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RESTORATION OF POSTERIOR TEETH

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МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ
БЕЛОРУССКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ
1-я КАФЕДРА ТЕРАПЕВТИЧЕСКОЙ СТОМАТОЛОГИИ

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РЕСТАВРАЦИЯ ЖЕВАТЕЛЬНЫХ ЗУБОВ

RESTORATION OF POSTERIOR TEETH

Учебно-методическое пособие

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Изложены современные взгляды на реставрацию жевательных зубов. Приведена информация о методах диагностики, методике препарирования кариозных полостей, способах уменьшения полимеризационного стресса при пошаговой реставрации полостей.

Предназначено для студентов 3-го курса медицинского факультета иностранных учащихся, обучающихся на английском языке по специальности «Стоматология» и курса по выбору студента.

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DIAGNOSIS OF POSTERIOR TEETH CARIES

CLASS I (BLACK CLASSIFICATION)

Class I cavities include defects located in pits and fissures on the occlusal surfaces of molars and premolars, the lingual surface of the upper incisors, and also in the vestibular and lingual grooves of molars connected with the occlusal surface. The main methods for diagnosing these cavities are questioning, examination, and probing.

During interviewing, patients can complain of an aesthetic defect — a dark spot in the tooth, a cavity in the tooth, pain from thermal, chemical, mechanical stimuli, immediately after removing the stimulus or without complaints. During asking a special anamnesis it is necessary to find out the presence of systemic and local fluorine-prophylaxis (use of fluoridated salt, the concentration of fluoride in the used toothpaste, the additional use of fluoride rinses or gels), the frequency of tooth brushing (in the morning and in the evening after eating), use of floss (once a day after evening brushing teeth), the frequency of meals (no more than 5 times, including tea or coffee with sugar).

At an early stage, the tooth may look intact. Later, pigmented fissures, a carious cavity can be detected.

Probing is possible with a cavity on the occlusal surface. The use of an acute probe has lost its significance and is not recommended. This method has no advantage in accuracy of diagnosis to the visual method currently recommended. It is possible to use the K-file to determine the presence of a carious cavity. Softened dentine is usually detected during probing the carious cavity. Probing is sensitive in the region of the amelodentinal junction or in the area of the floor of the carious cavity.

Additional methods for diagnosing Class I caries according to Black classification include drying, thermal test, electrodontometry, laser fluorescence, electrometry, radiography.

Drying allows more clearly visualize the border between healthy and carious tissues of the tooth. The criteria for the correspondence of visual and histological diagnosis of fissure caries are developed by K. R. Ekstrand (1998).

The thermal test and the electrodontometry allow to determine the viability of the pulp and to make a differential diagnosis of caries with the pathology of the pulp. Pain occurs immediately after the action of thermal stimuli and disappears immediately after their removal (pulp with hyperemia suffers for 30 seconds after stimulus removal). Electrosensitivity of pulp in carious tooth is 2–6 μA.

The «Diagnodent» device, based on laser fluorescence, is also used to diagnose occlusal caries.

The electrical sensitivity of carious enamel and dentine increases. It is determined by means of an electrodontometer or a special device. The Device KarieScan Pro is the most popular. The magnitude of the current passing through the hard tissues of intact teeth is in the range from 0.9 to 2.1 μA. Electric current, on average, moves from 2.6 to 4.0 μA through the foci of demineralization.

X-ray examination is not informative to identify small cavities. This method can be used to assess the localization of large cavities and pulpal cavity, to assess the presence of demineralization under fillings.

The use of visualization tools (magnifying glasses, binocular lenses, operating microscopes) allows to improve diagnosis of carious lesions. Using magnifying devices gives opportunity to increase the accuracy of hidden caries diagnosis to 75 %.

CLASS II (BLACK CLASSIFICATION)

It usually localized either in the area of a contact point or between the contact point and a neck of the tooth.

The main methods to diagnose Class II caries include questioning, examination, probing.

Patients may complain of pain from thermal, chemical, mechanical stimuli, which disappear immediately after removal the stimulus, food debris between the teeth or they may not complaint. The patient may have troubles with partial or whole tearing of the floss during flossing, bleeding and pain in the area of the interdental papilla.

The tooth may look intact when examined at early stages, a gray shadow of the dentine may be determined under the marginal crest. Later, a carious cavity is defined on the approximate surface with a mellow halo along the periphery of the cavity. After the destruction of the marginal crest, the cavity is also determined on the occlusal surface. It is possible to identify a filling on the proximal and occlusal surfaces or a crown during examination. The interdental papilla is usually inflamed near the carious cavity region. Probing is possible in the presence of a cavity on the approximal or approximal and occlusal surfaces. Softened dentine is detected during probing.

Additional methods to diagnose caries of class II include drying, thermal test, electrodontometry, selective separation, use of floss, transillumination, laser fluorescence, radiography.

Drying allows more clearly visualize the border between healthy and carious tissues of the tooth.

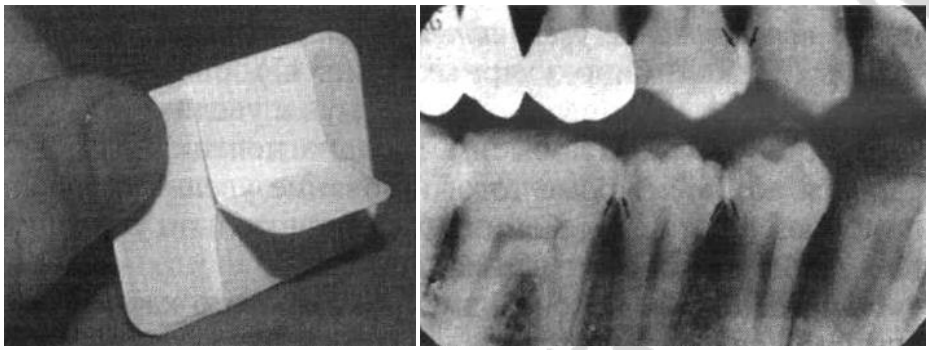
The thermal test and the electroodontometry allow to determine the viability of the pulp and to carry out differential diagnosis with the pathology of the pulp.
Selective separation is carried out using elastomeric orthodontic separators. For temporary separation of the teeth, the separator is placed between premolars for 3 days or between molars for 5 days. After this period, it is extracted. The interdental space is widened by 1 mm and examined with help of an obliquely held mirror. Inspection allows you to evaluate the surface to be examined and to detect whether the defect of hard tissues is cavitated or non-cavitated.

When flossing the examined approximal surface the doctor can define the partial or whole tearing of the floss, indicating the presence of sharp edges of the carious cavity or the overhanging edge of the filling.

You can use the light of a conventional polymezation lamp for transillumination of the tooth crown, but it is necessary to use protective glasses. There are special nozzles in some lamps which conduct white light.

There is a special nozzle for determining the optical density of tooth tissues on the approximal surfaces in the set of the «Diagnodent» device.

X-ray examination can be performed using orthopantomography or bite-wing radiography (fig. 1). The X-ray diffraction pattern reveals a carious lesion in the absence of its clinical manifestations. It is also possible to assess the presence of recurrent caries near the filling (fig. 2).



a ***b***

Fig. 1. Bite-wing radiographs for assessing the condition of the crown of the tooth, with previously inserted fillings, etc.:
a — a film for the production of bite-wing radiographs; *b* — bite-wing radiograph

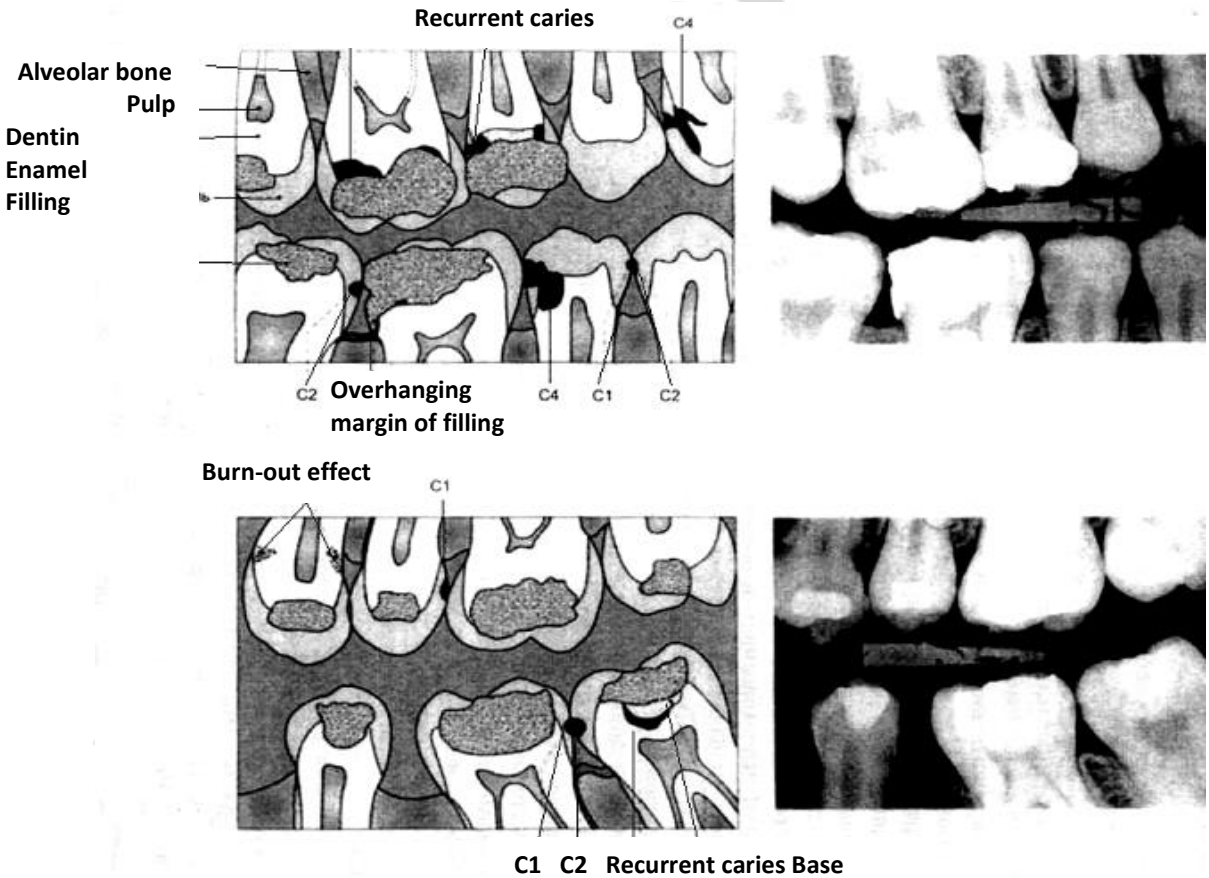


Fig. 2. X-rays are taken using a bite device to assess the condition of the teeth in the approximal areas

The negative result of X-ray examination is not a 100 % guarantee of the absence of a carious lesion in the tooth. A carious lesion of the enamel, as a rule, is not determined on the roentgenogram (fig. 3).

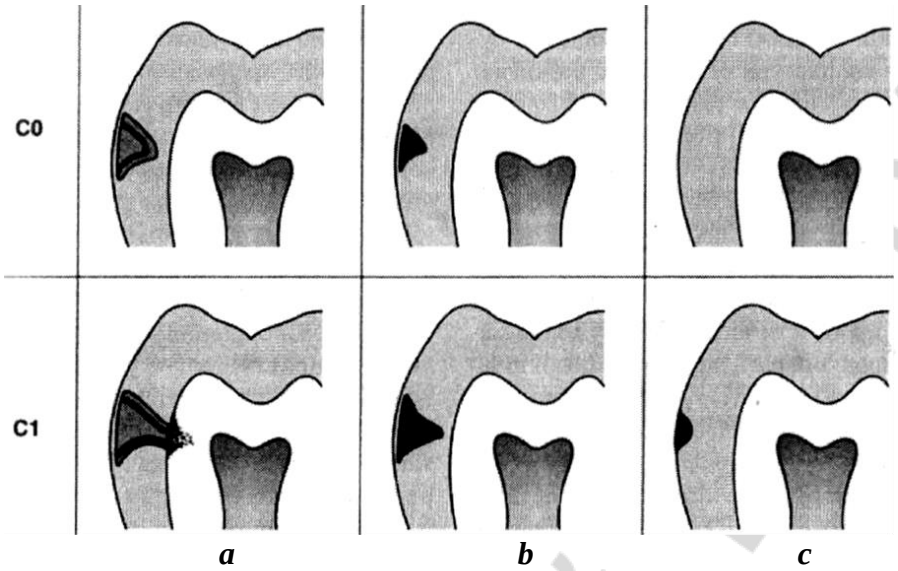


Fig. 3. Assessment of the degree of carious lesions of the enamel by:
a — histological methods, *b* — microradiography of the thin layer of the tooth; *c* — using radiography with bite device. The picture of a carious lesion on the X-ray is underestimated

The intensity of carious lesions is assessed as follows: C0 — caries in the approximal area is not detected (however, histological methods can establish the presence of an early initial carious lesion). C1 — X-ray transparency in the outer layer of enamel (corresponds to the histologically established initial carious lesion). C2 — X-ray transparency reaches the inner layer of the enamel (corresponds to the histologically established advanced carious lesion, on the surface of the enamel carious lesions may not yet appear). C3 — X-ray transparency reaches the outer layer of dentine. C4 — X-ray transparency reaches the inner layer of dentine (histologically, it corresponds to deep caries).

CLASS V (BLACK CLASSIFICATION)

Class V includes cavities in the cervical region of the vestibular or lingual surfaces of all groups of teeth. Cavities located on the vestibular and lingual surfaces of the roots of the teeth also belong to this class.

