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# RESTORATION OF ANTERIOR TEETH

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МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ  
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1-я КАФЕДРА ТЕРАПЕВТИЧЕСКОЙ СТОМАТОЛОГИИ

Л. А. КАЗЕКО, О. А. ТАРАСЕНКО

# РЕСТАВРАЦИЯ ПЕРЕДНИХ ЗУБОВ

# RESTORATION OF ANTERIOR TEETH

Учебно-методическое пособие



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RESTORATION OF ANTERIOR TEETH**

Учебно-методическое пособие

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## INTRODUCTION

The problem of dental caries continues to be of current interest in the Republic of Belarus. The caries of the anterior teeth deserves special attention, since the damage to the teeth visible when speaking and smiling is not only a medical but also a social problem. Beautiful healthy teeth are a symbol of success and prosperity. Recently, a number of concepts have appeared in the field of aesthetic restoration, which is reflected in the release of new restoration systems of varying degrees of opacity, the development of author's restoration techniques. The variety of proposed methods confirms the urgency of the problem of creating highly aesthetic restorations that take into account the age and individual characteristics of the patient's teeth.

### PREPARATION OF ANTERIOR TEETH CAVITIES

#### III CLASS (BLACK CLASSIFICATION)

##### 1. Gaining access.

Before the preparation, it is necessary to decide on which side to provide access to the cavity. We are guided not so much by the convenience of work as by the desire to preserve the maximum amount of unaltered enamel of the vestibular tooth surface. The edges of the cavity should be within the intact enamel, all affected, demineralized enamel must be excised.

Opening carious cavity III class can be carried out in various ways:

**A. Direct access** is provided in the absence of a neighboring tooth, if there is a cavity on the contact surface of the adjacent tooth, if there are spaces between the teeth (tremas and diastema) this access is technically possible.

The opening of the cavity by direct access is carried out with a diamond or tungsten ball-shaped bur of small size, removing the overhanging enamel margins, trying not to widen the cavity in the vestibular direction.

**B. Lingual access** is the most rational from the point of view of the subsequent aesthetic restoration of the tooth. It is used in the initial preparation of the cavities of the III class, especially with small size of the lesion, when it is possible to preserve unaffected enamel on the vestibular surface. Also, lingual access is possible if you need to replace the "old" restoration, which is located on the lingual surface of the tooth.

The opening of the cavity with this type of access begins in the projection of the carious lesion, having deviated from the tooth edge marginal by 0.5–1 mm. A ball- or pear-shaped diamond bur of a small size, is located perpendicular to the tooth surface. If possible, the trephine hole is displaced in the direction of the gum to avoid excision of the incisive part of the contact point.

After opening of carious cavity, we should protect the adjacent tooth with a metal matrix strip (Fig. 1) and the contact wall is cut by a pear-shaped or spherical diamond bur.

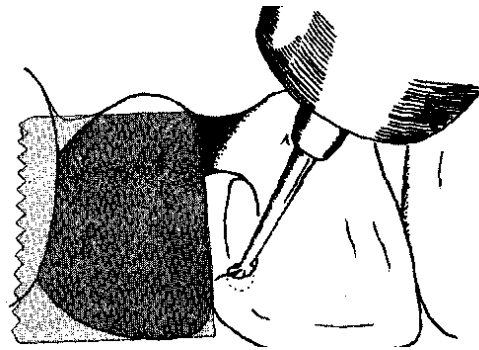


Figure 1. Opening of the class III cavity (lingual access): excision of the contact wall with protection of the adjacent tooth by a metal matrix strip

**C. Vestibular access** is simpler but undesirable from the point of view of further aesthetic restoration of the tooth. It is used in the case when the carious process captures a significant part of the vestibular tooth surface with a vestibular enamel defect. If you need to replace the “old” filling located on the vestibular surface, preparation and filling of the cavity is carried out through vestibular access.

**Widening the cavity.** Prophylactic widening of Class III cavities, as a rule, is carried out in a minimal volume, since caries susceptible areas on the front teeth is small and is usually limited by the zone of the contact point and the site located between the contact point and the neck of the tooth. In each specific clinical situation, the dentist must make an optimal decision, taking into account the aesthetics, preventive feasibility and residual mechanical strength of the tooth tissues.

There are the following recommendations:

- for preventive widening, tooth tissues are cut at the point of contact of the gingival margin of the cavity with the adjacent tooth. The incisive part of the contact point, if possible, is preserved. It is necessary to limit the widening of the cavity towards the cutting edge;

- if the lingual surface of the tooth has a deep, pigmented blind fossa and between it and the carious cavity of less than 1 mm of unaffected tooth tissues, the contact cavity is expanded and the area of the blind fossa is included;

- the cavity is not widened in the vestibular direction. The optimal location is the vestibular boundary of the cavity in the interdental space without reaching the vestibular surface of the tooth.

## 2. Removal of caries.

When preparing cavities of class III:

- removal of all demineralized enamel and softened and pigmented dentin is dictated by the need for subsequent aesthetic restoration of the tooth;

– necrectomy, especially in the area of the pulpal wall (bottom) of cavity should be carried out very carefully due to the proximity of the pulp and the danger of accidental opening of the cavity of the tooth.

### **3. Development of the final form.**

If the cavity was prepared by direct access, it has the shape of a triangle, the base facing the gingival margin.

If the cavity is prepared with lingual or vestibular access, it has a more complex configuration. The basic rules for cavity formation in such situations are as follows:

– the pulpal wall of the cavity penetrates into the dentin by no more than 0.5 mm. To remove the softened dentin, a local bottom deepening is carried out in separate areas;

– during cavity formation, the tooth tissues should be preserved as much as possible from the vestibular surface and from the side of the cutting edge;

– vestibular enamel, even without the underlying dentin, is maximally conserved. Vestibular enamel is removed if it has signs of demineralization or a crack;

– if only a thin strip of enamel is left on the cutting edge after necrectomy, without underlying dentin, it is removed by transferring the cavity to the IV class;

– if the doctor decided to excise the blind fossa and connect it with the contact cavity, an additional support area is formed. In this case you must follow certain rules.

The gingival wall of the support area should be located at a distance of 1–1.5 mm from the gingiva, perpendicular to the longitudinal axis of the tooth. A support area is made with a width of 1.5–2 mm, a depth of 1–1.5 mm. It should be located as far as possible from the cutting edge, so as not to weaken the tooth tissue. During preparation it is necessary to save enamel crest on a palatal surface of a tooth as much as possible;

– in case of lingual location of the cavity, the uniform bevel of the enamel is made on the oral wall at an angle of 40–45°, the width of the bevel is 0.2–0.5 mm (Fig. 2, *a*). Enamel on the contact surface is slightly beveled by diamond-coated strips. The point of contact of the incisal wall with the adjacent tooth is kept as much as possible, the bevel is not made on this site;

– in case of vestibular location of the cavity, a wide bevel at least 2 mm width is made on the front surface of the tooth. In the gingival region it becomes deep, on the entire thickness of the enamel, to the cutting edge the depth of the bevel decreases. To achieve the best aesthetic result, the contours of the bevel are made wavy (A. V. Salova, V. M. Rekhachev, 2003) (Fig. 2, *b*). Enamel on the contact surface is slightly beveled by enamel knives or strips;

– in case of large size of the carious lesion and destruction of the enamel both from lingual and from vestibular surfaces, a “through” cavity is formed

with maximum preservation of the vestibular enamel (Fig. 2, *c*). The bevels of the enamel on the lingual and vestibular walls are made according to the recommendations described above.

