working area. The dam manages to visually remove interferences and the eye can focus itself on a single tooth. The advertisement of a famous manufacturer of instruments for the assembly of the rubber dam correctly reads: "Do better what you see and see better what you do".

5. Reduction of delays: the patients, with fortunately rare exceptions, cannot converse except with great difficulty; besides, they will not have to rinse their mouth every five minutes.

6. The dentists and dental assistants are protected against infections which can be transmitted by the patient's saliva.

7. The dentists are more comfortable, as they may work at a more leisurely pace and may be permitted to answer an important telephone call, leaving the patients well protected with the rubber dam and the dental assistant close to them.

8. Better tactile sensitivity during the cleaning and shaping procedure. Without the rubber dam, the dentists, aware of the risk of causing the patients to ingest or aspirate an instrument, holds the files in such a way that they will not slip from their fingers. The pressure they apply to the handle of these instruments reduces the sensitivity of their fingers and precludes the use of the instruments to perform delicate procedures. With the rubber dam in place, on the other hand, they may hold the instruments delicately, without fearing that they may slip from their hand.

9. The patients are more comfortable, as they do not feel that their mouth is invaded by hands, instruments, and liquids. The dam acceptance rate is high when the dentist explains its advantages before application.

RUBBER DAM SET

Rubber dam (Fig. 1) is manufactured in different colored squares of two sizes: 130 and 150 mm. In endodontics, where one tooth is isolated at a time, the smaller format is more than sufficient, even for working in the posterior sectors of the mouth. A light-colored dam makes the operative field brighter and the intra-operative radiography easier. A variety of thicknesses are available. A bigger width will improve protection and soft tissue retraction, but sliding the dam within interproximal spaces will be harder. Before positioning the dam, it is an advisable

to lubricate the inner surfaces well with Vaseline or glycerin gel so that the sheet will slide better over the contours of the teeth, more easily overcome the contact areas, and close tightly around the cervix of the tooth.

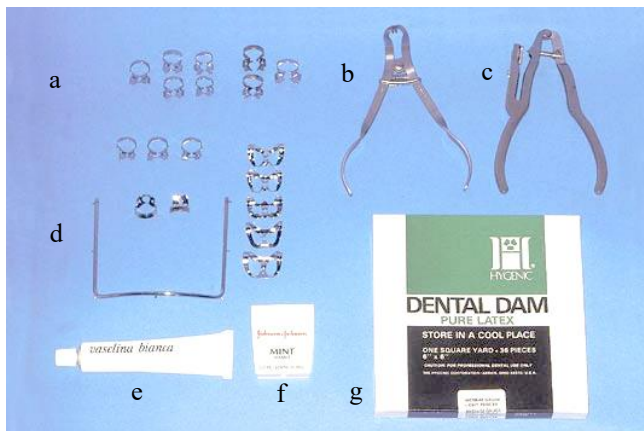


Fig. 1. The set of instruments necessary for the assembly of the rubber dam:
a — clamps; b — forceps; c — punch; d — frame; e — Vaseline; f — floss; g — rubber sheets

The *punch* may be used to make several different-sized holes in the dam. If several teeth need to be isolated a rubber stamp can be used to locate the holes precisely. The stamp becomes unnecessary when rubber dam is used routinely and for single tooth isolation only. It is necessary to check whether the dam opening is exactly round, without irregularities. To determine this, it suffices to punch a hole in a dam sheet and then enlarge this opening by stretching the sheet in different directions. The dam should not tear.

Forceps allow clamps to be placed and removed from teeth. The beaks should be deep enough to allow the clamp to be fitted around the gingival margin in a small mouth.

Frames should be wide enough to provide good access with good retaining spikes for the dam. This is necessary to maintain tension in the dam so that the lips and cheeks may be retracted well. Some frames are made of very thin metal, others are plastic. The latter have the advantage of being transparent; on the other hand, they are bulkier (Fig. 2). Some rubber dam systems have built-in foldable radiolucent plastic frame (Fig. 3).