The peculiarity of Class V cavities is that the cause of their occurrence, in addition to the carious process, can be connected with a number of other diseases of hard dental tissues: wedge defects, erosion, abfraction, hypoplasia, etc.

The main methods for diagnosing caries of Class V include questioning, examination and probing.

Patients can complain of an aesthetic defect — a light or dark spot on the tooth, or the cavity in the gingival part of the tooth. If the carious process reaches the dentine, a soreness of the mouth appears, pain from thermal, chemical, me-

chanical stimuli occurs and immediately disappears after elimination of the stimulus.

When examining a carious spot, we take into account its color, location, size, surface roughness, surface gloss, and spot uniformity.

The discoloration of the spot into light brown or brown, the reduction in the spot size, the smooth surface, the appearance of gloss, the movement of the spot from the gum towards the occlusal surface and the heterogeneity of the spot are signs of stabilization of the carious process.

When probing the spot, its surface can be smooth (initial caries) or rough (superficial caries) due to the destruction of the surface layer.

Additional methods for diagnosing class V caries include drying, vital staining, examination in ultraviolet light, thermal testing, electrodontometry, laser fluorescence.

The test tooth is thoroughly cleaned from plaque. When the border is dried, the spots become clearer, it is possible to determine the lack of gloss on the carious surface.

Vital staining is based on increasing the permeability of caries-affected hard tooth tissues for aqueous solutions of dyes (methylene blue or red). The dye is absorbed after contact with solutions of colorants in the areas of demineralization of hard tissues, while unchanged tissues are not stained. It is possible not only to identify focal demineralization of enamel using this method, but also to judge the activity of the pathological process. The most common color is 2% aqueous solution of methylene blue. The dye is applied to the tooth surface, which previously was cleaned, dried and isolated with cotton wools. Apply dye for 3 minutes, then the wools are removed and only after that the dye is removed from the tooth. Estimation of enamel staining is carried out either by means of a special scale having different shades of blue or visually, subdividing the intensity into light, medium and high, which corresponds to the degree of demineralization of the enamel. After this test, the color of the enamel is restored to normal within half an hour.

When carious spot is examined in the ultraviolet light bluish glow (luminescence) is absent.

The data of the other methods of examination are the same as for caries on another surface.

CLASS VI (BLACK CLASSIFICATION)

The literature describes the cavities of Class VI, which are localized on the incisal edge of incisors, cusp tips of canines, premolars and molars.

Caries of this localization is rare. Enamel erosion is the most common cause of the formation of such defects. Dentine, as a softer tissue, is abraded faster. It leads to the development of cup-like defects. Dentine can be light or pigmented, dense during probing.

PREPARATION OF POSTERIOR TEETH CARIOUS CAVITIES

CLASS I (BLACK CLASSIFICATION)

1. **Gaining access.** The amount of cutted tissues is determined by the size of the carious lesion. The purpose of this stage is to provide access for further manipulation and a good view of the cavity. The opening of the cavity is carried out by fissure or spherical water-cooled diamond or carbide burs held in an air turbine handpiece corresponding to the size of the cavity entrance.

Widening of the cavity.

In the framework of the «preventive filling» method, fissures are removed. The optimal configuration for fissurotomy is a conical bur with a rounded apex, which creates a cavity design corresponding to the fissure shape and provides simple and technological filling, while a cylindrical bur removes a large amount of healthy enamel and the flame shape bur has an area of increased friction with low efficiency and thermal damage to the tooth tissue.

Currently, a special set of carbide burs SS White Fissurotomy® is used for fissurotomy (fig. 4).

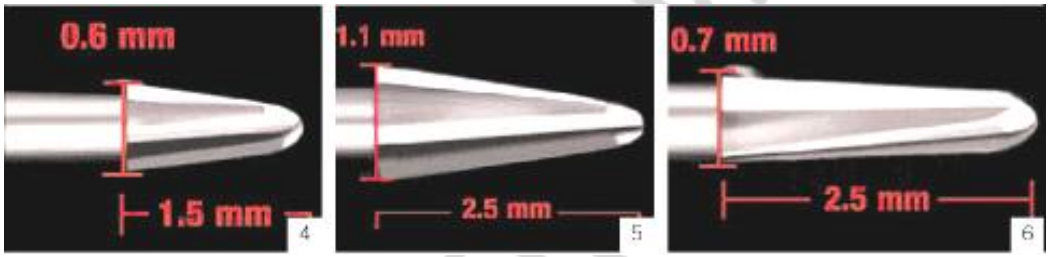


Fig. 4. A set of SS White Fissurotomy® burs

2. **Removal of caries.** With access established, caries is removed, first from around the amelodentinal junction and then, working apically, towards the areas overlying the pulp. When caries extends down to a vital pulp, one should be aimed to remove all soft, stained, infected dentine leaving either some stained but firm dentine or possibly some slightly softened, unstained dentine protecting the pulp from exposure. The rationale for this is that affected dentine (rather than infected dentine) may be retained and remineralised with the use of a therapeutic liner. It is common to experience difficulties in distinguishing between dentine that should be removed, and that which should be left. Fluorescenceaided caries excavation or a caries detector dye have been suggested as aids in such situations, but may actually lead to the over-preparation. The area of the amelodentinal junction must always be made completely caries-free.

Removal of softened dentine is made either by excavators or by spherical burs of large diameters (carbide or steel) using a low-speed handpiece.

When examining the probe, dentine must make a crepitating sound.

3. **Development of the final form.** According to the «adhesive preparation» used in preparing the cavity for filling with composite material, the cavity con-

tours should be smoothed, all internal line angles should be rounded. The cavity is given a slightly pear-shaped form, if necessary, the floor can be stepped. As a rule, all fissures of the occlusal surface are cutt away and filled. With shallow carious lesions, cavities in blind pits on the vestibular surface of the lower molars are formed as separate cavities (fig. 5 *a*). To maintain the strength of the crown, you should keep an oblique crest of the upper first molars (fig. 5 *b*) and the central enamel crest of the first lower premolar (fig. 5 *c*).

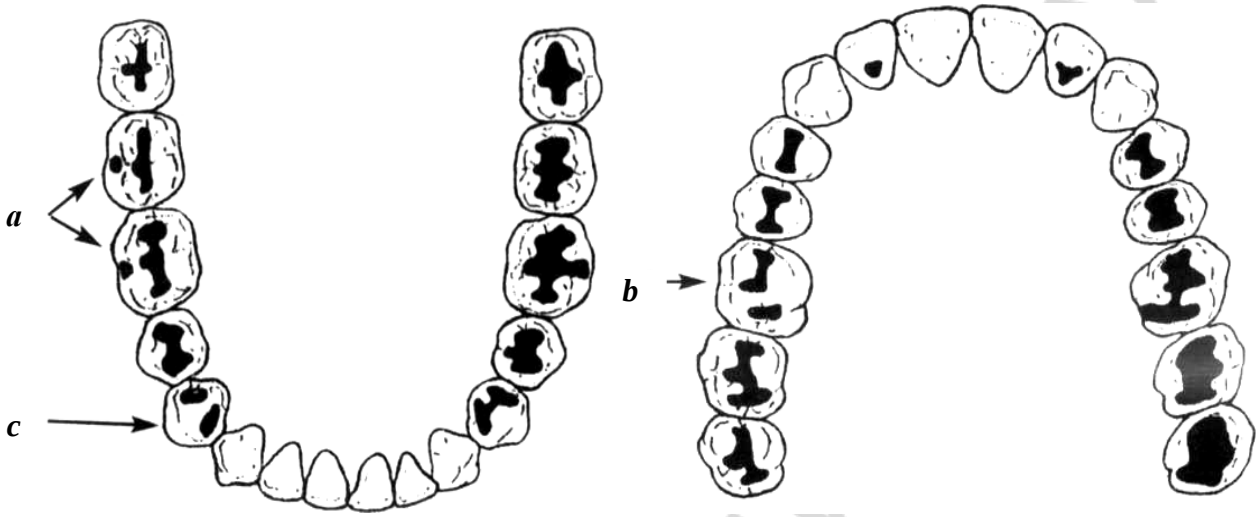


Fig. 5. Variations of the margins of Class I cavities in the treatment of dental caries by means of the method of «preventive» filling with composites (Petrikas A. Zh., 1997)

In accordance with modern principles of adhesive dentistry, fissures can be prepared minimally by ultrasound. The curved K-Reamer 0.02 should be placed in the deepest part of the fissure and moved along the fissure with the operating tip of the ultrasound attached to it (fig. 6). If the tip of the ultrasound scaler and the file do not destroy the enamel, then no cavity occurs under the enamel. If the tip of K-Reamer is self-retained in the fissure and there is pigmentation at its depth, it is necessary to apply only infiltration with a dentine adhesive followed by sealing with a sealant.

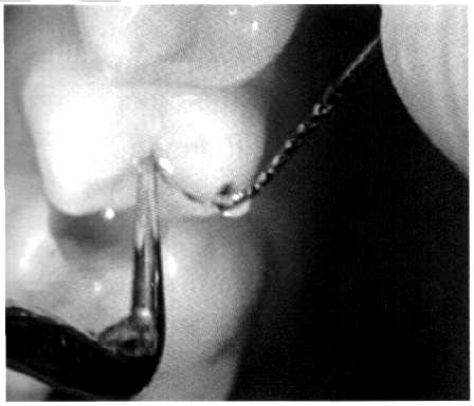
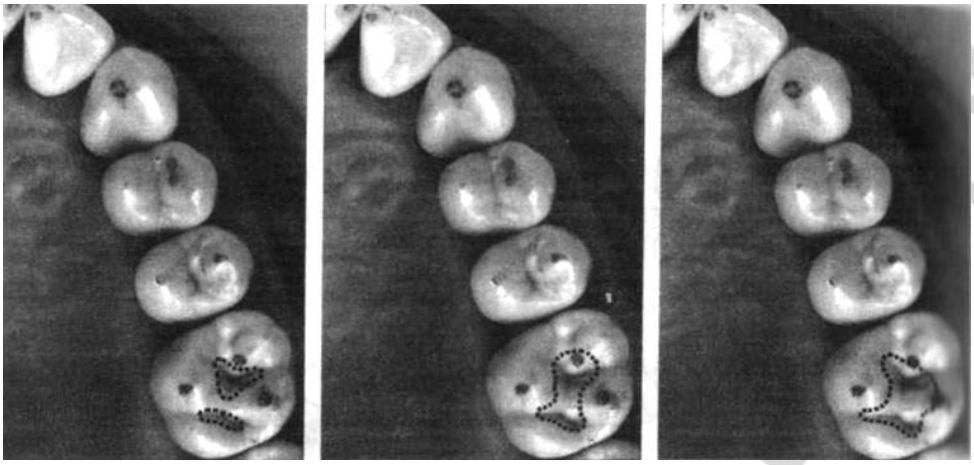


Fig. 6. Preparation of fissure with K-reamer and ultrasound scaler

Before the beginning of the preparation, the points of the occlusal contacts should be determined with the help of articulatory paper, since the filling margins

should not be in the area of occlusal contact as there is the potential for early breakdown at this weak interface (fig. 7). If the volume of carious lesion does not allow the cavity margins to be located inside from the occlusal points, the cavity is widened outward so that underneath the contact point there should be a layer of filling material not thinner than 2 mm.



a ***b*** ***c***

Fig. 7. Location of the cavity margins according to the points of occlusal contacts:
a — optimal, *b* — acceptable, c — undesirable

With a significant loss of tooth tissues to prevent cusp fracture, it is cutt at a height of 2 mm and covered with a composite (fig. 8).

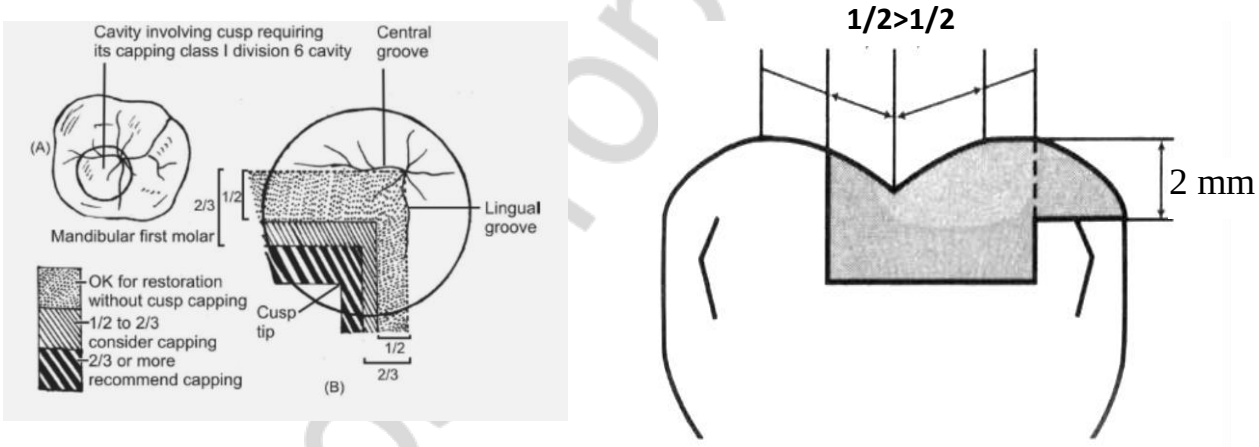


Fig. 8. Tactics for thinned, weakened cusps

There is no uniform approach to creating a bevel of enamel on the occlusal surface when using composites. V. N. Chilikin believes that when the composites fill the cavities of classes I and II, the bevel of enamel should not be done. E. Helvig, T. Attin recommend that the margins of the enamel should be beveled only in small cavities with concave cavity walls, while the enamel prisms are cut at an angle of 45 to 90°. In the presence of large cavities, parallel or slightly divergent walls, the bevel of the enamel is not performed (fig. 9).