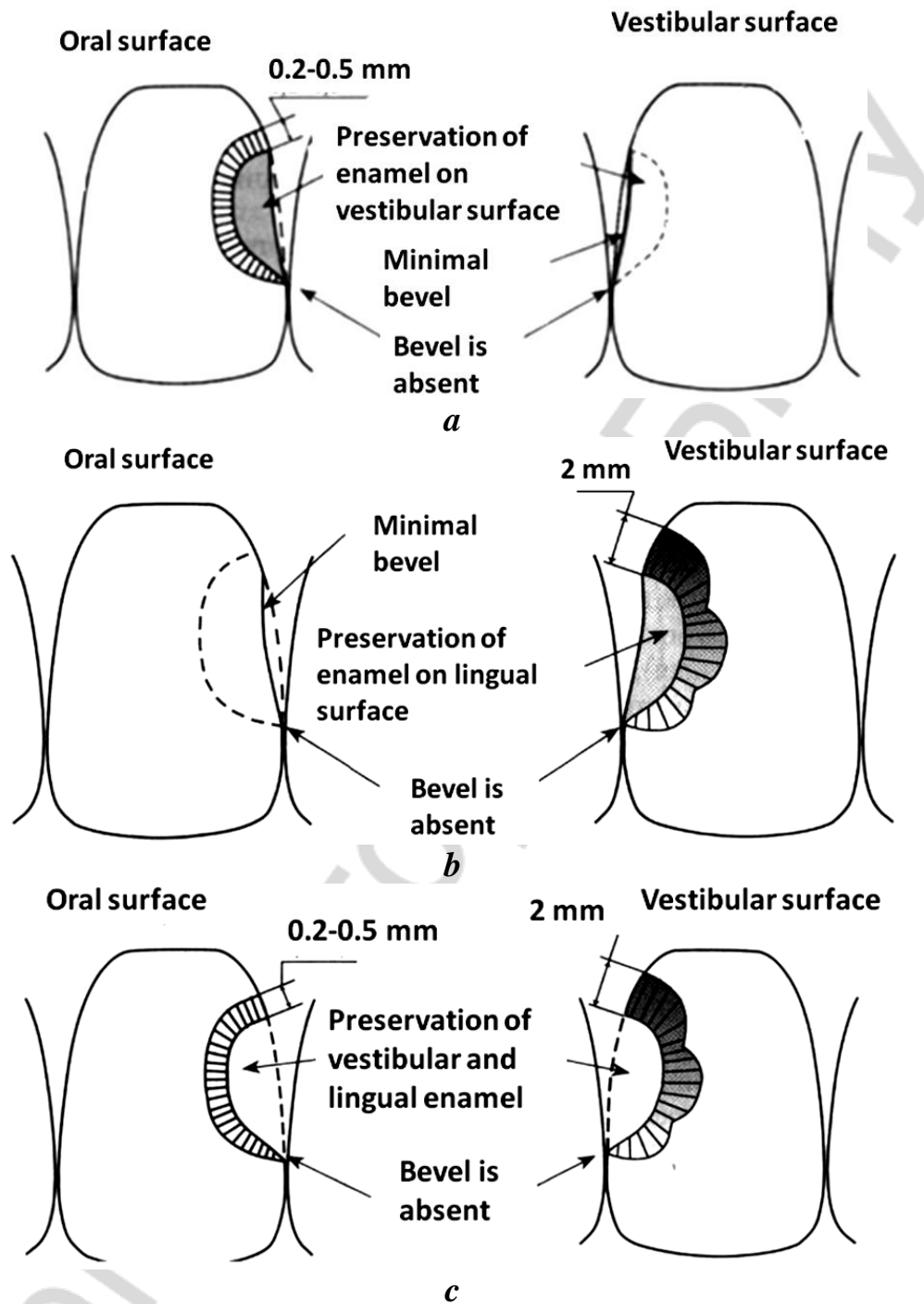


Figure 2. Creation of enamel bevel in cavities class III

Finishing the enamel margins.

Fine-grained diamond burs or carbide-tipped 20–32-fluted finishes not only grind the top layer of the enamel, but also achieve smoothness of the surface. It is believed that this treatment improves the marginal adherence of the filling

and optimizes the refraction and reflection of light at the border of the composite with the tooth tissues, which allows preserving the natural transparency of the tooth tissues and making the “composite-enamel” border invisible.

#### CLASS IV (BLACK CLASSIFICATION)

Despite the improved mechanical and adhesive properties of composite materials, the restoration of the anterior teeth with a large loss of hard tissues does not have sufficient strength and durability. It should also be noted that a number of insurance companies working with dental clinics on the principle of voluntary medical insurance limit the indications for direct composite restoration of the loss of hard tooth tissues by not more than 1/3 of the crown volume. In the conditions of “hard” financial and legal relations between the doctor and the patient, this restriction should be recognized as correct and justified. Therefore, when choosing the tactics of preparation and restoration of the cavities of Class IV, it is rational to adhere to the following indications:

- fracture of the crown less than 1/3 — composite restoration;
- fracture of the crown less than 1/2 — composite filling (veneer);
- destruction of the crown more than 1/2 — crown (metal, ceramic, etc.)

(Fig. 3).

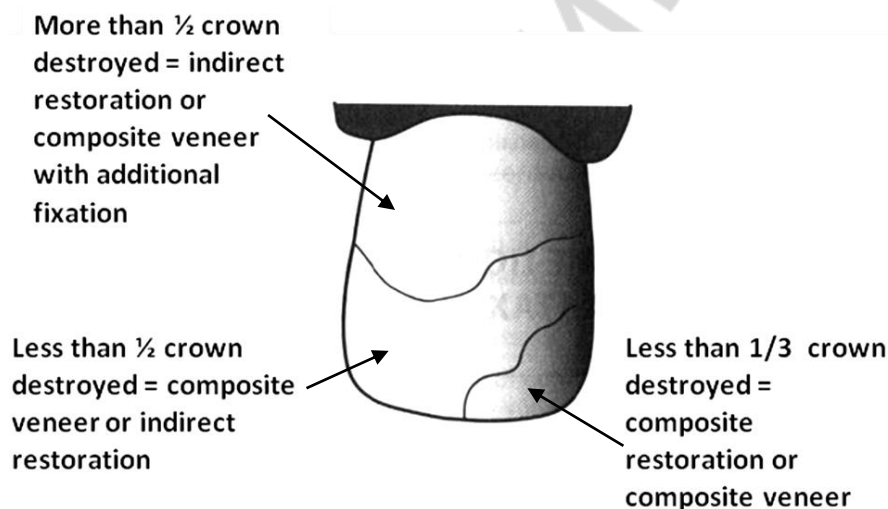


Figure 3. Choice of tactics for restoration of the anterior teeth, depending on the size of destruction of the crown part of the tooth (diagram)

These indications are valid in cases favorable for making direct composite restorations: absence of abnormalities and deformities of bite; absence of dentition defects, resulting in increased stress on the teeth to be restored; absence of other contraindications to direct composite restoration.

#### 1. Gaining access.

**A. Vestibular** access is the most common and allows creating optimal conditions for aesthetic restoration of the tooth and micromechanical retention of the restoration. The opening of the cavity is carried out through an enamel



defect on the vestibular surface, not only demineralized enamel is scraped, but also tissues that complicate the subsequent aesthetic restoration of the tooth. For example, to subsequently make a full, “aesthetic” bevel enamel, at this stage externally unchanged enamel, not having underlying dentin is exised from the vestibular wall. If the “old” restoration located on the side of the vestibular surface is replaced, the cavity is also prepared through vestibular access. All the old filling material must be removed.

The opening of the cavity is made with a diamond ball- or pear-shaped bur of small size.

If the defect of hard tissues is localized primarily from the lingual surface and the vestibular enamel in the area of the cutting edge can be preserved, direct or lingual access are used.

**B. Direct** access, as well as in cases of class III cavities, is performed in the absence of an adjacent tooth, if there is an adjacent cavity on the contact surface of the adjacent tooth or if there are tremas and diastema between the teeth that make this type of access technically possible.

**C. Lingual** access is used when it is possible to save a significant amount of unaffected enamel on the vestibular surface of the tooth crown. However, it should be remembered that in some cases, the preservation of vestibular enamel, which does not have underlying dentine, worsens the final aesthetic result of restoration. Therefore, the doctor makes decision on need of lingual access individually, taking into account the clinical situation, his experience and the possibility of further aesthetic restoration of the tooth.

**D. Incisial** access (through the cutting edge) becomes possible when, as a result of abrasion of the cutting edge of the tooth, access to the contact carious cavity (physiological or excessive attrition) is made possible. In this case, the class III cavity “passes” into the IV class not due to the spread of the carious process, but due to the decrease in the height of the crown of the tooth (Fig. 4), the enamel from the vestibular and lingual surface is, as a rule, intact.

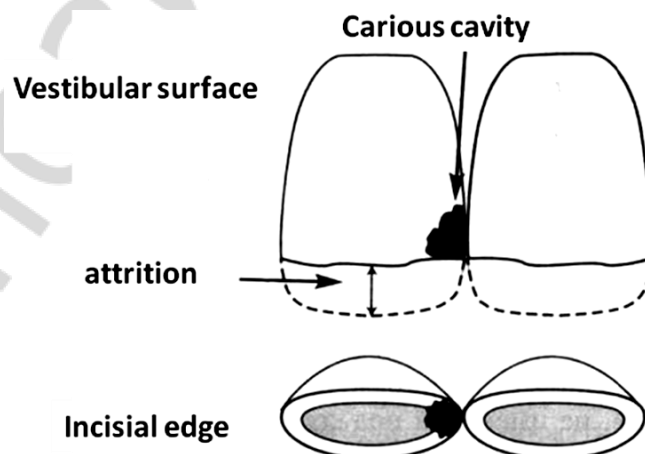


Figure 4. “Transformation” cavity III class in the IV class due to the abrasion of the cutting edge of the anterior tooth

The opening of the cavity in this case is carried out with a thin fissure bur through a wide, worn out cutting edge, trying to preserve as much as possible the enamel from the vestibular and lingual surface.