Rubber dam clamps. The fit of the rubber dam essentially depends on the choice of the appropriate clamp and its correct positioning. Clamps are manufactured in a wide variety of shapes and sizes to suit different teeth and situations. They are classified as anterior teeth clamps, bicuspid teeth (premolars)

clamps and molar clamps. Also, they come in a wide range of patterns: winged, wingless, with knurled jaws, satin-finished and plastic. The dentist may choose those with which he feels more comfortable. Sometimes wingless clamps are preferable, as they are less bulky and may be used easily in the posterior sectors. The clamps with slightly tilted or flat jaws are actually recommended for teeth with intact clinical crown (Fig. 4), while clamps with angulated jaws are made to reach the tooth at gingival sulcus depth, so they are recommended for teeth with damaged clinical crown (Fig. 5)

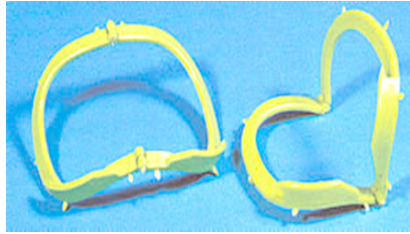


Fig. 2. Plastic frame



Fig. 3. Built-in foldable radiolucent frame



Fig. 4. Flat-jawed clamp



Fig. 5. Tilted-jaw clamp

The clamps may also be modified to improve their grip and allow a more precise fit. Moreover, there is no reason not to use a premolar clamp on a small molar, or frontal clamp on a hemisected root of a lower molar; any such adaptation is permitted, as long as the final result — correct placement of the rubber dam — is achieved.

To prevent the ingestion or aspiration of the clamp it is prudent to secure it with dental floss.

Dental floss. Apart from safety reasons, dental floss is particularly useful for assessing the condition of the mesial and distal contact areas, and thus for facilitating the passage of the rubber sheet beneath them and carrying out ligatures.

Barrier materials. Dam seal materials can be used in conditions where tight seal with clamp-dam unit is not achievable. In endodontics, once the clamp is stabilized, leakages are controlled by auxiliary systems. Some commercially available materials are resin-based dam seal (Liquid Dam), heatless and light-cured block-out resin (Kool-Dam), and caulking putty substance material (OraSeal).

ISOLATION PLANNING

Before starting the treatment, field isolation should be carefully planned in order to achieve a correct and comfortable dam placement and avoid rubber dam interference with subsequent operative maneuvers.

Correct isolation planning includes:

- determination of the extension of the isolation;
- clamp selection;
- inspection of the target area (problems interception);
- sheet and frame selection;
- sheet piercing.

Determination of the extension of the isolation. When it comes to Endodontics, one of the most frequently asked questions is about how many teeth must be included in the isolation. During endodontic treatment, the operating maneuvers are carried out in the direction of the occlusal surface of the tooth where the access cavity is present. So as a general rule, when it comes to a strictly endodontic, isolation will affect a single element. When it comes to carry out in a single visit the endodontic and restorative treatment in a tooth where an interproximal surface is involved, the operator will apply the rubber dam just one time and the isolation will involve multiple teeth. In the case of very damaged teeth which require immediate attention it may be useful to anchor the dam to the adjacent teeth.

Clamp selection. Root-canal treatment requires only a small number of clamps that will be used routinely. The main criterion for clamp selection is that

the jaws provide a four-point contact for best stability (Fig. 6). According to the “rule of 4”, a clamp gripping on the tooth with all its four contact points at the same time is considered potentially stable and the pressure applied on the tooth is equally distributed on the 4 points, thus reducing the possibility of causing iatrogenic damages to the dental structure.

In single isolation procedures winged clamps may be recommended so the sheet is more apically stretched around the tooth and the tooth itself is more visible and better highlighted.

When the tooth is clamped a couple of tests should be carried out. The first one checks stability by applying an up-and-over oscillating pressure upon the jaws with your fingers. Secondly the practitioner puts his/her finger distally to the bracket and pulls in mesial direction, outward from the oral cavity. Stability test must be carried out safely to avoid the clamp being swallowed and/or inhaled by the patient in case of displacement: for this purpose, dental floss ligature is by far the better solution.

In the case of incompletely erupted teeth that are very conical or where the bulge is apical to the gingival crest, there are no undercuts to prevent the clamp from sliding coronally. In such cases, one can acid etch the enamel buccally and lingually to allow the adhesion of two small ribbons of composite resin, which serve as areas which the clamp may grip. These composite ribbons must not interfere with the periodontium, but must be positioned 1 or 2 mm from the gingival margin to allow positioning of the clamp (Fig. 7).



Fig. 6. Four-point contact of the clamp jaws Fig. 7. Composite ribbons to grip the clamp

Inspection of the target area (problems interception). When the clamp has been chosen, it is necessary to test the accessibility to interproximal spaces — where the rubber sheet is going to be inserted — with the dental floss.