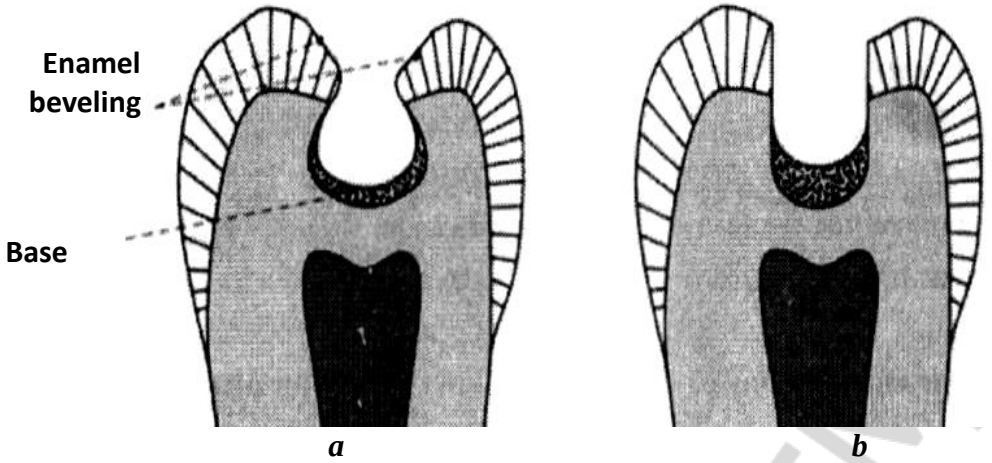


Fig. 9. Preparation of the enamel margins depending on the size of the cavity:
a — enamel prisms are cut; *b* — bevel of the enamel is not performed

A. I. Nikolaev, V. N. Tsepov believe that it is necessary to bevel the margins of the enamel. The angle of the bevel can vary from 10 to 40 degrees. The bevel line must not pass through the points of the occlusal contacts. The bevel can spread over the entire thickness of the enamel (long bevel), and can capture its part (short bevel) (fig. 10).

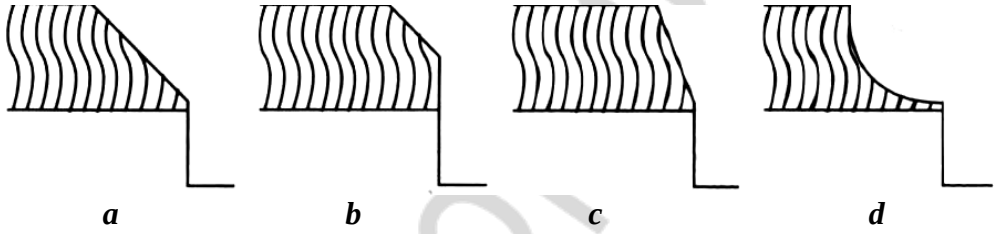


Fig. 10. Variants of enamel beveling:
a — long bevel at an angle of 45º, *b* — short bevel at an angle of 45º, *c* — long bevel at an angle of 10–40º, *d* — concave (gutter) bevel

The stage of formation is carried out with pear-shaped, conical, flame-like, water-cooled fissure diamond and carbide burs held in an air turbine handpiece.

Finishing the enamel margins.

The damaged areas, areas weakened during the preparation are removed, and enamel is smoothed. This manipulation is performed by 16- and 32-fluted carbide burs or fine-grained diamond heads (red or yellow strip). It is recommended to work at low speed without pressure with mandatory water cooling.

CLASS II (BLACK CLASSIFICATION)

The preparation involves the same steps as preparation of Class I cavities.

1. Gaining access. The opening of Class II cavity can be carried out in various ways (fig. 11):

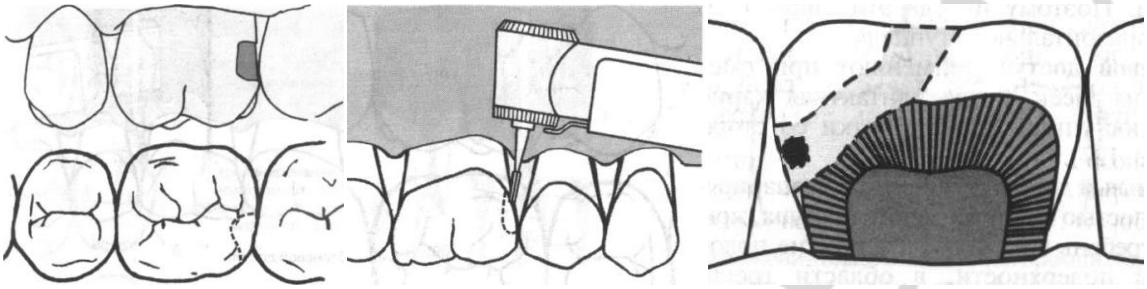
A. Direct access is used in the absence of an adjacent tooth or the possibility of the cavity treatment through the carious cavity in the adjacent tooth. In these cases, the cavity is prepared without involving the occlusal surface.

B. Occlusal access is the most common, when a wide preparation of tooth tissues on a chewing surface is performed.

C. Vestibular or lingual access (slot-preparation) is used when the cavity is localized in the cervical «region and with a high crown of the tooth. Sometimes these types of access are called the technique of a horizontal tunnel» (fig. 11 *a*).

D. Gingival access is used when tooth necks are exposed (fig. 11 *b*).

E. Tunnel access (tunnel preparation) is a kind of occlusal access, in which the marginal crest is preserved (fig. 11 *c*).



a ***b*** ***c***

Fig. 11. Types of access to Class II Black classification cavities:
a — lingual; *b* — gingival; *c* — tunnel

The most simple and reliable is occlusal access. A water-cooled spherical or pear-shaped diamond or carbide burs held in an air turbine handpiece are used for enamel trepanation over the carious cavity. After the bur «falls through» into the carious cavity, a thin fissure bur widens the trephine hole, removing the marginal ridge and overhanging sections of the enamel.

Small spherical burs with an elongated stem are used during opening the cavity by tunnel, vestibular, lingual or gingival access.

To protect the adjacent tooth, metal strips, wooden wedges, special tools are used (fig. 12).

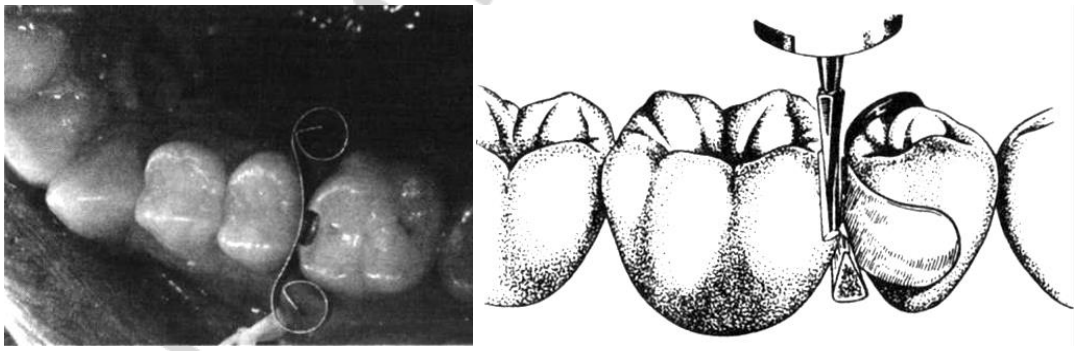


Fig. 12. Ways of protecting the adjacent tooth

Widening the cavity. Several approaches are possible.

A. Prophylactic widening is not carried out. The cavity form is a pear-shaped. According to A. I. Nikolaev, V. N. Tsepov, this approach is justified in well-motivated patients with a good oral hygiene, with daily use of flosses, a DMFT value of no more than 4, in the absence of caries recurrent and general pathology, which may affect the individual caries resistance.

B. In prophylactic widening according to Black method, preparation in the buccal lingual direction is carried out until the buccal or lingual curvature of the crown, with the tooth turning off from the contact point with the adjacent one. The degree of opening the carious cavity in the buccal lingual direction should be of such a size that when a straight line is drawn from the gap between the central incisors to the lingual edge of the cavity, the latter would be in the field of vision of the dentist (fig. 13).

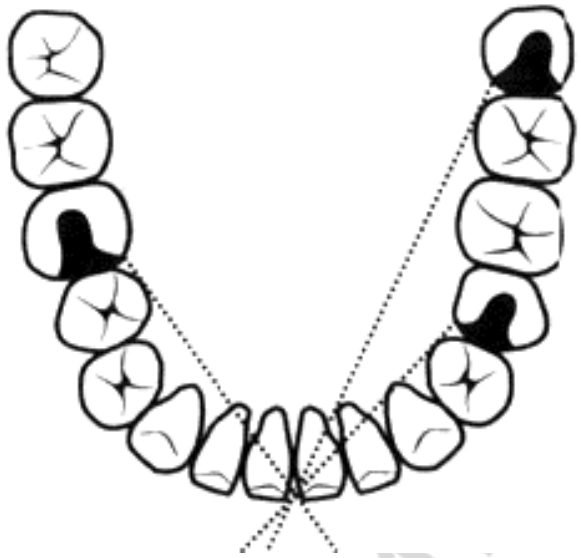


Fig. 13. Visual control of the size of preparation of the approximal (medial) wall of the cavity in accordance with the method of prophylactic widening according to Black classification (Gutner Ya.I., 1964)

On the occlusal surface all fissures are prepared in accordance with the method of «preventive filling».

It is recommended the gingival wall of the cavity to be lowered to the level of the gingiva to prevent recurrence of caries.

2. **Removal of caries.** Particular attention should be paid to the gingival wall. If you do not remove all demineralized enamel, there may be a recurrence of caries. Further stage is performed in the same way as in Class I Black.

3. **Development of the final form.** The main cavity should be pear-shaped with smoothed contours.

The side walls (cavosurface angle) should be located at an angle of 90º to the surface of the tooth.

The gingival wall is formed perpendicular to the vertical axis of the tooth. The angle between the gingival wall and the floor should be straight or sharp and slightly rounded. If there is a layer of enamel on the gingival wall, then a bevel is made on it to improve the marginal fit of the filling. If there is no enamel, then the bevel is not done (fig. 14).

On the occlusal surface, the margins of the fillings and the area of the enamel bevel should not be in the area of occlusal contact with the antagonist.

Cusp is cutt at a height of 2 mm and covered with a composite to prevent cusp fracture if significant loss of tooth tissues takes place (fig. 8). The grind-

ing cusps is especially indicated with MOD-cavities in endodontically treated teeth. The features of creating an outer contour of the Class II cavity are shown in fig. 15.

Finishing the enamel margins is carried out in accordance with the rules described above.

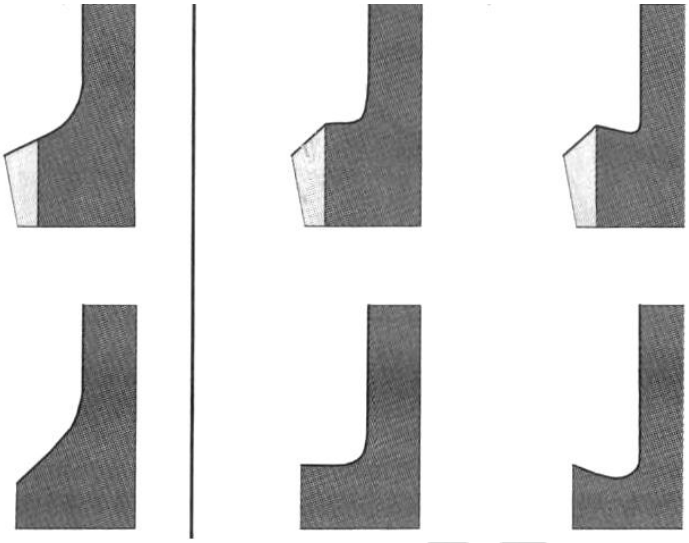


Fig. 14. Variants of formation of a gingival wall in Class II cavities:
a — correctly, *b* — incorrectly

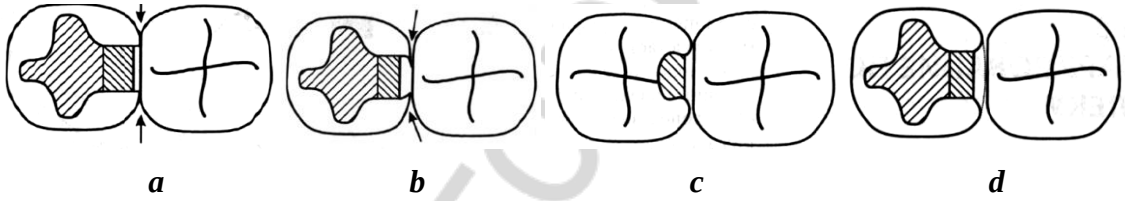


Fig. 15. Peculiarities of creating an outer contour of a Class II Black cavity:
a — incorrectly: the side walls of the cavity are not withdrawn from contact with the adjacent tooth (the risk of recurrent caries); *b* — incorrectly: on the side walls of the contact cavity there are sharp, thinned edges of the enamel (danger of their breakage); *c* — incorrectly: on the chewing surface are left unclosed fissures (the risk of recurrent caries and carious lesions of these fissures); *d* — correctly

CLASS V (BLACK CLASSIFICATION)

1. **Gaining access.** The opening of the cavity is usually not required as a defect on a smooth, convex surface. An exception is only the lesions of «acute» caries in patients of young age.

Widening the cavity. Several approaches are possible.

A. Prophylactic widening is not carried out. According to the opinion of A. I. Nikolaev, V. N. Tsepova, this approach is justified in patients with low caries intensity level (see above).