### **Prophylactic widening.**

For preventive purposes, it is recommended to excise only the enamel at the point of contact of the gingival margin of the cavity with the adjacent tooth (Fig. 5).

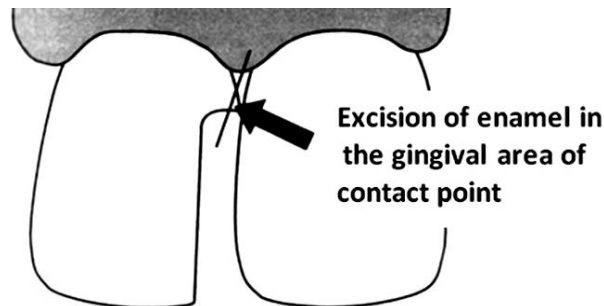


Figure 5. Features of preventive widening of the IV class cavity

## **2. Removal of caries.**

It is necessary to remove not only softened, but also pigmented dentin. Also remove intact vestibular enamel, which does not have dentin under it.

Formation of the cavity.

It is believed that the reliable fixation of the restoration due to the adhesive properties of the composite provides the bevel of the enamel, over an area 2 times greater than the area of the defect (Fig. 6).

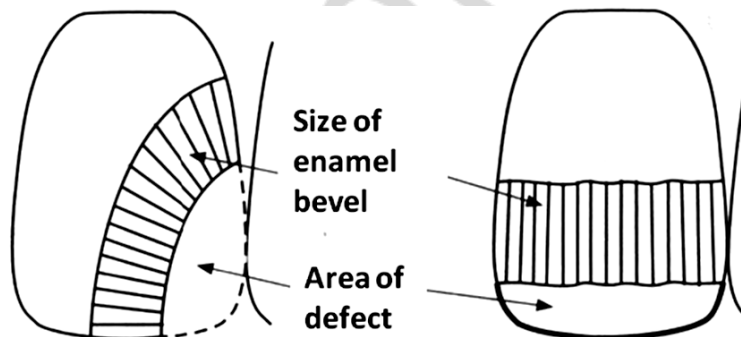


Figure 6. Ratio of the area of the enamel bevel and the area of the defect

*First option.* In case of vestibular access, the bottom of the cavity becomes convex, the pulpal wall of the cavity penetrates into the dentin by no more than 0.5 mm. The angle between the gingival and the pulpal walls of the cavity becomes straight or sharp and slightly rounded (Fig. 7). To enhance macromechanical fixation, it is recommended to do retentional groove on the border of pulpal and gingival walls from the vestibular to the lingual surface. In the case of a destruction of 1/4 of the tooth crown, with preservation of more than half of the cutting edge on the vestibular surface, an enamel bevel 4 mm

wide with wavy contours is made, and a concave bevel 2 mm in width is prepared on the palatal wall (Fig. 8, *a*).

In the case of a destruction of 1/3 tooth crown and more than half of the cutting edge, the remaining cutting edge is shortened by 2 mm (Fig. 8, *b*). On the vestibular surface, a 4 mm enamel bevel with a wavy contour is made, and a concave bevel with a width of 2 mm is prepared on the palatal wall.

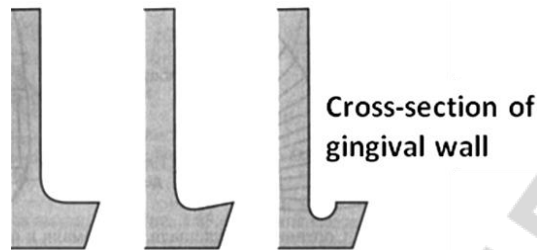


Figure 7. Variants of the formation of the angle between the gingival and pulpal walls in the cavities

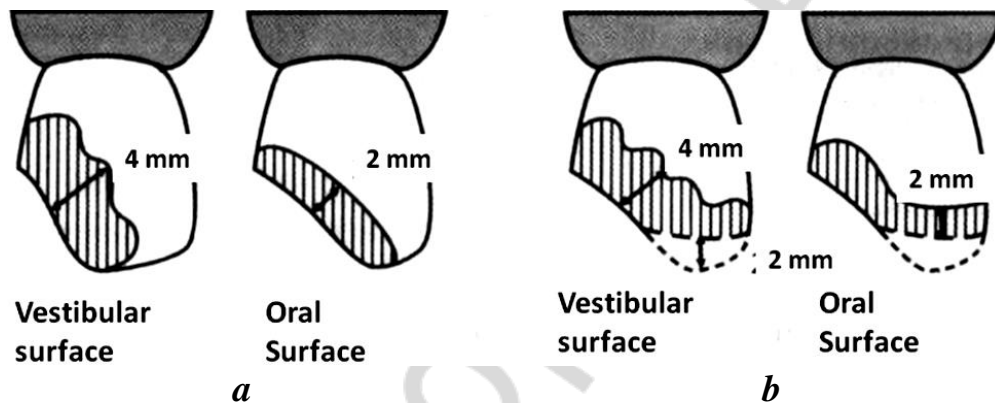


Figure 8. Creation of an enamel bevel in case of defect of 1/4 of the tooth crown with (*a*) or without (*b*) preservation of more than half of the cutting edge (A. V. Salova, V. M. Rekhachev, 2003)

*The second option.* In the case of lingual access, vestibular enamel, even without the underlying dentin, is saved. Pulp wall of the cavity is deepened into the dentin by no more than 0.5 mm. The angle between the gingival and pulpal walls of the cavity is straight or sharp and slightly rounded. To enhance macromechanical fixation, it is recommended to do retentional groove on the border of pulpal and gingival walls from the vestibular to the lingual surface. The enamel on the vestibular and contact surfaces is slightly grinded by fine-grained burs or metal strips.

*The third option.* If the cavity was prepared through incisial access, the enamel on the vestibular and oral surfaces is preserved. The angle between the gingival and pulpal walls of the cavity is straight or sharp and slightly rounded. Enamel on the contact surface is slightly grinded with fine-grained burs or metal strips. The point of contact with the adjacent tooth, if it is preserved, is not excised, the bevel on this site is not made.

*The fourth option.* If the defect of the tooth tissues is from 1/3 to 1/2 of the crown volume, a preparation is made for the veneer. Making veneer allows to achieve an aesthetic result easier, and long-term results are better. The excision of the vestibular surface in this case is more radical. Removal of all enamel (without underlying dentin), as well as all the old fillings are made. The depth of excision of hard tissues from the vestibular surface of the tooth crown is 0.3–0.6 mm. Special depth markers are used for accurate preparation. First, these burs are sawed grooves of a given depth in the enamel (Fig. 9), and then the cylindrical burs dissect the tissues which remain between the grooves.

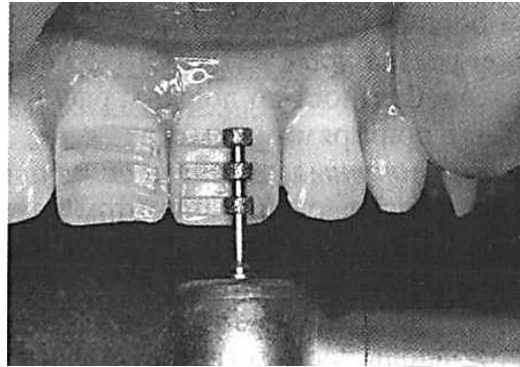


Figure 9. Making of grooves on the vestibular surface of the tooth crown with a bur-marker of the depth

The borders of the veneer with the tooth tissues should be located in areas that are invisible during direct examination. On the approximal surfaces it is important to keep your own tooth tissues in the lingual part of the contact point. In the gingival region of the approximal surface, it is recommended to create a depression in the form of a “dog’s” leg [1] (Fig. 10). The border of the veneer on the approximal surfaces is formed in the form of a groove (concave bevel).