In endodontics (and usually in single tooth isolations), any major obstacles preventing the dam from sliding into interproximal space is not a problem. If an interference arises from the treated tooth and is caused, for example, by an old restoration needing to be removed, the operator can remove the interference with a separating bur, apply the dam easily and then remove the old restoration.

On the contrary, if the interference is due to orthodontic splints or arches, gaps arising from a poorly fitting rubber sheet around the tooth are likely to cause saliva leakage: these gaps can be properly sealed using liquid dams.

Sheet and frame selection. The practitioner chooses the type of rubber sheet and frame according to his preferences. Nevertheless, endodontics calls for a light-colored dam to make operative field brighter and a radio-transparent plastic frame to ease intraoperative radiograph without removing the dam.

Sheet piercing. Piercing the rubber sheet is an important step to be performed with the utmost care since a wrong execution could affect leakage control. First of all, holes must be perfectly round, otherwise the sheet will be less resistant to tearing during placement and will poorly fit to the tooth neck ruining the seal and predisposing to saliva leakages.

The size of the hole plays a lead role in building up a proper seal so it should not be overlooked. When it comes to a single isolation for endodontic treatment, it is suggested to use the bigger size, while gradually smaller diameters should be used to isolate molars, premolars, canines and incisors, as the case may be.

Regardless of the implemented technique, the hole should be placed in such a position to have enough space between its rim and the sheet rim.

RUBBER DAM PLACEMENT

The dam positioning techniques vary slightly, but the final result is the same. There are four main placement techniques described in literature, they share the same basic concepts — clamp stability and correct hole positioning — and they all lead to the same outcome. A stable clamp together with a pierced sheet is the common starting point for the application of the dam, regardless the technique used.

Clamp first technique. The target tooth is first clamped, then the dam is inserted by stretching the rubber around the bracket and subsequently around the branches until tooth neck is entirely covered (Fig. 8). It can be implemented only with single-bracket and preferably wingless clamps. It is a two handed procedure so it doesn't need any assistance. Its biggest benefit is the excellent operative field visibility during placement, but the risk of clamp swallowing and/or inhaling is surely higher so the clamp should be fastened with a ligature.

Wing technique. This method is to insert the wings of the clamp into a hole punched in the dam, then carry the dam and clamp to the mouth (Fig. 9) and place them over the tooth; the dam is then slipped off the wings so that it lies around the neck of the tooth.

It is also a two-handed procedure and moreover it is safe without risks of the clamp being swallowed and/or inhaled by the patient. Dam placement is very quick and the patient does not feel the oral cavity invaded by practitioner's hands.

Using winged clamps is a necessary condition of this technique. The main issue lies in limited tooth visibility. To prevent clamping of the wrong tooth, marking of the target tooth is recommended. Wing procedure is very quick and minimally invasive. For this reason, it should be considered the most suitable technique for patients with a strong emetic reflex or who seem baffled by dam usage.



Fig. 8. The steps of “clamp first technique”

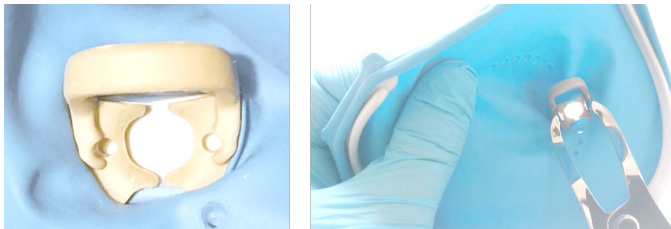


Fig. 9. The steps of “wing technique”

Rubber first technique. This is a four-handed procedure thus the presence of a second operator is needed. One operator, generally the assistant, stretches the hole with his/her fingers and places the dam directly into the oral cavity by fitting the tooth through the open gap. Now the dentist can clench the tooth with the previously “armed” clamp from the dedicated plier (Fig. 10). This technique is quick and safe being suitable for every type of clamp, in particular for double-bracket wingless clamps. But it is often difficult, if not impossible, especially in the posterior areas or particularly small mouths.

Bracket (“parachute”) technique. The bracket is passed through the hole until it comes out from the sheet side facing the practitioner. With the dominant hand, the practitioner “arms” the clamp by means of the plier, while the other hand laterally folds and gathers the rubber sheet. When the tooth is clamped, the dam is stretched over the frame then it is manually slid beneath both clamp branches (Fig. 11).

This is a two-handed and safe procedure with good oral cavity visibility. But it cannot be implemented with double-bracket anterior teeth clamps and with latex-free dams due to high risk of tearing.