B. Preventive widening according to Black method. Widening the cavity is performed in the mesiodistal direction to the level of the crown's rounding. The

gingival wall is widened to the level of the gingiva or 0.1–0.3 mm below it, for this purpose it is necessary to perform a gingival retraction. The margin of the cavity is preferably left within the enamel. In the direction of the occlusal surface, the cavity is expanded to the border of the middle and cervical third.
Prophylactic widening is not required for defects of non-carious origin.

2. **Removal of caries.** At this stage, all necrotic dentine should be removed. Considering close location of the pulp, necrectomy should be done carefully, preferably with hand tools.

In the treatment of non-carious lesions, despite the absence of visible tissue demineralization and a smooth, «polished» surface of the cavity walls, dentine is cutt from the walls and floor of the cavity to a depth of 0.5–1 mm, if pronounced morphological changes are determined on the surface of the defect. The stage is performed with a spherical or pear-shaped carbide burs with lower-speed handpiece.

3. **Development of the final form.** The cavity is given a kidney or oval form. The floor of the cavity is formed convex, taking into account the topography of the tooth cavity. The depth of 1.5 mm from the surface of the enamel and up to 1 mm from the surface of the root is considered to be safe. The cavity is given a retention form (fig. 16), between the floor and the walls there should be slightly rounded angles (up to 45°). The medial and distal walls are formed at an angle of 90° to the surface of the tooth.

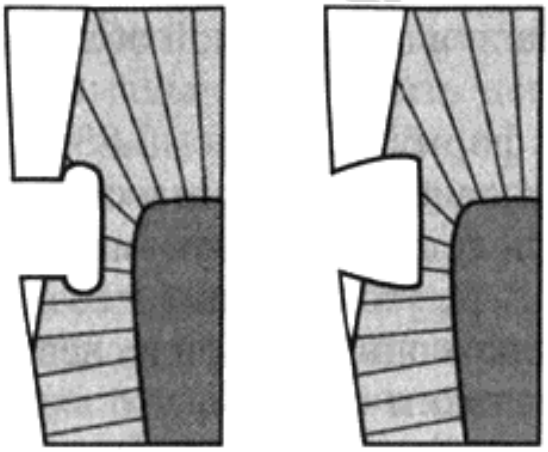


Fig. 16. Variants of making the retention form for the Class V cavity

The retentive grooves in the dentine is created with a small spherical bur at the junction of the walls with the bottom of the cavity (fig. 16), the grooves are not necessary at the medial and distal walls.

If the cavity is limited only by enamel, a circular bevel is made around the perimeter. The bevel is small (0.5–1 mm) in the gingival area. It is formed in such a way because the margin of the filling material is located in the gingival groove. A small (up to 1 mm) bevel is also made or it is not made on the medial and distal walls. In the direction of the occlusal surface, a shallow bevel is performed on an enamel (width of 2–5 mm), depending on the clinical situation. There is the recommendation to make the contours of the bevel wavy.

If the margin of the cavity is limited by dentine and cement, or the entire cavity is limited by cement, then the bevel is not performed (fig. 17).

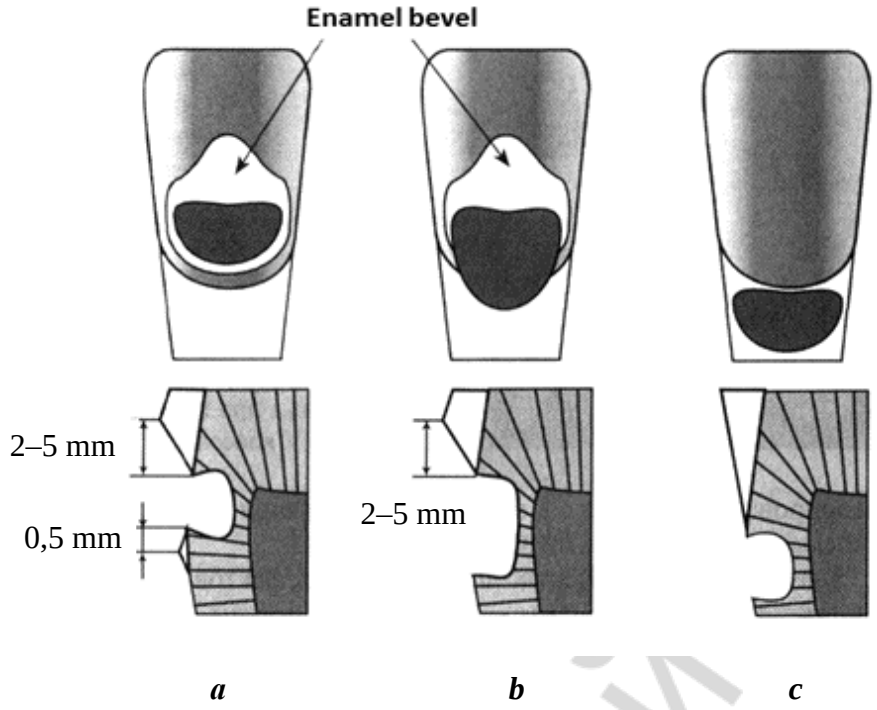


Fig. 17. Variants of forming the margins of Class V cavity and creating the bevel of the enamel depending on the location of the cavity in relation to the enamel-cement border:
a — the cavity is surrounded by enamel on all sides; *b* — the cavity is located in the area of the enamel-cement border, only a part of its perimeter is enamel; *c* — the cavity is located on the root below the enamel-cement border and is surrounded by dentine and cement of the root on all sides

Finishing enamel margins. It is carried out in accordance with the rules described above.

CLASS VI (BLACK CLASSIFICATION)

The most frequent formation of Class VI defects is observed due to increased abrasion. Preparation and filling is not always an optimal therapeutic tactic for Class VI cavities. Such patients often require complex orthopedic treatment with restoration of the occlusion height. If a decision is made to fill such defects, then, as a rule, this occurs without changing the height of the occlusion. In the literature, the experience of a filling of a large number of Class VI cavities with composites during one visit is described with simultaneous increase of the occlusion height on these fillings, but the results of dynamic observations are not given.

1. **Gaining access.** The opening of the cavity is not required as it has a cup-shaped form.

Widening the cavity. On the cusps of the chewing teeth, the cavity widening is performed in such a way that the margin of the filling with the tooth tissues does not pass through the points of the occlusal contacts.

2. **Removal of caries.** The preparation of tissue at this stage is very economical. Remove only the pigmented dentine.

3. **Development of the final form**. Cavities at the top of the cusps are given a cylindrical shape with parallel or slightly converging to the floor walls. The inclination of the walls can be achieved by creating the bevel of the enamel along the margins of the cavity at an angle of 10–15º. The optimal depth of the cavity is 1.5–2 mm, if there is no indication for deeper preparation. After determining the margins of the restoration, sharp parts of the enamel are ground (fig. 18).

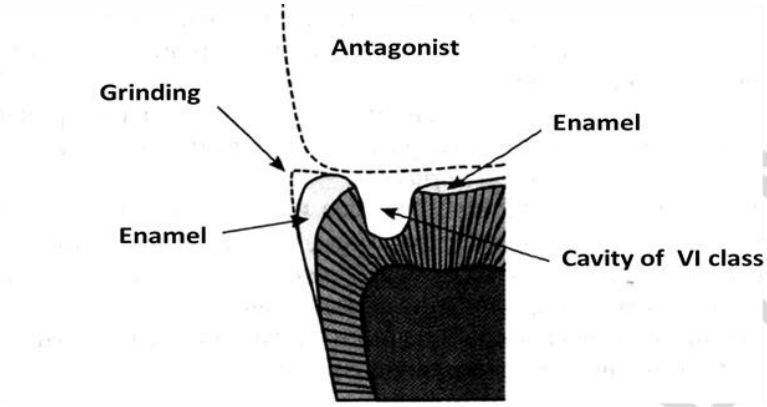


Fig. 18. Cavity of Class VI in the region of the tip of the masticatory cusp

Finishing the enamel margins is carried out in accordance with the rules described above.

STAGES OF CARIOUS CAVITY RESTORATION

The sequence of Class I cavity restoration (Black classification):

1. Choosing of color.
2. Anesthesia.
3. Using the cofferdam.
4. Cleaning the restored and two adjacent teeth with brush and paste.
5. Preparation of the carious cavity.
6. Adhesive preparation.
7. Composite application and polymerization.
8. Finishing the restoration.

The sequence of Class II cavity restoration (Black classification):

1. Choosing of color.
2. Anesthesia.
3. Using the cofferdam.
4. Cleaning the restored and two adjacent teeth with brush and paste. Cleaning the approximal surface to be restored by strips.
5. Placement of a metal strip to protect the adjacent tooth during preparation, placement of a wedge to protect the gingival papilla during preparation.
6. Preparation of the carious cavity.
7. Removal of a metal strip, wedge.
8. Placement of the matrix and wedge, checking the density of the matrix adherence to the gingival wall (by probe).

9. Adhesive preparation.

10. Composite application and polymerization (defect MO (medially occlusal), DO (distally occlusal), MOD (medially-occlusally-distal) is transferred to O (occlusal), then restored as Class I cavity).

11. Removal of the matrix.

12. Finishing (removal of the wedge before finishing approximal surface).

The sequence of Class V cavity restoration (Black classification):

1. Choosing of color.
2. Anesthesia.
3. Using the cofferdam.
4. Cleaning the restored and two adjacent teeth with brush and paste.
5. Preparation of the carious cavity.
6. Packing retraction cord.
7. Adhesive preparation.
8. Composite application and polymerization.
9. Finishing (removal of retraction cord after macro- and micro- contouring).

POLYMERIZATION OF COMPOSITES

Restoration of big volume cavities is a typical clinical situation that occurs daily in dental practice, when several tasks arise at once for the doctor: ensuring the reliability of restoration, optimal aesthetics and saving time during the restoration. Recently, the use of composites has increased significantly due to the improvement of their optical and physicomechanical properties. Nevertheless, polymerization shrinkage and polymerization stress are the main drawbacks of modern composites. These concepts have a causal relationship and are not synonymous. The proportion of the filler was increased in traditional composites, in order to reduce polymerization shrinkage, and accordingly, the proportion of the resin was reduced. It led to a reduction in shrinkage and an increase in the density of the material or modulus of elasticity, which still retained the polymerization stress at a high level.

Polymerization stress is the stress experienced by the material during the development of polymerization shrinkage. The polymerization stress is not only present in the composite itself, but also affects any adhesive surface to which it is attached and causes the postoperative sensitivity, the development of caries recurrence, the breaking of the marginal fit, the deformation of cusps, the appearance of cracks and fractures of hard tissues, the loss of restoration.

The influence of the factors causing the occurrence of stresses on the filling-tooth interface (polymerization stress) can be expressed by the formula:

$$s = f(S) \times f(E) \times f(D) \times f(C) \times f(X),$$

where: s — polymerization stress; f (S) — the effect of polymerization shrinkage; f (E) — the effect of the elasticity of the material; f (D) — the effect of the polymerization rate; f (C) — the influence of the C-factor; f (X) — the influence of other, less significant factors.

A layer-by-layer technique for applying a composite, a «parquet» technique, was proposed in order to reduce the effect of polymerization shrinkage. Microhybrid materials are recommended to be applied into the cavity by layers up to 2 mm, with the thickness of the first layer being even smaller — 0,5 mm. The material is applied to no more than 1–2 surfaces at the same time. Parguet technique is used for composites of regular viscosity. At the end of the 90s, packable composites with reduced shrinkage of 1,6–2 % were produced, which made it possible to recommend the application of material into the cavity by horizontal layers and to abandon the directional polymerization principle (fig. 19).

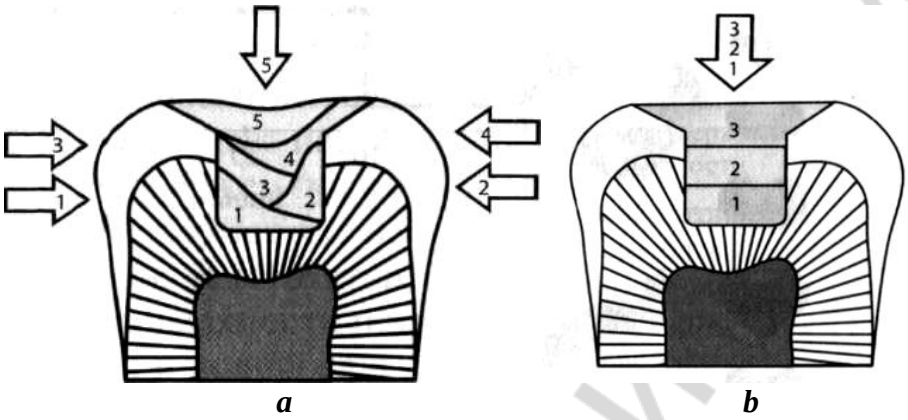


Fig. 19. Application and polymerization of a light-curing composite:
a — parquet technique (directed polymerization), *b* — applying composite by horizontal layers

However, the packable materials have more dense consistency and less elasticity after curing than microhybrid. It leaves the problem of polymerization stress when using the materials being packaged, especially in the area of enamel.

The polymerization stress can be reduced by applying a «soft start» technique, the essence of which is the extension of the pre-gel phase of composite polymerization. In the pre-gel phase, the material has the properties of a liquid body, the polymerization stress is compensated by its fluidity. In the post-gel phase of the polymerization, the material passes into a solid body and there is a stress at the filling-tooth interface, which is less than that of conventional polymerization. It should be hold in mind that the polymerization of the material by the light of full intensity should correspond to the time recommended by the manufacturer. For example, if it is recommended to polymerize a layer of material 2 mm thick 30 seconds, then the material «lights up» as follows: 10 seconds «soft start» + 30 seconds full intensity light. The previously proposed «directed polymerization» technique (fig. 20) «works» in a similar way. When the ray is directed through the tooth tissues, the power of the light weakens, this stage lasts half the time recommended by the manufacturer (10–15 seconds). Then the beam is directed directly onto the material and the «curing time» also corresponds to the recommended time of the manufacturer. It should be remembered that during the time of irradiation of the composite by the activating lamp, polymerization occurs only by 50–60 %, in the next 24 hours — by another 35–40 %, and within 7 days by 5–10 %.