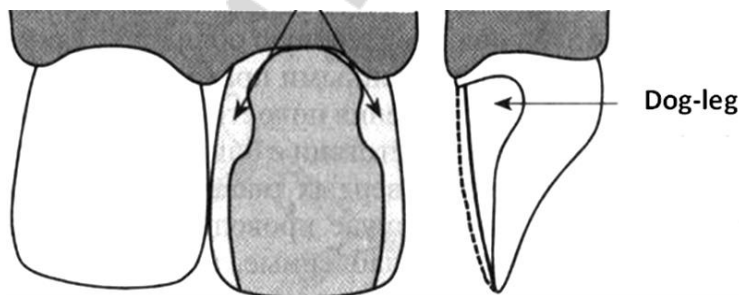


Figure 10. Formation of a depression in the form of a “dog-leg” (dog-leg) when the tooth is prepared under a straight composite veneer (I. K. Lutskaya, A. S. Artyushkevich, 2000)

The gingival margin of the veneer is located at the level of the gingival margin or 0.1–0.3 mm below (within the gingival groove). To conduct the preparation and filling below the level of the gingival margin, it is necessary to perform a retraction of the gum before adhesive preparation. For these purposes, retraction threads, special pharmacological preparations or mechanical

retractors of the gum are used. It should be noted that the optimal location of the veneer border is at the gum level, as when the border is located under the gum it is difficult to ensure the dryness of the operating area, to make qualitative finishing subgingival margin of the veneer. Usually, a rounded ledge, a flat notch or a smooth transition to the tooth neck are formed in the gingival region (Fig. 11).

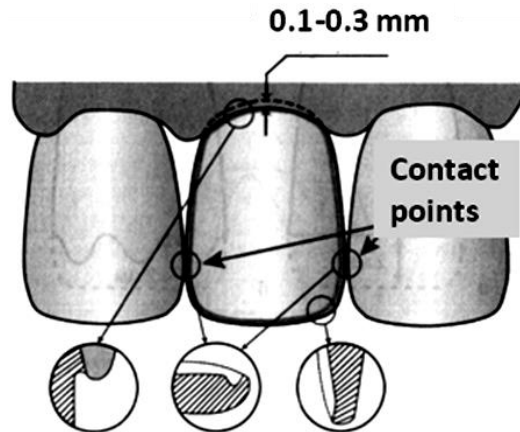


Figure 11. Formation of the composite veneers margins

The incisal border is made along the cutting edge. If less than half of cutting edge length destroyed, remaining part of cutting edge is saved. If more than half of cutting edge destroyed, the remaining cutting edge is shortened by 2 mm. The shortening of the cutting edge can also be carried out according to aesthetic indications.

On the palatal surface a concave bevel with a width of 2 mm is formed. In this case, the palatal surface is also prepared in such a way as to create a space for a composite of at least 1.5 mm. The corners must be rounded.

Finishing the enamel.

The step is carried out by fine-grained diamond burs or 20–32-fluted bur over the entire surface prepared.

#### **CLASS V (BLACK CLASSIFICATION)**

The preparation of class V cavities is described in the instruction manual “Restoration of posterior teeth”.

#### **CLASS VI (BLACK CLASSIFICATION)**

According to the addition to the Black classification, class VI cavities localized at the cutting edge of incisors and on the tips of cusps of canines, premolars and molars. A feature of cavities in this region is cutting edge in the form of a groove with a slightly narrowed bottom (Fig. 12). Its depth should be 1.5–2 mm. We strive to preserve all the enamel margins of the incisor’s cavity. Sometimes, to ensure the location of the filling at the level of the walls of the cavity, the tooth antagonist is grinded.

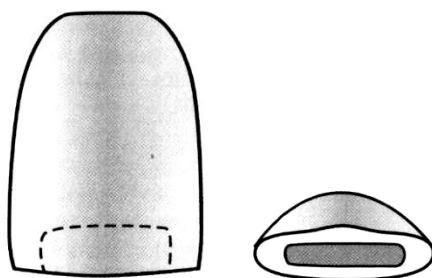


Figure 12. Class VI cavity

The cavity is finished according to the rules described above.

## STAGES OF ANTERIOR TEETH RESTORATION

**The sequence of the Class III, IV (Black classification) cavities restoration:**

1. Selection 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. Installation of a metal strip to protect the adjacent tooth during preparation, installation of a wedge to protect the gingival papilla during preparation.

6. Preparation of the carious cavity.

7. Removal of metal strip, wedge.

8. Installation of the matrix and wedge, checking the density of the adherence of the matrix to the gingival wall (by probe).

9. Adhesive preparation.

10. Composite application and polymerization.

11. Removal of the matrix.

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

**The sequence of the Class V (Black classification) cavities restoration:**  
the sequence of Class V cavities restoration is described in the instruction manual "Restoration of posterior teeth".

**The sequence of the Class VI (Black classification) cavities restoration:**

1. Selection 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.

## CONCEPT OF ANTERIOR TEETH RESTORATION

### Planning the construction of restoration.

#### A. *Anatomical diagnosis* includes:

- evaluation of tooth size (for example, the width ratio of upper central and lateral teeth is 1 : 1.3 : 1.3 : 1, and the ratio of width and length of the incisors is 1 : 1.6–1.25, depending on the age of the patient);
- evaluation of the geometric shape of the tooth, which can be triangular, oval, square;
- evaluation of the morphological features of the tooth. The sign of the crown angle is that the angle formed by the medial surface and the cutting edge of the anterior teeth is sharper than the angle formed by the lateral surface and the cutting edge. A sign of the curvature of the crown is that the medial part of the vestibular surface of the crown of the tooth is more convex, and the distal one is more sloping;
- assessment of a macrorelief presence — vertical, horizontal grooves;
- assessment of a microrelief presence (periquimatis) — uniform throughout the crown, in the cervical region, absent;
- an estimation of a bare tooth root — is, is not present; symmetrical, asymmetrical;
- evaluation of a cutting edge shape. In women, the cutting edges of the upper incisors are rounded, with triangular spaces between them. In men, the cutting edges of the upper incisors are generally straight, their corners touching each other;
- assessment of the topography of contact points;
- evaluation of the occlusal relationship of the restored tooth.

**B. *Color diagnostics*** include assessment of the optical characteristics of the tooth and planning a method for imitating them with restoration materials.

Choosing the color of the teeth is carried out with the help of special colors. The scale “Vita” is considered universal.

1. Shade. According to some researchers, 95 % of the population have teeth of “A” shade. Less common shades are “B”, “C” and “D”.

2. Chroma (color saturation). From the lightest to the darkest within the shade of “A” they are arranged as follows: A1, A2, A3, A3.5, A4.

3. Hue. In vivo greatest opacity tooth has a tooth cavity, more in descending order prepulper dentin — mantle dentin — inner layers of enamel — cutting edge and outer layers of enamel.

When conducting color diagnostics, it is necessary to take into account such optical effects as opalescence, fluorescence and metamerism. The phenomenon of metamerism lies in the fact that different materials and tissues have different colors under different lighting conditions. To date, no material has been created whose color would ideally match the color of the tooth

tissue under any lighting conditions. Therefore, in complicated cases, the selection of shade of the restorative material and lighting of the environment should be made taking into account the lifestyle of the person, either in daylight on a sunny day, or under incandescent lamp, or under mild UV light in a darkened room. It is recommended to conduct color diagnostics under various lighting conditions, taking as a basis neutral daylight.

The definition of color includes the following steps:

- choosing the basic shade of the tooth and its chroma/saturation;
- an estimation of individual color features: a shade of a tooth neck, a cutting edge, contact surfaces;
- assessment of transparent areas topography. The most common are four types of transparency areas localization:
  - a) the enamel is uniformly transparent in all parts of the crown;
  - b) pronounced transparency of the proximal surfaces;
  - c) only cutting edge is transparent;
  - d) a transparent cutting edge and proximal surfaces;
- presence of cracks in the tooth: a) light; b) pigmented;
- individual color features of the tooth (spots with hypoplasia, fluorosis, etc.).

It is allowed to conduct color diagnostics and under artificial lighting (fluorescent lamps). There are also special devices to ensure optimum illumination of the teeth during color diagnostics, for example, “Demetron Shade Light” (Kerr).

Color diagnostics with the halogen lamp of a dental unit, as a rule, leads to a selection of a lighter shade. A vivid coloring of interior items causes distorted color perception. The color of the surfaces of the walls, ceiling, floor and curtains in the office should be neutral light gray or pale blue shades. In this case, interior decoration materials of light tones with a reflection coefficient of at least 40 % should be used.