The bracket technique is a desired technique when the clamp must be placed on the second or third lower molars and the bracket is clearly pressing the mucosae covering the mandibular ramus during clamp testing, or when the clamp must be placed on the second upper molars and the bracket is clearly pressing the mucosae covering the zygomatic process of the upper jaw bone during clamp testing.

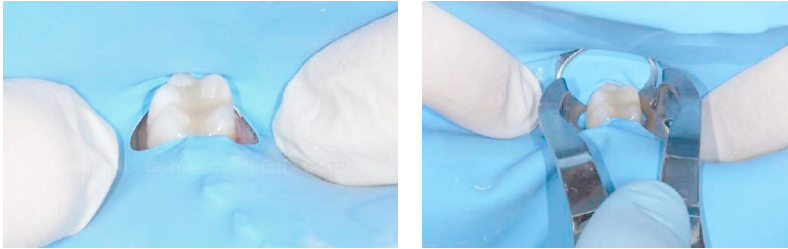


Fig. 10. The steps of “rubber first technique”

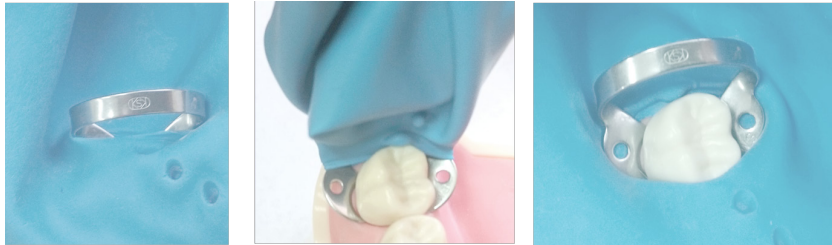


Fig. 11. The steps of “bracket technique”

RUBBER SHEET FITTING AND LEAKAGE CONTROL

Regardless of the technique, once the dam has been applied the practitioner must slide the sheet by means of dental floss through the mesial and distal interproximal spaces of the clamped tooth to get a proper fitting that will result in a good leakage control.

Even though the dam is correctly placed and slid through the interproximal surfaces, there still could be a poor fitting of the clamp-dam system to the tooth shape in the cervical area. In clinical practice gaps can be managed with special materials providing us with a perfect seal. The liquid dam extension should not be restricted solely to covering the defect, but it should also include a tooth portion and the part of the sheet close to the gap: this is the only way for the liquid dam to create a proper seal for the whole treatment duration (Fig. 12).

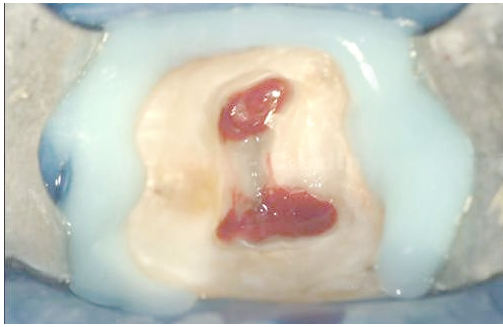


Fig. 12. The liquid dam extension

So, the dam is an absolute necessity for treatment. It ensures a surgically clean operating field that reduces the chance of cross-contamination of the root canal, retracts tissues, improves visibility, and improves efficiency. It protects the patient from aspiration of files, debris, irrigating solutions, and medicaments. From a medicolegal standpoint, use of the dam is considered the standard of care.

CONTRAINDICATIONS TO RUBBER DAM USE

Contraindication to the use of the rubber dam includes:

1. Respiratory tract obstructive diseases or acute infections. These diseases are regarded as a strict contraindication to dam usage that should be postponed until their complete resolution.

2. Patients with allergy. Powder-free latex sheets for people suffering from contact dermatitis and synthetic material latex-free sheets for latex-allergic patients are available; it ought to be remarked however that these dams are less elastic and less resilient compared to the latex ones. But they can be even more resistant to corrosion when in contact with endodontic solutions like sodium hypochlorite or endodontic solvents like chloroform.

3. Psychological reasons. Even though claustrophobia is an obvious and severe contraindication to dam usage, still the practitioner can put the patient at ease with some professional courtesies (piercing the sheet away from the operative area to provide the patient with an air flow to the oral cavity and adopting a proper psychological approach) to increase the chances of performing isolation anyway.

4. Epilepsy and other motor disabilities. Precautions to be adopted with these patients should be done on a case-by-case process.

PRE-ENDODONTIC RESTORATION

More often than not, the dentist is confronted with the need to treat teeth destroyed by large carious lesions. Where the tooth tissue loss is great enough to prevent easy placement of a rubber dam clamp, the predictable restorability of the tooth must be questioned. An endodontic treatment should not be undertaken unless the tooth — particularly if damaged — has not been reconstructed to allow easy positioning of the rubber dam.