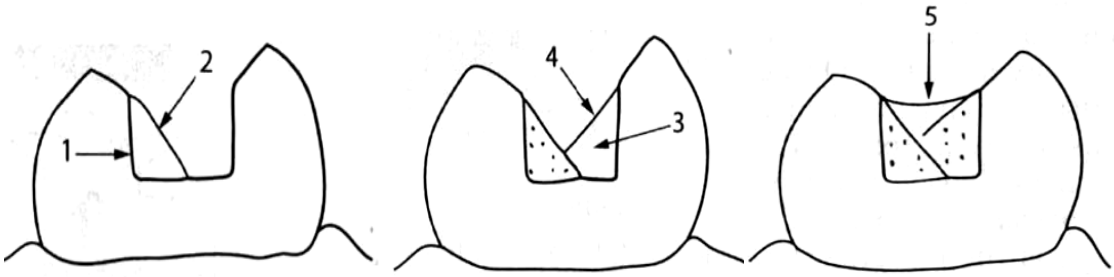


Fig. 20. The principle of «directed» polymerization. The light-curing sequence is indicated

The problem of polymerization stress is especially important in cavities that have high C-factor indices. The C-factor (cavity configuration factor) reflects the interaction between the design of the cavity and the ability of the material to reduce stress due to elastic deformation of the cavity walls. The more walls interact with the material, the greater the C-factor and the greater the polymerization stress develops in the cavity during curing.

The C-factor is the most unfavorable in cavities of classes I and V, since they have 5 bound (in interaction with the material during polymerization) and one free surface.

Variants of filling of a big volume cavities by direct restoration:

1. Sandwich-technology.
2. The technique of layer-by-layer restoration.
3. Bertolotti's technique.
4. Using the SDR.

Restoration of big cavities of posterior teeth using sandwich technology due to the use of glass ionomers has a number of positive properties, among which:

– compensation of material shrinkage due to hygroscopic enlargement;

– prophylactic release of fluoride ions;

– chemical bond with dentine (although the adhesion strength does not exceed 10–14 MPa);

– the possibility of adding material in large portions.

However, there are also negative parameters for the use of glass ionomer cement in the sandwich technique:

– glass ionomers are inferior to composites in a number of strength characteristics (modulus of elasticity, flexural strength, crack resistance);

– the complexity, multi-stage and time-consuming procedures associated with the need to first use an adhesive system for the glass ionomer, then add the glass ionomer and only then apply an adhesive system for the composite and, in fact, make the composite;

– low resistance to abrasion that does not allow leaving the glass ionomer without overlapping with a composite layer on the occlusal surface, and contact points should be restored by composite in the technique of an «open sandwich»;

– the adhesion strength between the layers of the glass ionomer-composite is inferior than adhesion strength between the composite-composite layers, i. e. materials of the same methyl methacrylate chemical nature.

The technique of layer-by-layer restoration consists of the combination of composites with various moduli of elasticity. In the case of Class I cavities, where the C-factor is 5, it is recommended to use a layer of a low-modulus flowable composite as liner with a thickness of no more than 1–2 mm to compensate high polymerization stress. Flowable composites have a high elasticity and cause a lower stress compared to composites of usual consistency due to a smaller content of inorganic filler. But high polymerization shrinkage (5 % and higher) and low abrasion resistance do not allow to use them as the main material for the restoration of cavities with high C-factor. After the application of the adaptive layer of the flowable composite, further restoration of the cavity is carried out using composites of traditional consistency using the «parquet» technique (fig. 21, *a*). It should be said that the volume restoration of the cavities by composite is even more time-consuming process compared to sandwich technology.

Bertolotti's technique consists of adhesive preparation of the cavity, application of a composite chemical cure, and, without waiting for its curing, the application of a light curing composite (fig. 21, *b*).

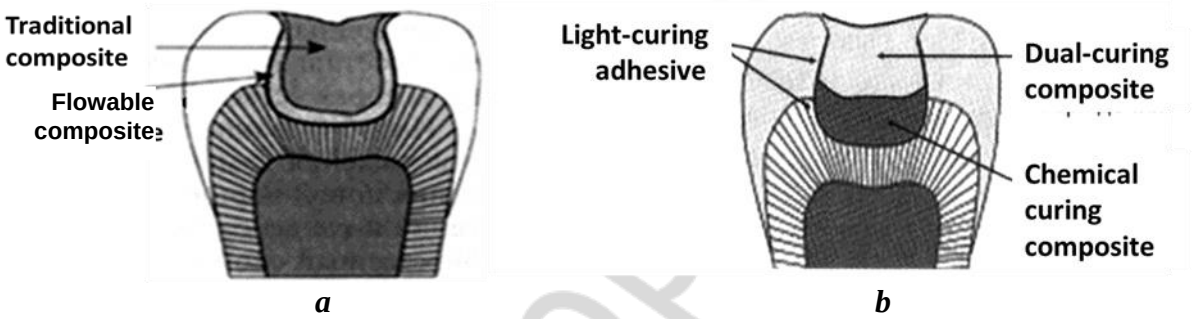
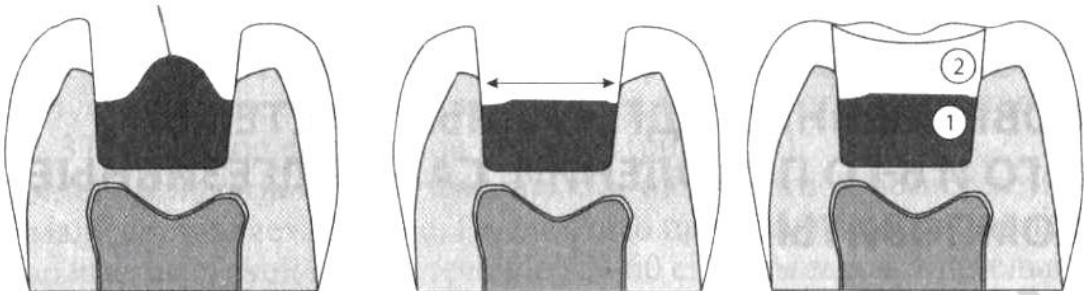


Fig. 21. Techniques of restoration by composite materials:
a — layer-by-layer technique of restoration; *b* — Bertolotti's technique

Currently, SDR material («smart dentine replacement») is widely advertised, which can be applied in one layer up to 4 mm thick. The material has a flowing consistency (filler content of 68 % by weight, 44 % by volume). The property of self-adaptation — leveling of the surface of the material after application (fig. 22) — allows to abandon the stage of condensation, it is also not necessary to distribute the material with a probe, even in the zone of undercuts. The material thickens after application, which prevents it from flowing out of the cavities when applied in large portions, for example, in the teeth of the upper jaw.

The SDR material is produced in the one shade, corresponding to the shade B1 Vita scale. This shade has a minimum amount of pigment. It leads to homogeneous and rapid polymerization to a depth of 4 mm or more. The aforementioned properties allow to save time for the restoration by 30% in comparison with traditional restorative materials.

The Rh-contrast SDR meets the requirements of the ADA.



a ***b*** ***c***

Fig. 22. Technique for filling the cavity in the chewing tooth using «SDR»
(1 — layer «SDR», 2 — layer of the universal composite):
a — insertion of «SDR» into cavity by the cannula-applicator with one layer up to 4 mm thick;
b — self-leveling of the surface of the material and its self-adaptation in the cavity during10 s;
c — material «SDR» + overlapping it by universal composite

Viscosity of failure — an estimate of the resistance to the spread of cracks inside the restorative material under conditions of occlusal loading. SDR has the highest viscosity among the tested materials.

The matrix of SDR is based on methacrylates, therefore the material perfectly interacts with traditional adhesives and composites on a methacrylate base.

Conventional dental composite materials are composed of reactive organic resins and mineral fillers. SDR™ differs from conventional resin by incorporating a Stress Decreasing Resin (SDR) technology. When a resin system is exposed to visible light, polymerization proceeds rapidly with concurrent volumetric shrinkage. With traditional resin systems, this rapid polymerization and shrinkage leads to a large increase in polymerization stress. In contrast, with SDR™, under the same conditions, the increase in stress with time is greatly reduced. SDR™ resin provides an approximate 20 % reduction in volumetric shrinkage and almost an 80% reduction in polymerization stress compared to a traditional resin system.

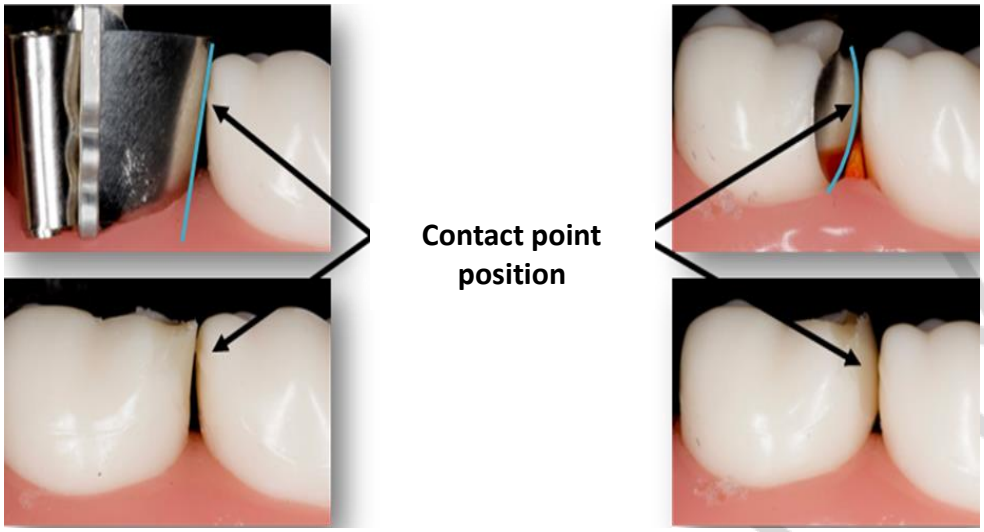
Modern bulk fill composites are divided into two groups:

1. Flowable «Bulk Fill» composites, which are needed coverage by layer of traditional hybrid composite. This stage is needed as content of filler in flowable composites is lower. As result they have high roughness, abrasive wear, low modulus of elasticity and emergence of self-leveling effect.

2. «Bulk Fill» composites of regular and high viscosity, which can fill whole cavity. Their consistency allows to model occlusal surfaces.

CREATION OF CONTACT POINT

To restore the contact surfaces of the posterior teeth, circular and sectional matrices are used. They can be flat and contour (fig. 23). Circular matrix systems (Automatrix, Dentsply, Supermat, HaweNeos) require the placement of a matrix on both contact surfaces (which requires considerable wedging of the teeth to form tight contact points), but they are irreplaceable in restoring distal surfaces on third molars, where it is impossible to establish an interdental wedge.



a ***b***

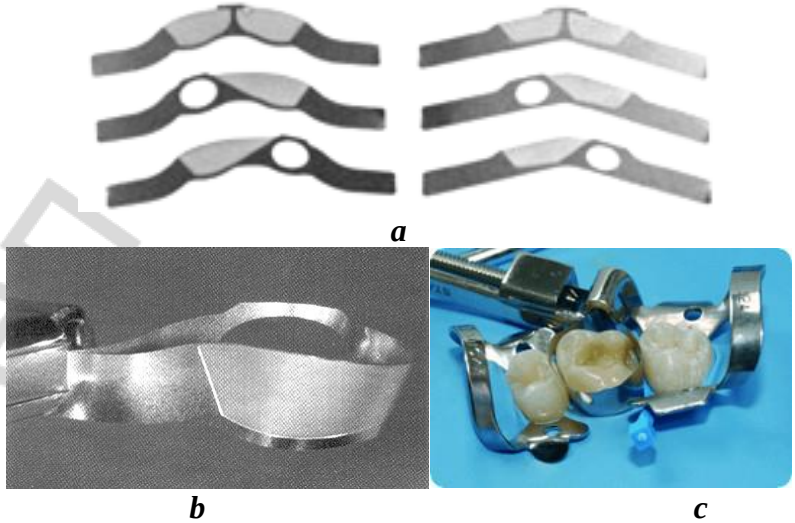
Fig. 23. Position of the contact point, depending on the shape of the matrix:
a — flat; *b* — countour

The exception is OptraLine, Vivadent, which has a perforation in the area of the second contact point. Vivadent's OptraLine system (tabl., fig. 24, *a*, *b*, *c*) is a combined matrix with perforations in the area of the contact point opposite to the restoration of the tooth's side.

Table

Features and benefits of OptraLine, Vivadent

Features	Benefits
Selective thinning up to 10 microns in the area of the contact point	More dense and wide contact, its correct location
In two-surface cavities, the matrix has the property of opening in the region of intact contact	The absence of a matrix material between the teeth determines the absence of the need for strong separation by large wedges
Special form like a boomerang	Excellent cervical adaptation and isolation
Matrices are used with traditional Tofflemire matrix holders	No purchase of a new tool and development of a new methodology is required



a

b ***c***

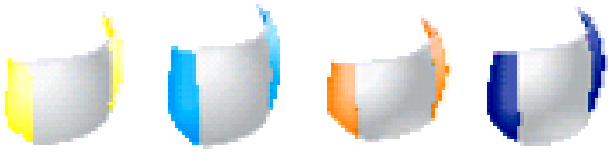
Fig. 24. The OptraLine system from Vivadent:
a — matrices; *b* — matrix in the matrix holder ; *c* — matrix fixed on tooth

Recently, the method of modeling contact surfaces using sectional matrices (ComposiTight, 3M, Palodent, Palodent Plus, Dentsply) has become the most common. These systems can be installed simultaneously on one contact surface or two.