The tooth should be moist during choosing the color, the shade samples should also be moistened with water. Optimal background for choosing color is gray, to this end, the firm “Heraeus / Kulzer”, for example, completes his materials by special gray plates with slot — “Pensler Shields”. The set of composite materials, as a rule, includes its own coloring.

Usually, color templates are arranged in a color scale, for example, A1, A2, A3, A4, B2, B3, etc.

It is convenient to arrange templates in a chromatic order, i.e. by the saturation of the shades in the following sequence:

B1	A1	B2	D2	A2	C1	C2	D4	A3	D3	B3	A3,5	B4	C3	A4	C4
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Furthermore, there is a letter encoding of filling material colors, which is either used alone or complements shade samples by colors not provided scale



“Vita”, e.g., DYD (Dark Yellow Dentin) — dark yellow dentin, CG (Cervical Grey) — cervical gray, XL — very light, etc.

There are three color zones of the crown part of the tooth, differing in shade and opacity: cervical region, body, and the region of the cutting edge.

Most modern composites are available in three degrees of opacity: enamel, dentin and cutting edge. Enamel shades are universal. To restore small defects of hard tissues, often enough one “enamel” opacity of material. In case of big restorations, dentin is restored with a dentine material, the cutting edge is with a transparent one. Then the shape of the tooth is restored with a material that simulates enamel, taking into account the transition of colors (Table 1).

Table 1

Transition of colors

Cervical third of a crown	A2	A3,5	C4	C3	B4	C4	C4	C4	C4
Body	A1	A2	A3,5	B2	B3	C2	C3	D2	D3
Cutting edge	B1	C1	C1	B1	C2	C2	D3	C1	C1

After choosing the main color of the tooth (body) with the help of the “Vita” coloring the color of the neck and the cutting edge is selected according to the table.

The intensity of the restoration color depends on its thickness, so many manufacturers make color templates of different thickness. In color diagnostics, the thickness of the color templates should correspond to the thickness of the restored area of the tooth.

Thus, for aesthetic restoration with the “traditional” approach, usually 1–2 opaque shades, 3–4 shades for the restoration of enamel and 1 transparent for the restoration of the cutting edge, i.e. 3–7 components of different colors and degrees of opacity are needed (Fig. 13).

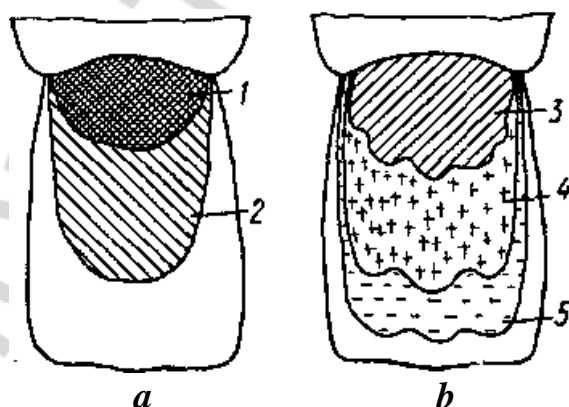


Figure 13. Scheme of composite layers application in veneer:

*a* — in-front cut; *b* — sagittal cut;

1 — opaque dark; 2 — opaque light; 3 — enamel dark; 4 — enamel base; 5 — enamel light

There is a constant improvement of methods of aesthetic restoration of anterior teeth. In addition to the principle described above, the principle of biomimetics is proposed, the use of four degrees of opacity in aesthetic

restoration, the concept of layer-by-layer restoration (Dr. D. Dietschi), the stratification principle (Dr. L. Vanini), the use of silicone templates.

### PRINCIPLE OF BIOMIMETICS

According to the table of determining the transition of colors according to the plan of the restoration, corresponding to the B2 standard on the Vita shade scale, the neck should be restored with a shade of C3, the body — B2, the edge — B1, add a transparent hue and thus obtain a close equivalent of the color standard. However, in the crown of a natural tooth, the appearance of the neck, body and edge is determined by the different ratios of dentin and enamel. In a biomimetic construction, restoring artificial dentin and enamel with appropriate shades according to the topography of dental tissues, the necessary appearance is obtained in another way:

- neck — C3 = A3.5 opaque + B2 regular,
- body — B2 = A3.5 opaque + B2 regular,
- edge — B1 = B2 normal + B1 transparent.

Conversely, the combination in one construction of the Vita scale principle — “neck, body, edge — three shades” with a biomimetic approach, will lead to an error in the form of a darker neck and a brighter edge of the crown. Thus, the different appearance of the crowns of teeth and their parts can be obtained not through multi-color constructions, but by a biomimetic combination of only three shades corresponding to the basic dentin, the main and surface enamel.

#### **Restoration construction of the Class III (Black classification) cavity:**

1. Restoration of the main dentin.
2. Restoration of oral main enamel. In the area of the cutting edge, you can add a transparent shade in the teeth of high transparency.
3. Restoration of the vestibular main enamel.
4. Restoration of vestibular superficial enamel.
5. Restoration of proximal enamel.

#### **Restoration construction of the Class IV (Black classification) cavity:**

1. Restoration of prepulper dentin.
2. Restoration of the main dentin. The main volume of the cavity is restored by opak shade, leaving for the enamel space of about 0.5 mm along the oral, proximal and vestibular surfaces and about 1 mm along the cutting edge.
3. Restoration of oral main enamel. A space of about 0.5 mm for artificial surface enamel should be reserved on the cutting edge and it can be larger or smaller depending on the transparency of the crown of the tooth.
4. Restoration of oral surface enamel.
5. Restoration of the vestibular main enamel. One or two portions of a conventional transparency composite restore the main vestibular enamel. The mamelons, corresponding to the inner layers of the three rollers on

the vestibular surface of the crown, are modeled by a stunner. Mamelons should be elegant enough to not be seen in the completed restoration, but only guessed.

6. Restoration of vestibular surface enamel.

7. Restoration of proximal enamel.

**Restoration construction of the Class V (Black classification) cavities:**

1. Restoration of the main dentin.

2. Restoration of the main enamel is carried out in two portions with a rather thin layer.

3. Restoration of the main enamel.

4. Restoration of superficial enamel.

**Restorative construction of the Class VI (Black classification) cavities:**

1. Restoration of the main dentin. The dentin is restored by one to two portions in the usual topographical contours.

2. Restoration of oral main enamel.

3. Restoration of oral surface enamel. The main volume of the cutting edge is restored by two portions of the composite.

4. Restoration of the vestibular main enamel. The medial and lateral portions are applied in any order.

5. Restoration of vestibular surface enamel in one or two portions.

**THE CONCEPT OF USING FOUR GRADE OF OPACITY IN AESTHETIC RESTORATION**

The concept of using four grade of opacity in aesthetic restoration is based on the fact that the dentin of the tooth has different optical characteristics (color, opacity) at different depths. The area of the tooth cavity, the tertiary and prepulper dentin, for example, is lighter and opaque in comparison with the mantle dentin.

Four degrees of opacity is, for example, the material “Filtek Supreme XT”:

*Dentin* has maximum opacity;

*Body* has less opacity (close to the opacity of the outer layers of dentin and the inner layers of the enamel);

*Enamel* simulates the opacity of the surface layers of the enamel;

*Translucent* shades of very low opacity to simulate the transparency of the cutting edge.

In clinical conditions, the need for using the four-color restoration technique described above arises in about 5 % of cases, mainly with a significant destruction of the tooth crown and in young patients. In ordinary clinical cases (95 %), it is sufficient to use two- and even one-color technique.

In the material “Filtek Supreme XT” the Body shades are universal and they are intended for single-color technique of restoring small cavities.

“Filtek Ultimate Universal Restorative” (3M ESPE) has new shades and a new scale, has a unique patented wheel-selector for color choosing. Once you have decided on the basic hue on the Vita scale, the selector offers

recommendations for restoration with one shade, two shades, or a multi-color technique.

The concept of **layer-by-layer restoration** of the color and optical properties of the tooth was developed by Dr. D. Dietschi and implemented in the universal composite “Miris” (Coltene / Whaledent).

### **THE CONCEPT OF NATURAL LAYERS OF DR. D. DIETSCHI**

The concept of natural layers of Dr. D. Dietschi provides seven dentinal shades of the same color, the same opacity and differing in the degree of color saturation of S1, S2, S3, S4, S5, S6 and S7 (Shade 1, Shade 2, etc.). Enamel shades have three primary colors (white, neutral, ivory) and various degrees of transparency (low, medium and high). In addition, four special shades are provided for creating optical effects and specific characteristics.