When there is missing tooth structure but adequate retention, missing structure can be restored with reinforced intermediate restorative material (IRM) containing zinc oxide-eugenol, glass ionomers, or resins. These materials provide an adequate coronal seal and are stable until the definitive restoration is placed. Bonded materials provide a better seal with improved strength and esthetics. Four walls should be restored to enable rubber dam positioning and to reconstruct the pulp chamber so that there is an adequate space for the irrigating solutions and temporary medications (Fig. 13).



Fig. 13. Four walls restoration

PARTIAL OPERATING FIELD ISOLATION

Absorbents, such as cotton rolls and cellulose wafers, can also provide some isolation. Absorbents are isolation alternatives when rubber dam application is not possible. In conjunction with profound anesthesia, absorbents can provide acceptable moisture control for some clinical procedures. Placing a medium-sized cotton roll in the facial vestibule isolates the maxillary teeth. Placing a medium-sized cotton roll in the vestibule and a larger one between the teeth and the tongue isolates the mandibular teeth. Cellulose wafers may be used to retract the cheek and provide additional absorbency.

Using suction devices like saliva ejector or high-volume evacuator in conjunction with absorbents may further abate salivary flow.

Special oral retractors also help to open operating field, provide safety and improve isolation.

SELF-CONTROL OF TOPIC COMPREHENSION

1. While using a dental dam you can avoid the following complications:

- a) dryness in the pulp chamber and root canals;
- b) ingestion of tools;
- c) aspiration of instruments;
- d) additional infection of the root canal.

2. Moisture control refers to excluding:

- a) gingival bleeding;
- b) sulcular fluid;
- c) dental pulp bleeding;
- d) saliva.

3. Indications for rubber dam use in endodontics:

- a) all the cases;
- b) pulpitis treatment;
- c) molar endodontics;
- d) apical periodontitis treatment;
- e) incisor endodontics.

4. Advantages of rubber dam application:

- a) easy to use on third molars;
- b) increased access and visibility;
- c) retracts soft tissues;
- d) keeps area dry;
- e) protects patient and operator.

5. When rubber dam application is not possible isolation can be provided with:

- a) cotton rolls;
- b) a saliva ejector in conjunction with retractors and absorbents;
- c) cellulose wafers;
- d) soft tissue retractors.

6. The use of the rubber dam is best indicated for:

- a) quadrant dentistry;
- b) patients with chronic obstructive pulmonary diseases;
- c) adhesive procedures;
- d) root canal treatment.

7. Rubber dam clamp styles:

- a) wingless;
- b) provisional;
- c) retentive;
- d) retraction.

8. What is the main source of microorganisms entering the root canal system during endodontic procedures?

- a) external trauma;
- b) blood circulation;
- c) salivary contamination;
- d) airborne contamination.

9. Disadvantages of rubber dam application:

- a) some patients object;
- b) partially erupted teeth;
- c) decreased visibility;
- d) extremely malpositioned teeth.

10. The reason to invert a rubber dam is:

- a) to prevent the dam from tearing;
- b) to prevent the underlying gingiva from accidental trauma;
- c) to provide a complete seal around the teeth;
- d) to get esthetic pictures.

Key to the test: 1 — b, c, d; 2 — a, b, d; 3 — a; 4 — b, c, d, e; 5 — b; 6 — a, c, d; 7 — a, c, d; 8 — c; 9 — a, b, d; 10 — c.

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Учебное издание

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**МЕТОДЫ ИЗОЛЯЦИИ ОПЕРАЦИОННОГО ПОЛЯ
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**OPERATING FIELD ISOLATION METHODS
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Учебно-методическое пособие

На английском языке

Ответственная за выпуск В. А. Андреева
Переводчик Л. Н. Полянская
Компьютерная вёрстка М. Г. Лободы

Подписано в печать 03.09.25. Формат 60×84/16. Бумага писчая «PROJECTA Special».
Ризография. Гарнитура «Times».
Усл. печ. л. 1,16. Уч.-изд. л. 0,83. Тираж 36 экз. Заказ 599.

Издатель и полиграфическое исполнение: учреждение образования
«Белорусский государственный медицинский университет».
Свидетельство о государственной регистрации издателя, изготовителя,
распространителя печатных изданий № 1/187 от 24.11.2023.
Ул. Ленинградская, 6, 220006, Минск.