In the ComposiTight system, the teeth are wedged by an interdental wedge. The clamping ring presses the matrix against the oral and vestibular walls of the crown. The matrices are made of steel.

In the Palodent system, the teeth are diverged and the matrix are pressed against the oral and vestibular walls of the crown by a clamping ring. The matrices are made of aluminum.

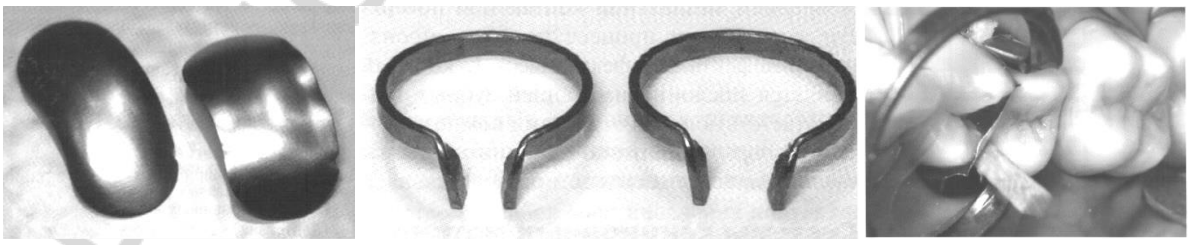
It is known that the mesial surfaces are more straight, and the distal ones are more convex. However, this anatomical axiom is not considered in the most systems. Only HaweNeos offers matrices of different convexity (fig. 25).



a ***b*** ***c*** ***d***

Fig. 25. Polymer sectional matrix:
a — yellow strips 5 mm height, moderate curvature; *b* — blue strips 6 mm in height, moderate curvature, *c* — orange stripes 5 mm height, increased curvature, *d* — blue strips 6 mm in height, increased curvature

S. Radlinsky proposed to reduce the convexity of the matrices of the Palodent system by pulling the device for contouring the lavsan matrices through the narrow smooth edge, the thus modified matrix will correspond to the shape of the medial contact surface (fig. 26, *a*). He also proposed the use of rings with different degrees of activation (fig. 26, *b*) for the restoration of defects in premolars and molars, since using the same ring molars will be diverged excessively, and premolars are not enough. Another improvement concerns the shape of the matrix. If two folds are formed by small forceps in the corners of the fixed sectional matrix, then the edge of the matrix tilts to the occlusal surface, thus forming the necessary smooth transition from the contact point to the marginal ridge (fig. 26 *c*), the contact surface shape with the asymmetric localization of the contact point to the vestibular surface).



a ***b*** ***c***

Fig. 26. Modification of the components of the matrix system Palodent
a — modified matrix; *b* — different degree of rings activation; *c* — smooth transition from the contact point to the marginal ridge

The new Palodent Plus system (fig. 27, *a*) consists of six components: rings, wedges, protective plates (guards) for wedges, matrices, tweezers and forceps. Rings (round and oval) for breeding teeth are made of nickel-titanium alloy. They are placed by forceps entering the system, the dens of which are alternately superimposed first in the outer, and then in the inner embrasure of the interdental contact. V-shaped plastic ring dens do not enter the interdental spaces, which makes it possible to use the ring when there is a clamp from the cofferdam fixed on the tooth. The ring can withstand more than 1000 cycles of sterilization. Wedges consist of two plates, located at an angle to each other (fig. 27, *b*). When inserted into the interdental space, such a wedge passes over the gingival papilla, without damaging it. Traditional wedges squeeze the gingival papilla. Wedges with protection are used in the preparation stage to protect the adjacent tooth from damage (fig. 27, *c*). After preparation, you can remove the protective plate, leaving the wedge in the interdental space (fig. 27, *d*). Small, medium, large wedges and wedges with protection of the same dimensions are produced.

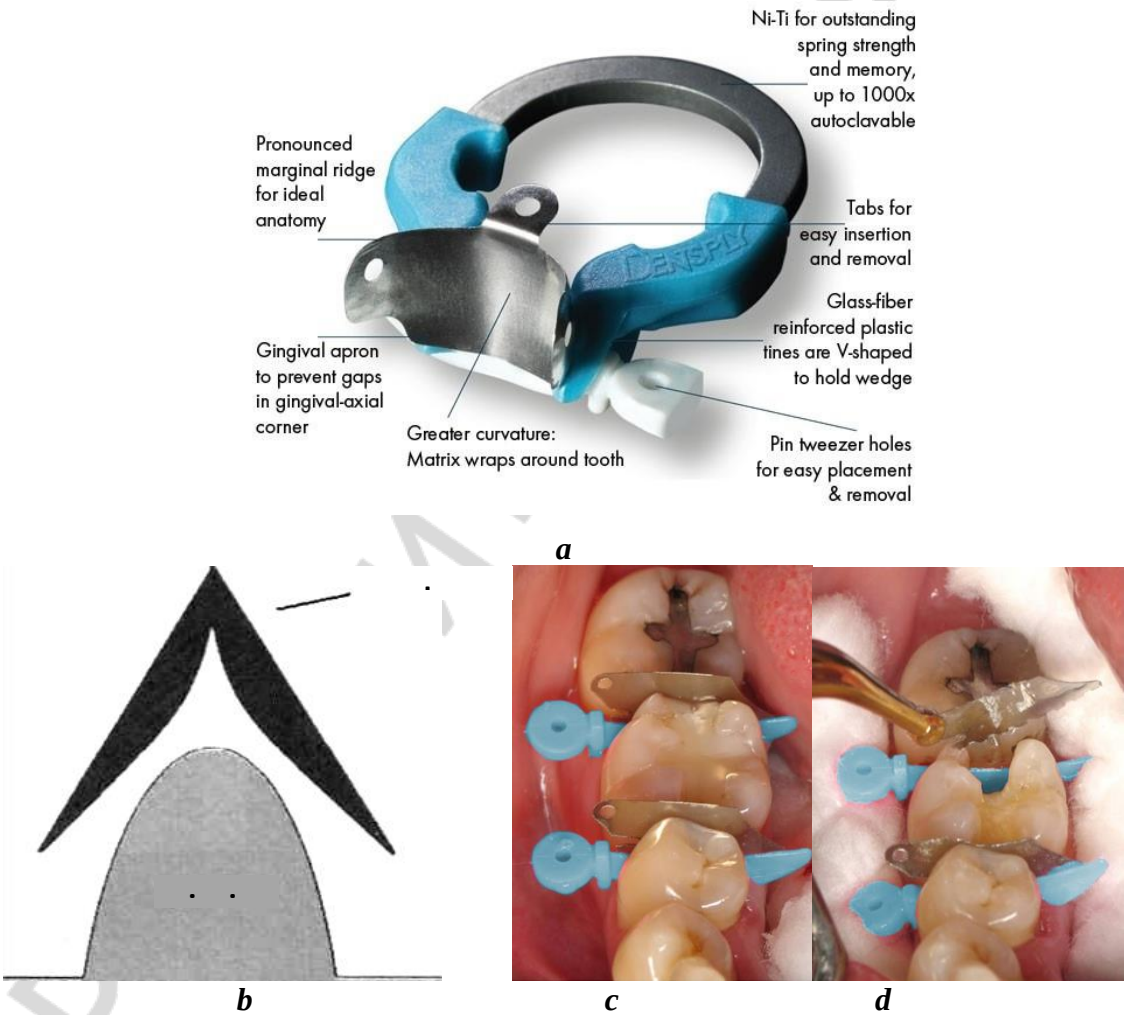


Fig. 27. Components of the matrix system Palodent Plus

a — features of matrix system Palodent Plus; *b* — cross section of wedge; *c* — wedge with protective plate; *d* — removing protective plate

The matrices, unlike the other contour matrices, are characterized by the presence of a bend in the region of the marginal ridge. A perforation hole located in the middle of the edge forming the marginal ridge makes it easy to place the matrix. It should be located in the middle of the approximal surface or slightly vestibular. The matrices are available in four sizes (3.5, 4.5, 5.5, 6.5 mm). After placement the matrix, it is necessary to mark the place of the contact point with a smoother.

The tweezers entering the system work according to the principle of the door catch, easily fixing the matrices using perforations, and the wedges for the corresponding protrusions and indentations.

On the lower jaw, the contact point is located along the middle line, on the upper jaw it has a vestibular displacement. Therefore, some authors recommend that when restoring approximal cavities on the teeth of the upper jaw, insert a wedge from the palatal surface, and when restoring the teeth of the lower jaw — from either side. Other authors recommend inserting a wedge from the side of the more damaged wall. S. Radlinsky proposed strategies and principles for the restoration of posterior teeth.

RESTORATION OF POSTERIOR TEETH

The strategy of posterior teeth restoration can be conditionally referred to as MOD→ O, where the MOD is a mesial occlusal-distal defect, and O is the occlusal defect of the crown. The defect MOD consists of two cavities of class II, connected together in one tooth. The advantage of this approach is the better polymerization of the proximal parts of the restoration, since the light of the polymerization lamp easily penetrates through the unfilled central space of the crown. The central part of the crown is filled at the end as restoration of the class I cavity.

The principles of restoration of the posterior teeth consist of modeling by separate cusps, the number of storeys of posterior teeth restoration, the wedging of the posterior teeth, the polymerization of a contact surface, the gluing of thin walls.

Modeling by separate cusps. Each cusp of the chewing surface resembles a tetrahedral pyramid whose base has the form of an irregular quadrilateral and is located inside the dental crown. The four faces of the pyramid are triangular with a common vertex. The triangular faces of the pyramid form 4 edges at the joints between them. One edge corresponds to the corner of the crown, two more edges — to the transition of two vertical planes forming this angle into the chewing surface, the fourth rib is located on the chewing surface of the crown of the posterior tooth. The last, the fourth, the edge is the most important from the point of view of chewing efficiency. Occlusal contact points are located on these ribs at the distance of 1–2 mm from the tips of the cusps, and these ribs of the antagonist teeth crush the food. It is very important to imagine that the fissures do not separate the cusps between themselves, namely the cusp form fissures. Dental tissues for-

mation begins from the tips of the cusps, which, as they grow, merge at the base, resulting in fissures formation. Therefore, it is more appropriate to start construction and finishing from work on individual cusps, and then the fissures will be formed by themselves, as a secondary element of chewing surface architecture. When modeling by separate cusps, the occlusal surface anatomy is so close to natural that the final finishing is carried out only with very fine grain burs.

Storey restoration of the posterior teeth. Biomimetic is the method of restoration that consists of achieving an aesthetic result by imitating individual dental tissues with the appropriate shades of restorative material in the topography of the restored tooth.

It is necessary to construct a laminated structure with imitation of the main dentine, the main enamel and the surface enamel to create a biomimetic restoration (fig. 28).

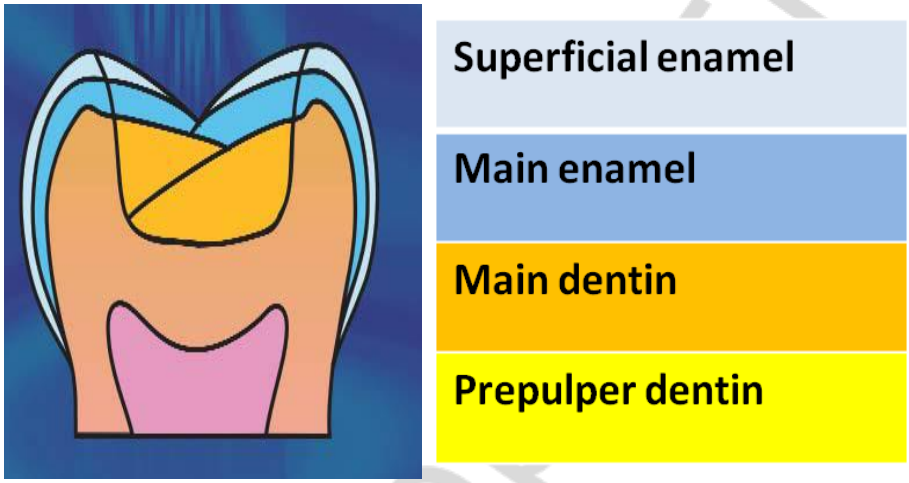


Fig. 28. Construction of biomimetic restoration

All restoration materials have limitations on the thickness of the layer to ensure optimal polymerization. It is logical to divide the structure into layers of permissible thickness, called storeys, and construct them with different shades of restoration material. Each storey is formed from several fragments, the number of which depends on the anatomy of the tooth and the shape of the cavity floor. It is not necessary to irradiate each portion of material for 40 seconds to complete polymerization in the case of storey restoration. Initially, directional initial polymerization can be carried out by 10 second irradiation of each portion within one floor of the restoration (the surface of all fragments must be solid, which can be checked by smoother), then, after building the whole storey, irradiate the entire restoration from the occlusal surface to complete polymerization (40 s light-curing with a polymerization lamp). The irradiation before the complete polymerization of the main and superficial enamel can be carried out in one step, since they have fewer limitations the thickness of the layer and are restored by shades of ordinary and high transparency.

Wedging lateral teeth. It is imperative to wedge the teeth when restoring posterior teeth with class II cavities. To this end, special interdental wedges are

made of durable plastic or wood with special impregnation. The shape of the wedges usually corresponds to the shape of the wedged contact surfaces. When the teeth are wedged, the contouring means are fixed, an marginal fit is formed and the optimal contact between the teeth is achieved. Using wedges prevents overhanging of restorative material in the interdental space.