Restoration of the tooth by the method of D. Dietschi is carried out in 3 stages: restoration of dentin, creation of special optical effects and characteristics, restoration of enamel.

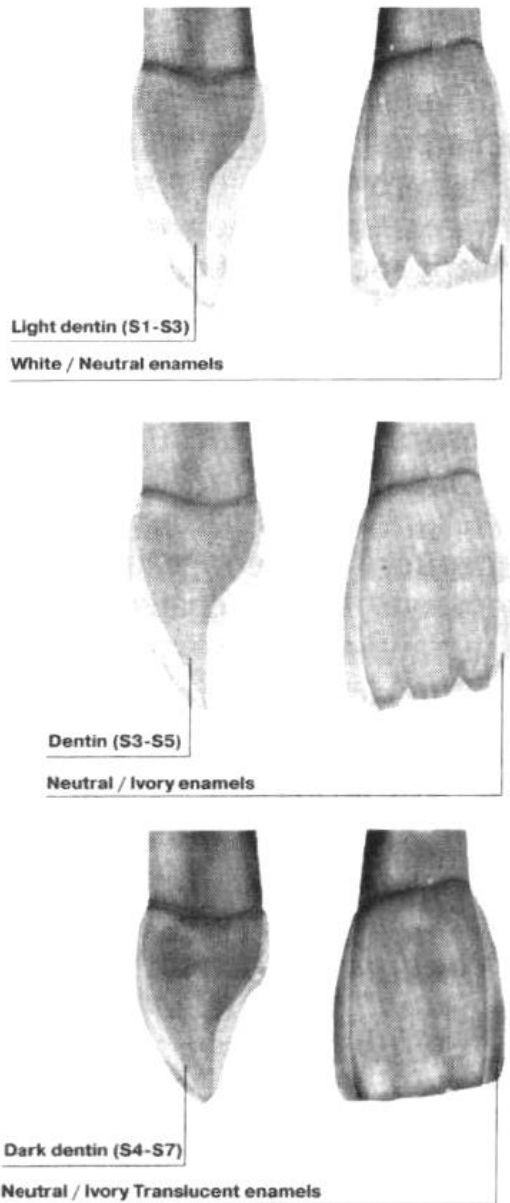
First You should choose the shade of dentin. The color of the dentin is recommended to be determined in the cervical region, where the enamel has a minimum thickness and practically does not affect the color of tooth. During the diagnosis, remember the “damping” effect of the enamel and take a darker shade of dentin. For example, when choosing a dentine shade of S3 according to the middle of the buccal surface, the underlying dentin actually corresponds to the shades of S4 or S5. The color of the dentin can be determined after preparation of the carious cavity, if the treatment was conducted with sufficient water cooling. The color and the grade of transparency of the enamel are selected according to the cutting edge and the contact surfaces of the tooth, where the dentin layer is absent or has a minimum thickness. After the individual selection of the shade of enamel and dentine with the help of the original scale, a color model of the tooth is made. To do this, an enamel template is applied to the dentine template of the selected color. Between them drop of glycerin is put a to more accurately match the characteristics of the refraction at the boundary of different shades. The obtained model is compared with the patient's teeth and, in case of a satisfactory result, they begin the restoration.

In addition, Dr. D. Dietschi describes various variants of age-related changes in teeth that should be considered when restoring teeth in patients of different age groups (Fig. 14).

To obtain a good aesthetic result of restoration, it is required to restore the individual characteristics of the patient's teeth (cracks, color spots, fluorosis, etc.).

Yu. A. Boldyrev describes a method of **simulating cracks**. The author recommends that at the final stage of restoration, when forming enamel layers, cut the composite mass sharply with a thin instrument, creating a step directed to the thickness of the tooth. On the side surface of this step a thin layer of

a composite dye of the appropriate color (transparent, yellow, brown, black) is applied and pressed with the next portion of the enamel mass. For a more natural reconstruction of the “old tooth” one can simulate several cracks parallel to each other on one tooth.



Young patients.

In the area of the cutting edge enamel exhibits a clear opalescent effect and the mamelons are completely covered with enamel. Dentin is light with a small number of variations.

Adult patients.

Enamel is less white, it is closer to neutral shades or the ivory color. Dentin can come out on the surface of the cutting edge due to physiological abrasion of the enamel. The dentin is darker.

Elderly patients.

Enamel is thinner and more transparent. On the cutting edge, the structure of the dentin looks like a “chipped wall”, the mamelons are barely discernible, they are separated by small depressions. Dentin is relatively dark.

Figure 14. Features of anatomical, color and optical properties of teeth, depending on the age of patients according to D. Dietschi

The color of the composite does not always match the color perfectly. Therefore, in case of doubt, it is recommended to use a “layout”. For this, the “pea” of the material of the selected shade is placed on the cleaned tooth. Its thickness should correspond to the thickness of the restoration. The material is cured and color matching is evaluated in different lighting conditions. Then the material is removed by smoother. If the color did not match, select another and repeat the modeling.

## **THE CONCEPT OF STRATIFICATION OF DR. L. VANINI (ITALY) (USE OF SILICONE KEY)**

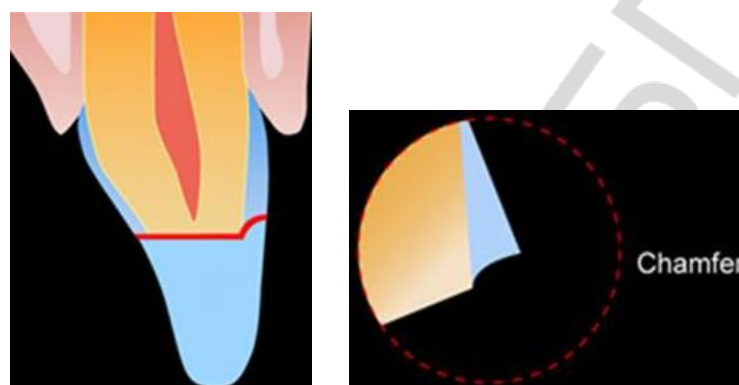
Dr. L. Vanini (Italy) [7] developed a technique for anatomical layering of the tooth, called stratification. The anatomical technique of stratification provides the construction of lingual enamel, internal dentinal body and vestibular enamel. Dr. Vanini is the creator of Enamel plus HFO, a micro-hybrid light-curing composite. The proposed restoration system makes it possible to reproduce all the optical effects of the cutting edge.

The Enamel plus HFO kit includes three main enamels (GE1-GE3), seven universal fluorescent dentines (UD1-UD7), two intense enamels (IW, IM), opalescent enamels (OBN, OG, OA, OW), which can emphasize internal incisal opalescences and mamelons, as well as special fluorescent coloring agents. In young patients, the most common shade is UD1-UD2, in adults — UD2-U3, in elderly patients — UD3-UD4. For restoration of teeth in elderly patients with a thin, transparent enamel of low brightness, the shade of the main enamel of GE1 is used. When restoring the teeth in adult patients with medium transparency and brightness of the enamel, GE2 shade is used. When restoring teeth in children with bright, thick, less transparent enamel, GE3 shade is used. Intensive white enamels are used to simulate individual features of the appearance of enamel (color spots, fluorosis sites). Opalescent enamels are designed to simulate the opalescence of the cutting edge and approximal surfaces. In addition, the kit includes the Glass Connector. It is a flowable composite that simulates a protein layer of natural teeth and six colors to restore individual characteristics. To determine the color, it is suggested to use the Enamel plus scale, completely made of a composite. The set also includes a special color card. This card will remain in the medical history, and in the future work the doctor can use it.

There are some features of the cavity preparation for the Enamel Plus HFO restoration. Preparation for this material is characterized by the possibility of maximum preservation of healthy tooth tissues and does not require bevel on the enamel. It is by increasing the width of the bevel and overlapping the larger surface of the enamel with a composite material that dentists often try to make the material transitions to the tooth tissues less noticeable and avoid the appearance of a gray band on the border between the filling and the tooth. In this case, at times, the restoration of extensive cavities of classes III and IV are transformed into the manufacture of veneers using a direct method. When preparing the tooth for Enamel plus HFO on the vestibular enamel and approximal surfaces, a groove is formed along the margin of the prepared cavity with a spherical bur, the palatal side is prepared at an angle of 90 degrees. This method of preparation is very sparing/gentle (Fig. 15).