Teeth are wedged after the placement of the contouring device: the ring of system Palodent Plus (Dentsply), the matrix of system SuperMat (HaweNeos), contour metal matrix (3M) or ordinary lavsan strip («StomaDent»). Wedge is inserted in the interdental space by a diving movement, while the tip of the wedge should be directed as deeper as possible to the gingiva and it should not be allowed to tilt in any direction. Tip should rise above the gingival from other side of interdental space. Wedging the restored teeth should be sufficient to create a contact point of the desired density, taking into account the thickness of the contour matrix and the surface polymerized layer, which will be removed during finishing. As a result of the insertion of the interdental wedge, the contacting teeth slightly move apart, and the contour matrix is pressed against the proximal surface of the crown or root of the restored tooth. Completing the wedging of the teeth, you need to make sure that the wedge is inserted below the margin of the cavity.

Polymerization of the contact surface. It is necessary to comply the polymerization direction during light-curing the restorative material on the contact surfaces, and also to prevent stratification in the region of the floor of the cavity and to achieve material polymerization to the full depth. To avoid or reduce the risk of adhesive breakdown, it is recommended to make pre-glue of cavity floor. A small amount of a flowable composite is applied first for the restoration of the contact wall, then transparent shade imitating the edge enamel is applied on the uncured flowable composite. After the modeling, directional polymerization is carried out through the cavity from the side opposite to the contact surface (fig. 29).

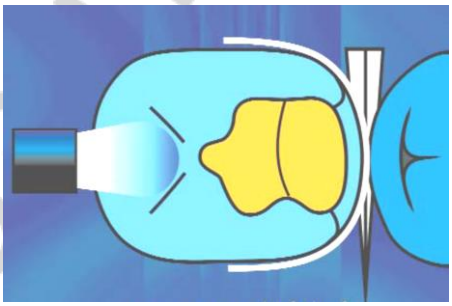
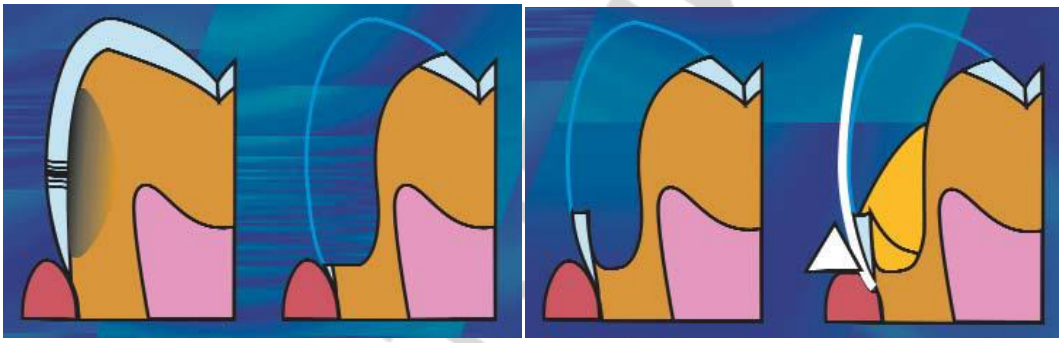


Fig. 29. Polymerization of approximal surface

It should be taken into account that the power of the light decreases when the optical fiber light guide is removed from the surface of the material. It is established that if the distance between the optical fiber guide and the material surface is 5 mm, the power of the light reaching the material is reduced for 30 %, and at a distance of 10 mm — for 50 %. If during the polymerization of the composite on the gingival wall the light guide can be placed only 5–6 mm from the surface of the material, the polymerization time should be doubled. If the light output of the

polymerization lamp is more than 550 mW/cm^2, the polymerization time may not be increased.

Gluing of thin walls. Carious lesions are more spread in the dentine than in the enamel. At the same time, a significant part of the enamel remains intact (strong and transparent), surrounding the demineralized (softened and pigmented) dentine. Unlike the classical preparation by Black, the adhesive technique allows to save most of the enamel over the demineralized dentine. The problem of internal preparation is the low strength of enamel, which is devoided of dentine. This issue can be solved by gluing the enamel layer with a light-curing restorative material with directional shrinkage. If in a classical restoration the filling is fixed on the walls of the cavity, then in the adhesive technique everything is the other way around: the walls are fixed on the filling. The light of the polymerization lamp must be directed through a glued enamel wall. The composite strengthens the enamel in this case, and its shrinkage will be compensated by the following fragments of the restoration material. The strengthened enamel wall can be used as support for wedging of teeth. This approach is an advantage of adhesive technique. It allows you to preserve the natural shape of the enamel surface, and also ensures the smoothness of the enamel-dentine transition along the neck, which can not be achieved by restoration material (fig. 30).



a ***b*** ***c*** ***d***

Fig. 30. Gluing of gingival wall:
a — the initial situation; *b* — classical preparation; *c* — preparation of a thin wall; *d* — wedging with support on the glued wall

Algorithm for posteriorteeth restoration. The color of the future restoration is determined by the anterior teeth. First, identify the appearance of the anterior teeth according to the Vita shade scale. The upper anterior teeth must be cleaned of plaque and pellicles with professional toothpaste and a nylon brush at a speed of 2000–3000 rpm, then rinse the paste. Hygienic procedure should be fast enough (2–3 minutes) to prevent changes in the appearance of the teeth due to drying. To compare the anterior teeth with the Vita scale, it is necessary to moisten both the crowns of the teeth and the standards. Identification is best done under dim, but sufficient illumination to exclude tension or blindness of the eyes (a lamp of a dental unit at a minimum level of brightness, a shadowless lamp). The closest standard should be selected within 30–40 s, while sufficient color perception potential is preserved. If during this time we failed to decide, we need a 3–4-minute

rest for the eyes. It is usually first determined how much the patient's teeth are light or dark (color standard 1, 2, 3, 3.5 or 4), and then determine the color group (A, B, C or D). After that, the anterior teeth are dried and the test polymerization of standard portions of the applied restoration material is carried out. Then, the identifiable teeth are again moistened and the appearance of the polymerized material is compared with the central part of the crowns.

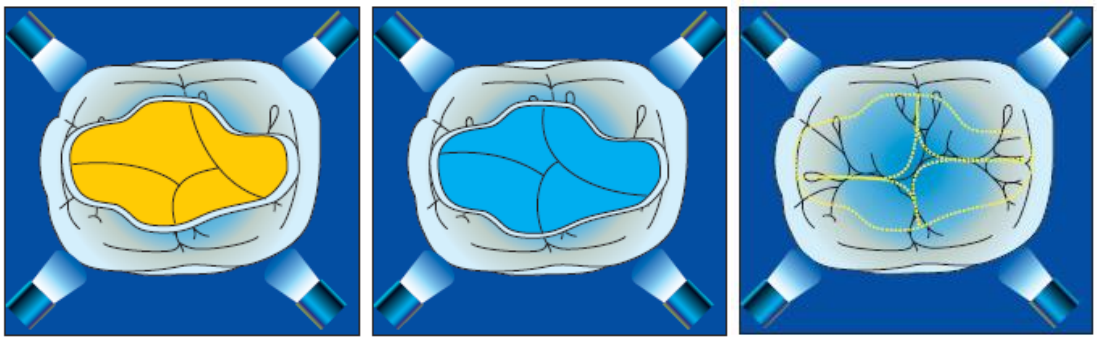
After all the above is done, filling is glued from the selected shades. Control the quality of «gluing» the layers in the process of work. Composite must be adhered to the surface, tearing away from the instrument. When trying to separate a portion of the composite from the surface to be glued, it must deform, but not separate. The filling should look monolithic. The presence of white strips in the depth or on the surface of the filling indicates that there is no gluing between the layers of the composite or between the filling and tooth tissues.

Additional irradiation of the class II filling from the vestibular and oral sides is carried out after removal of the matrix and the wedge.

Restorative construction of cavity Class I (Black classification). Restoration of dentine is carried out by the number of portions corresponding to the number of cusps of the occlusal surface (fig. 31, *a*).

Restoration of the main enamel. The number of portions remains the same as on the dentine storey (fig. 31, *b*).

Restoration of superficial enamel. The material must be rubbed from the center of the chewing surface to the enamel margin (fig. 31, *c*).



a ***b*** ***c***

Fig. 31. Class I Black Restoration:
a — restoration of dentine; *b* — restoration of the main enamel; *c* — restoration of superficial enamel

Restorative construction of cavity Class II (Black classification). To exclude or reduce the risk of polymerization tearing of the proximal wall, it is necessary to pre-glue the floor of the cavity (fig. 32, *a*).

Restoration of proximal surface. The contour matrix is fixed with an interdental wedge, which is usually inserted with considerable force, and pressed against the vestibular and oral surfaces. One portion of transparent shade is applied and rubbed it against margins of the cavity. The contact point is pushed by condenser before the light curing of composite (fig. 32, *b*).

Restoration of dentine, the main enamel and superficial enamel is shown in fig. 32, *c–e*.

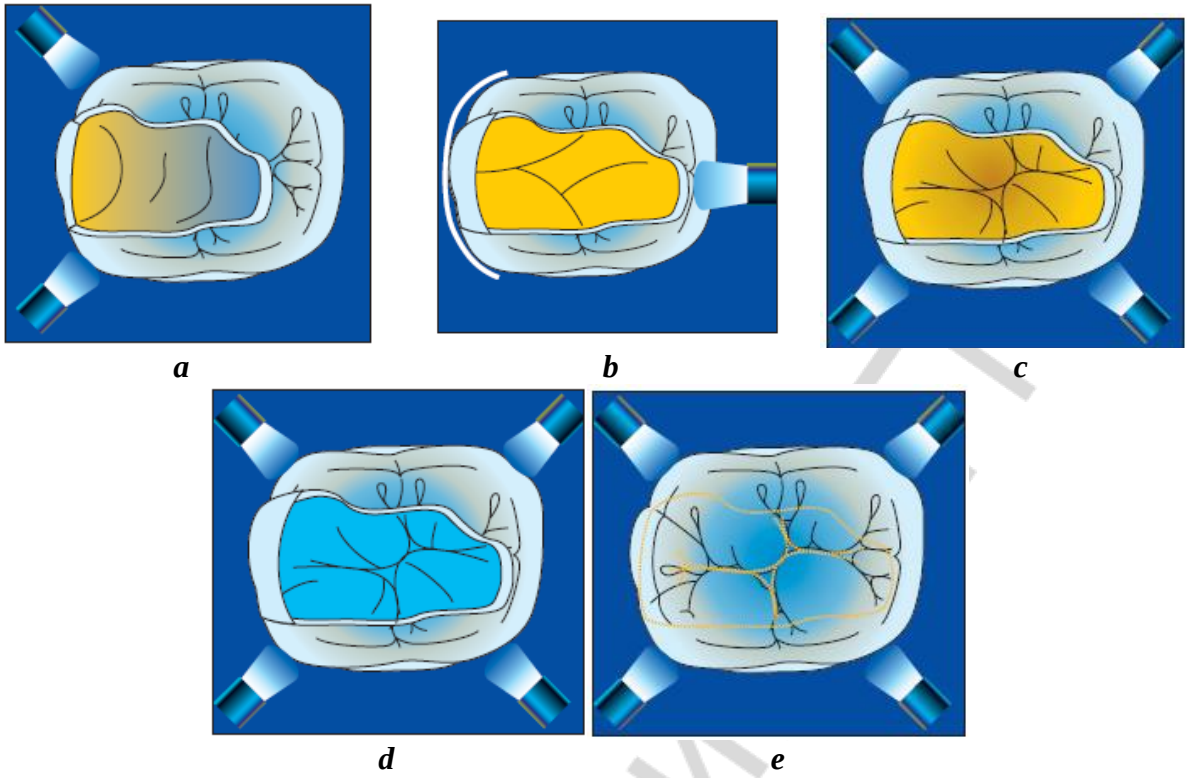


Fig. 32. Restoration of cavity Class II Black:
a — gluing the floor of the cavity; *b* — restoration of the proximal surface; *c* — restoration of dentine; *d* — restoration of the main enamel; *e* — restoration of surface enamel

S. Radlinsky proposed «Quadra-Seal» method of the restoration for saving time. It consists of modeling four separate portions of a composite, respectively to cusps and their simultaneous polymerization (fig. 33, *a*). After that, the gaps between the portions of a composite are filled with a flowable composite and polymerized (fig. 33, *b*). The upper storey of the restoration is performed in the traditional way (fig. 33, *c*).

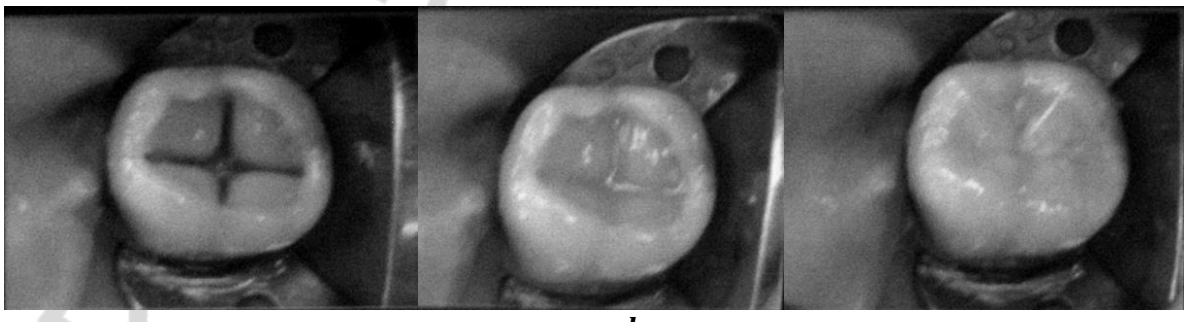


Fig. 33. Method of restoration «Quadra-Seal»:
a — separate portions of regular composite; *b* — flowable composite filled space between portions of regular composite; *c* — restoration of enamel

There are special tools for modeling occlusal surfaces (fig. 34).

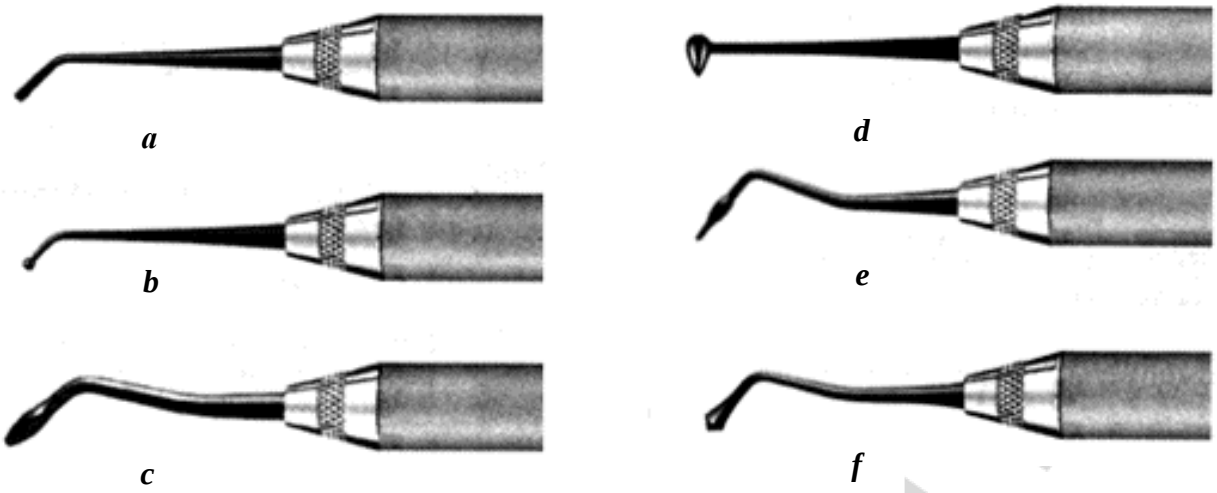


Fig. 34. Condensres for working with composite materials:
a — universal rounded condenser of small size; *b* — spherical condenser; *c* — an oval (olivoid) condenser for condensation of material in the cavities of class II; *d* — teardrop-shaped stopper for modeling occlusal surfaces of teeth; *e* — condenser «duck head» for modeling chewing surfaces of teeth; *f* — condenser with working part in the form of an acorn for modeling occlusal surfaces of teeth

Restorative construction of cavity Class V (Black classification). *Restoration of dentine* is carried out in two parts, which are glued together with the walls of the cavity or with each other. This is done in order to comply with the rules of directed polymerization. Initially, it can be light-cured vestibularly-mesially from the cervix along the surface. In the cavity with the margins the mesial part of the restoration is polymerized first, and the distal cavity in the cavity without margins (fig. 35 *a, b*).

Restoration of the main enamel. Also, two layers of restorative material of ordinary transparency are restored the main enamel layer (fig. 35 *c*).

Restoration of superficial enamel. To polymerize a transparent fragment, the ray of the polymerization lamp is directed through the vestibular cusps from the side of the occlusal surface (fig. 35 *d*).

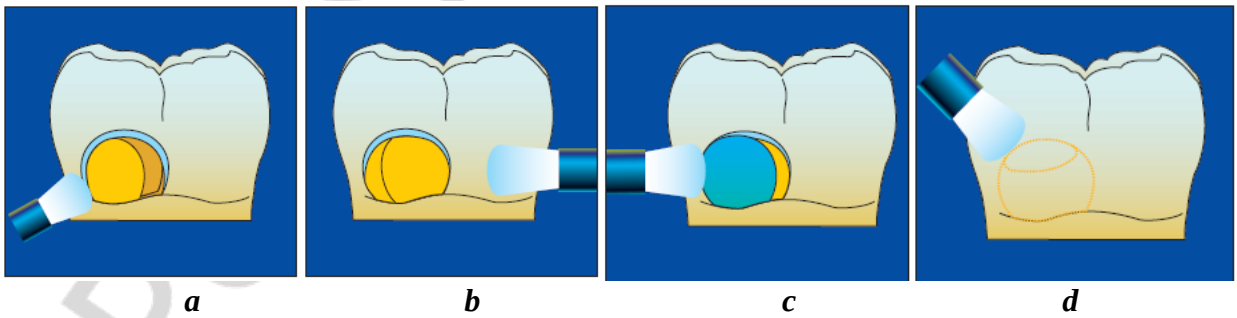


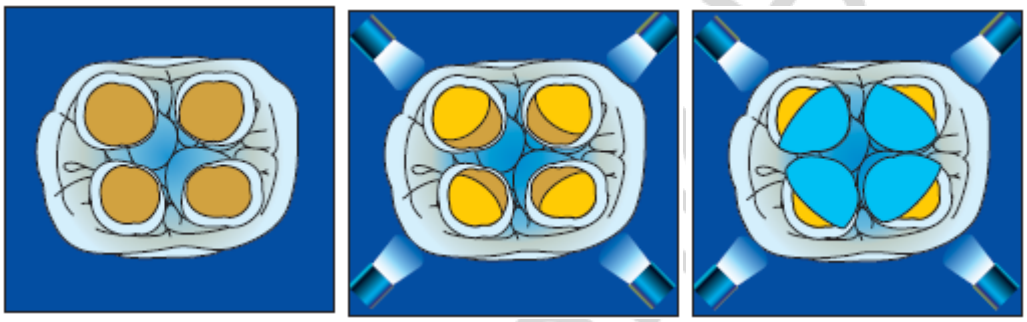
Fig. 35. Restorative construction of cavity class V by Black:
a, b — restoration of dentine; *c* — restoration of the main enamel; *d* — restoration of superficial enamel

Restorative construction of the cavity Class VI (Black classification). The space for restoration remains minimal, and if the dentist does not need to increase the bite height, dentine does not restore or place small portions of restorative material in the area of the cusps (fig. 36, *a*).

Restoration of the main enamel. The specifics of enamel restoration are also due to the amount of the defect, and it is usually possible to add only one portion of the enamel composite, leaving place for a transparent shade. Directional polymerization should be carried out diagonally through the vestibular and oral surfaces.

Optical fibre light guide of polymerization lamp should be below the occlusal surface. In this case, each portion of the composite must be «attracted» by the light beam to the enamel, therefore, on each cusp it is necessary to build a separate structure (fig. 36, *b*).

Restoration of superficial enamel. A portion of the transparent shade is placed on the top of the cusp (fig. 36, *c*).



a ***b*** ***c***

Fig. 36. Restorative construction of the cavityVI class:
a — restoration of dentine; *b* — restoration of the main enamel; *c* — restoration of superficial enamel

When modeling, remember the differences in shape between the non-working and working cusps. The tips of the lower teeth cheek cusps are displaced to the central fissure, the lingual ones are modeled closer to the lingual surface. On the upper teeth, on the contrary, the tips of the palatal cusps are displaced to the central fissure, the vestibular ones are modeled closer to the buccal surface.

When arranging the cones of cusps it is rational to use the recommendations of I. K. Lutskaya and N. V. Novak. One should mentally draw lines connecting the cusps of intact adjacent teeth, as well as lines perpendicular to them, connecting the central points of the most convex parts of the buccal and lingual surfaces (fig. 37).

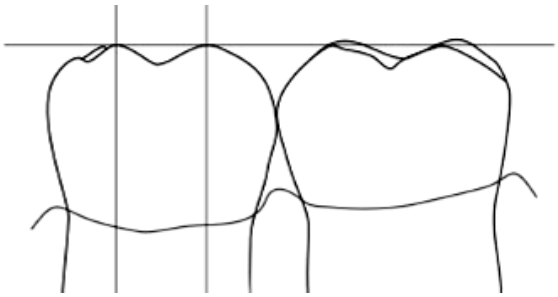


Fig. 37. Placement of cusps cones

A circular method with the mock-up technique can be used if it is a significant destruction of the cusps. The composite is applied on the restored tooth and the patient is asked to close his teeth. Then, on the resultant print using a caliper, the height of the tubercle is measured (fig. 38), which is guided during the restoration of the occlusal surface.

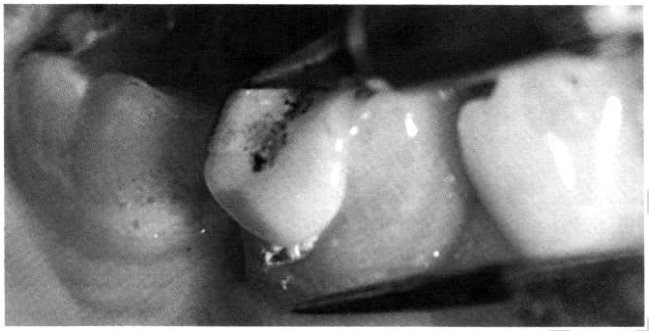


Fig. 38. Measurement of the projected height of the cusps with a caliper

Wax-up is another method that facilitates the restoration of severely damaged teeth. First get impressions and cast models. Then the models are gypsum into an occludator or articulator. The shape of the destroyed teeth is modeled by wax, taking into account occlusion. After that, in the vacuum apparatus, the model is crimped with a rigid polymer plate. The resulting kappa is cut into segments in which grooves are cut to remove excess composites. These segments are used as a template for tooth restoration.

FINISHING

Finishing includes the following steps:

1. Macrocontouring of a filling is performed by tools of high abrasiveness by turbine and lower-speed handpiece.

2. Microcontouring (formation) of a filling. Correction of occlusal contacts, proximal correction is performed by tools of standard abrasiveness by turbine and lower-speed handpiece.

3. Polishing with tools and pastes is performed by tools of low abrasiveness (3 μm) by lower-speed handpiece.

4. Super polishing is performed by tools and pastes with very low abrasiveness (1 μm) by lower-speed handpiece.

Macro- and microcontouring is most often performed with diamond burs with a red color code, carbide burs with 8, 10, 12 and 16 fluted by movements from the filling material to the tooth tissues. The occlusal surface is macro- and microcontoured by a diamond head of low abrasiveness with a working part of an olive-like shape. This surface is polished by silicone polishers of a flame-shaped or cup-shaped shape.

The most difficult finishing is for restorations cavities Class II according to Black. There is task is to keep the created contact point when finishing the gingi-

val wall of such fillings. A thin finish bur with an elongated a flame-shaped working part or a disc is used for smoothing the angles of the contact surface after matrix removal. The protruding part of the contact point is treated with a metal fine-grained abrasive strip, while the interdental wedge retains the working space for finishing the contact surface. After placement of the abrasive strip as deeper as possible in the interdental space, it is necessary to remove the wedge, and to protect contact point by the usual separation strip from damage (fig. 39). The concave sections of the contact surfaces are treated with coarse and fine-grained parts using the following algorithm: 10 reciprocating movements along the contact surface, 10 — along the angle of transition to the oral surface and 10 — along the angle of the transition to the vestibular surface. After the coarse-grained part of the abrasive lavsan strip is treated, it is necessary to wash off the abrasive particles from the surface to be treated and only then to work with the fine-grained part of the abrasive strip.

Fig. 39. Protection of the contact point with a separating strip during grinding with an abrasive strip

Transitions of the contact surface into the oral and vestibular in the subgingival region is treated with the finish bur (with a yellow strip) of a cylindrical shape which, 1 mm before the active tip, smoothly passes into a conical shape, or 8-, 16-, and then 30-fluted carbide burs with non-aggressive tip.

Small diameter discs can be used to handle fillings in the cervical region, in addition to the above-described burs and polishers in the form of a disk. Stage of contouring, and the stages of formation and polishing can be carried out using it, which depends on the particle size of the abrasive.

QUALITY CONTROL OF RESTORATION

Quality control is carried out according to the following criteria:

- form;
- marginal seal;
- color;
- the presence of a «dry» shine;
- homogeneous structure.

Correspondence of the form of restoration to the anatomical shape of the restored tooth. The form of the restoration is assessed visually, using a mirror.

Using articulation paper, check the presence of uniform occlusal contacts on the restoration, on the tissues of the restored tooth and on the adjacent teeth. The points of occlusion must necessary be present on the marginal ridges, supporting cusps, in the center of the fissures, and be the same in intensity.

It is required that the marginal ridge and its clivus be expressed, and the contact point was on the border of the occlusal and middle third of the crown of the tooth. Inflammatory changes in the papilla should be absent. The density of contact between the teeth is determined with a floss: it must be inserted into the interdental space with effort and be removed from the interdental space with a characteristic click.

Marginal seal. The acute probe should slide without a delay across the border of the filling — tooth.

Smoothness of the surface in the area of the contact point should be checked by floss. After flossing through the contact point, several movements are made up and down along the center of the contact surface, along the transition of the contact surface to the oral surface and the transition to the vestibular surface. Then withdraw it through the contact point back. Floss should not be broken or stay on the surface of the tooth.

There should be no inflammation of the gingival margin in the area of restoration, staining of the border of the filling — tooth with dye solutions, white (gray) line along the edge of the restoration, postoperative sensitivity.

Presence of «dry» shine of restoration. Over time, the «dry» shine disappears due to abrasive wear on the surface of the restoration. In this regard, restoration of microhybrid is recommended to grind and polish every 6 months, from nanofilled composites — once a year.

Homogeneous structure of the restoration structure. The absence of pores is checked by radiating the restoration with a polymerization lamp or other light source. In case of detection of surface and subsurface pores, they must be eliminated by grinding and sealing with a composite. There should be no white lines in the thickness of the restoration.

CONCLUSION

Careful and consistent performance of all stages of treatment, from diagnosis to finishing, is the key to the successful work of the dentist. The variety of materials offered, the restoration technique allows you to choose the tactics of treatment in various clinical situations. Knowledge of modeling techniques and the use of matrix systems allows to obtain the optimal result from the anatomical and physiological point of view and to reduce the time spent on the fillings finishing.

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Учебно-методическоепособие

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