After filling the color map, you need to get a silicone impression of the anterior teeth. After cutting the impression to the dimensions of interest, it is

necessary to check its adaptation (Fig. 16). After the preparation, the cavity is etched, the bond is applied and activated. After this, the main enamel (GE) is applied directly to the impression, protecting the composite from the light source, which can accelerate the polymerization. First, “palatal enamel” is applied, then interproximal one. After the creation of the palatal wall, the impression is removed and a transparent matrix and a wooden wedge are installed. The interproximal wall is constructed as follows. At this stage it is necessary to check the thickness, taking care not to exceed the thickness of the enamel layer by 0.4 mm, because this thickness is the best for controlling the difference in the refractive indices between the natural enamel and the enamel of the composite.



*Figure 15.* Preparation of the tooth for the Enamel plus HFO composite material



*Figure 16.* Fitting a silicone key

Silicone smoothers (Micerium) in addition to conventional smoothers are used during modeling. It gives a “finger effect”.

To restore the protein layer, it is necessary to apply a very thin layer of Glass Connector to the inner surface of the enamel sheet with a special brush, taking precautions not to touch the cavity boundaries, then perform polymerization. Glass Connector is a fluid milky white material with a high degree of fluorescence, which modulates the diffusion of light from the enamel to the dentin body.

After applying the Glass Connector, they begin modeling the dentinal body. To achieve the optimal saturation of the restoration, 3 colors of the main dentin are used. For example, if you want to finally get the color of A2 (by

Vita), you should start with UD4, then layer by layer, UD3 and UD2 (lighter). When building a dentine body, the first layer of dentin must have a stronger saturation than the base layer. The dentin body should create an internal chromatic composition with desaturation — a decrease in the intensity of the color from the cervix to the incisal area and from the palatal to the vestibular area. This can be achieved using segmental stratification of three different shades: from the top two to the final lower one.

Mamelons are modeled at the stage of overlapping the last dentin layer.

The finished dentine body is covered with a thin layer of Glass Connector.

To restore the opalescence of the enamel, opalescent enamel (OBN) is applied between the mamelons and in the area of the cutting edge. The mass of OBN in the grooves between the mamelons should be applied carefully. It must reach the incisor part above the mamelons to reproduce the shadow effect. This mass is applied with a flat brush. After that, if necessary, apply intensely white enamels (IM, IW), opalescent enamels (AO, OW) and paints to create individual features with small-area tools (Fig. 17).

The final stage is the application of the main enamel (GE3) — vestibular enamel sheet.

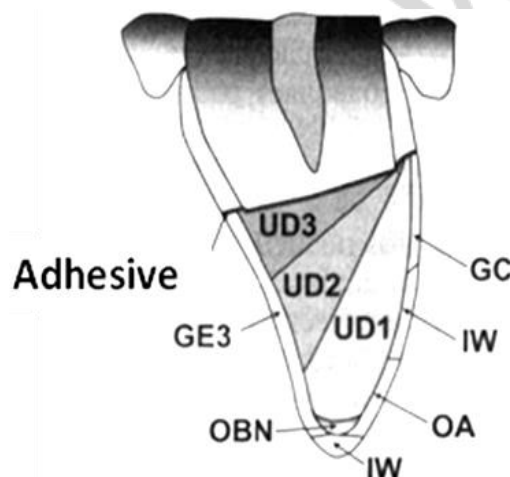


Figure 17. Example of aesthetic restoration of the anterior tooth with the material “Enamel plus HFO” using stratification technique according to the Lorenzo Vanini technique (scheme)

Nanocomposite “Ceram X” by “Dentsply” company also has its own coloring system.

“Ceram X mono” is a material for the creation of restorations of one opacity, having seven shades overlapping the “Vita” scale (Table 2). The material is designed for small restorations, when there are no increased requirements for aesthetics.

“Ceram X duo” has 3 enamel and 4 dentine shades. These shades also overlap the entire spectrum of the “Vita” scale (Table 3). Transparency of dentinal shades increases from D1 to D4, and from enamel shades increases from E1 to E3. Similarly, the color saturation increases.



Table 2

**Correspondence of shades of the material “Ceram-X mono”  
to the shades of the “Vita” scale**

“Ceram-X mono”	“Vita”
M1	A1, B1
M2	A2, B2
M3	C1, D2
M4	C2, C3, D4
M5	A3, D3
M6	A3,5, B3, B4
M7	A4, C4

Table 3

**Correspondence of shades of material “Ceram-X duo” to shades of the “Vita” scale**

“Ceram-X duo”	“Vita”
Duo enamel E1	B1, B2, C2, D4
Duo enamel E2	A1, A2, A3, C1, C3, C4, D2, D3
Duo enamel E3	A3.5, A4, B3, B4
Duo dentin D1	A1, B1
Duo dentin D2	A2, B2, C1, D2
Duo dentin D3	A3, A3.5, B3, B4, C2, C3, D3, D4
Duo dentin D4	A4, C4
Duo dentin DB-Bleach	Bleached teeth

To facilitate the selection of shades in the kits there is a self-adhesive correspondence scale for being glued on the reverse side of the “Vita” coloring.

“Ceram X duo” is designed to perform complex restorations, when higher demands are placed on aesthetics.

Composite “Synergy D6” of the company “Coltene/Whaledent” also has its own coloring system. There are six shades of dentin and one additional (WB, BL/O, A1/B1, A2/B2, A3/D3, A3,5/B3, C2/C3) and enamel “Enamel Universal” for middle-aged patients, “Enamel White Opalescent” for young patients.

For the restoration of cavities near gingival margin, if necessary to restore the contour of the gum line, for example, in case of localized gingival recession, “VOCO” produces a light-curing composite of pink color called “Amaris gingiva”. The set of the material includes three pink-burgundy opaque shades of a fluid consistency of different saturation, as well as a paste-like composite of pink color to create a surface layer of restoration.

**Method of restoration of teeth with composites using a silicone template.**

A silicone template (silicone, occlusal key) is required to accurately reproduce the anatomical shape of the tooth, especially the palatal surface. It is used for restorations of upper incisors and made from ordinary A-silicone, directly in the oral cavity. Impression should grasp the cutting edge of the restored tooth and one adjacent tooth for support. The impression is cut along the line formed by the cutting edge.

Stages of tooth restoration using a silicone template:

1. Selection the color of hard tooth tissues.
2. Direct (mock-up) or indirect (wax-up) modeling of the tooth shape.

The wax-up technique (reproduction of the form of teeth on the model using wax) is performed with mandatory verification of occlusal relationships. Based on wax-up, a silicone key is produced, which allows reproducing the palatal surface of the teeth in accordance with occlusion.

The mock-up technique (model in full size) is modeling the anatomical shape of the tooth directly in the oral cavity of the patient. It is carried out to determine the optimal shape of the teeth, taking into account the need to increase their size and reduce the width of the interdental spaces. It is recommended to apply a composite material, the color of which differs from the original color of the teeth. It is necessary to pay special attention to modeling the shape of the palatal surface, without which it is impossible to produce an appropriate impression.

3. Removing the palatine silicone impression and making a silicone template for the palatal surface of the restoration. If the tooth was previously restored, this stage is carried out before the removal of the existing restoration.

4. Removal of the restoration and composite materials that were used for the mock-up procedure. Preparation of the carious cavity. According aesthetic requirements, pigmented tissues should be removed. The bevel of the vestibular surface of the enamel is formed for the imperceptible transition of color from the restoration material to the tooth tissues.

5. Cleaning the tooth with rotating brushes and abrasive pastes.

6. Re-selection of the color of hard tooth tissues.

7. Isolation of the tooth from saliva, adhesive preparation.

8. Application of the composite of the enamel shade to the cutting edge of the silicone matrix. The prepared silicone template is fixed on the palatal surface of the tooth. The base layer of the enamel shade is created first on the palatal surface. Thus, the palatal template forms the basis for the application of subsequent layers of composite material.

9. The matrix is installed and fixed with a wedge. Then the basic shade of the enamel is applied.

10. The dentine shade is applied layer by layer to the formed palatal surface. The structure of the tooth is restored successively from the oral surface to the vestibular one. At this stage, the modelling of specific anatomical formations, for example, mamelons, is begun.

11. The restoration is completed by the application of the enamel shade, which has the same tone as the palatal and approximal layers.

Creation of the **anatomical features** of the tooth during restoration is a complex and responsible process. The first stage is modeling the basis of restoration — contours of the geometric form of dentin, including mamelons at

the cutting edge and a clear designation of the lateral and lower boundaries of the dentine layer. At the second stage, the dentist forms the signs of tooth characterizing the left or right side. The sign of the *angle* is that the angle formed by the mesial surface and the cutting edge of the anterior teeth is sharper than the angle formed by the lateral surface and the cutting edge. The sign of the *curvature of the crown* is that the medial part of the crown is more convex than the lateral part. To compare the expression of these features with those of the neighboring teeth, with the lateral surface of the pencil lead you can draw the edges of transition of the vestibular surface into lateral surfaces, and by dividing the resulting central segment by one third, check the length of the resulting lines using calipers (Fig. 18). If necessary, carry out a correction to achieve similarity to the neighboring tooth. The third stage is the reproduction of individual tooth features, including the dentogingival contour, the shape of the cutting edge, the macro- and microrelief of the tooth crown. Macro-relief includes vertical and horizontal grooves. In Fig. 19 marking is used to form vertical grooves. Before the formation of the microrelief in the form of periquimatias, it is also possible to pre-coat the markings (Fig. 20).



Figure 18. Marking with a pencil and measuring the width of the crown

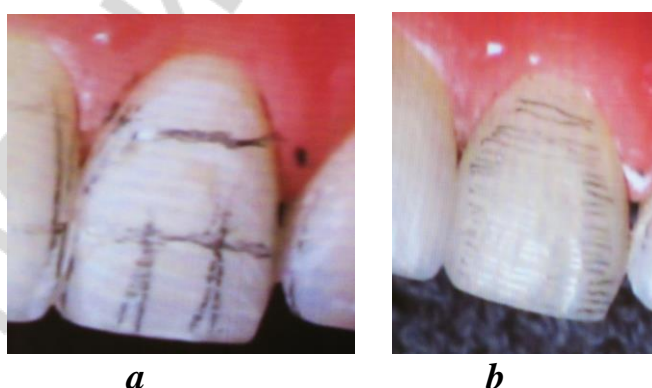


Figure 19. Marking on the vestibular surface of tooth 21:  
a — for the formation of groove; b — for the formation of periquimatias

## FABRICATED VENEERS FROM COMPOSITE MATERIALS

The Swiss company “Coltene” in 2011 introduced a system for the reconstruction of the anterior teeth called “Componeer” (set veneers) [9]. The system can be used to restore one tooth or a group of teeth. There are four types of veneers for the teeth of the upper jaw, two sizes for the anterior teeth of the lower jaw and two sizes for the premolars of the lower jaw. Each of the standard sizes is represented by three colors. To match the size of the package, there are special plastic transparent Contour Guide in the kit (Fig. 20).

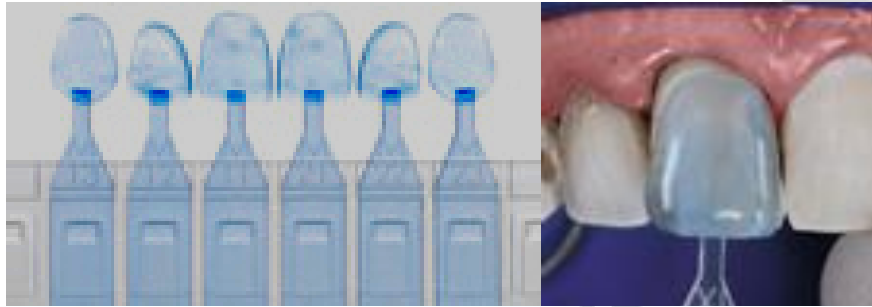


Figure 20. Contour Guide for determining the size of “Componeer”

The “Componeer” system is created from a polymerized under pressure, nano-hybrid material. This makes it easy to adapt the veneer to the size and shape using a high-abrasive polishing disc. The special feature of the Synergy D6 composite, which is used to fix the “Componeer”, is the creation color restoration due to dentine. In the cervical region the veneer has a thickness of 0.3 mm, in the region of the cutting edge it is 0.7 mm. The combination of the shades of the dentin and the veneer allows to achieve a realistic type of reconstruction. The use of fabricated composite veneers relieves the dentist from the need to model the anatomical shape of the enamel plate, to control its thickness and symmetry, and also eliminates the risk of the appearance of vesicles and pores on the vestibular surface of the restoration.

Class V “Componeer” is a composite veneer system for successful restoration in the cervical region. There are four variants of the form in five color shades. The surface of the veneer is provided with a special holder.

Indications for the use of componeers [8]:

1. Change in tooth color (age, trauma, endodontic treatment).
2. Carious lesions and poor-quality restorations.
3. Diseases of non-carious origin associated with impaired development and formation of hard tissues of the teeth (fluorosis, tetracycline teeth, hypoplasia, imperfect amelogenesis and dentinogenesis, etc.).
4. Diseases of teeth that develop after eruption (abrasion, grinding, erosion, abfraction, etc.).
5. Tremas, diastema, discrepancy between the transverse dimensions of the teeth, slight rotations along the axis and / or inclinations of the teeth.

### Contraindications:

1. Occlusion disorders.
2. Parafunctions (bruxism).
3. Insufficient hygiene.
4. Inflammatory periodontal disease.
5. Significant amount of destroyed hard tooth tissues.

### Stages of restoration using the “Componeer” system:

1. Cleaning the tooth with paste and rubber cups, strips.
2. Preparation.
3. If necessary, correction of the “Componeer” form.
4. Fitting veneers (on a small portion of the composite).
5. Packing retraction thread.
6. Adhesive preparation of the tooth.
7. Application of the composite on the tooth surface.
8. Etching the inner surface of the veneer, applying the adhesive and composite to the “Componeer”.
9. Installation and adaptation of “Componeer”.
10. Removal of surplus composite.
11. Polymerization of the composite.
12. Finishing.

The company “Ultradent” introduced a system of fabricated composite veneers “Edelweiss”, sintered by a laser (Fig. 21) [10]. The selection the size of the veneer is carried out using templates printed on a transparent film.

Determination of the color of the dentine is carried out along the cervical third of the crown, the determination of the enamel color along the cutting edge. To determine the correct shade, the dentine insert is placed in a shell made of an enamel shade (Fig. 22).



Figure 21. Composite veneer



Figure 22. Selection of color for the manufacture of veneer

### Stages of using veneers:

1. Preparation of the tooth and correction of the veneer, creating roughness on the inner surface of the veneer with a sandblaster or diamond bur.

2. Etching the inner surface of the veneer for 5 seconds, adhesive preparation.
3. Installation of a transparent matrix, etching the tooth surface for 20 seconds, adhesive preparation.
4. Applying 1 cm of composite to the veneer from the capsule, the distribution of the composite along the inner surface of the veneer.
5. Placement of the veneer on the tooth. Removal of composite excess in the cutting edge area, polymerization for 3 seconds (6 seconds if the lamp power is less than  $600 \text{ mW/cm}^2$ ). Removal of any composite excess on the periphery of the veneer and polymerization of the medial and distal surfaces through a transparent matrix (the matrix must be stretched). Application of DeOx gel to the gingival margin of the veneer. Polymerization from the vestibular and palatal surfaces for 20 seconds (40 seconds, if the lamp power is less than  $600 \text{ mW/cm}^2$ ).
6. Finishing.

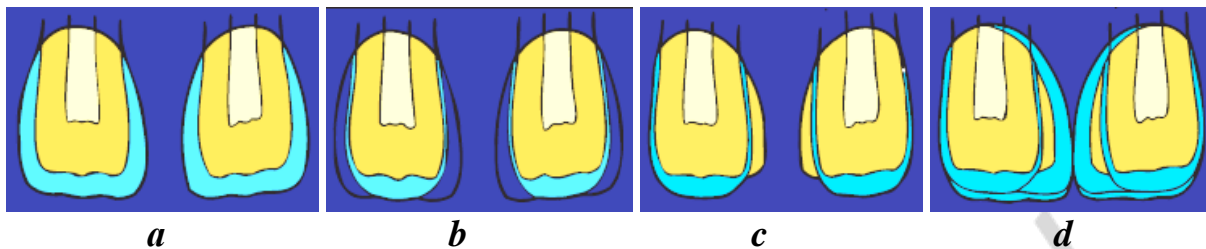
### **RECONSTRUCTION OF THE DENTAL ARCH AND TRANSFORMATION OF THE TEETH**

When working with the anterior part of the dentition, the dentist faces a variety of clinical situations. In addition to the restoration of carious defects, sometimes it is necessary to change the shape of the tooth crowns to harmonize the anterior part of the dentition.

Changing the position of any tooth entails correction of the shape of at least two adjacent teeth. And this is a task that goes beyond the restoration of the tooth, which can already be called the reconstruction of the dentition [4].

Indications for the reconstruction of the dental arch are the crowding of teeth, diastema/tremas or combined deformities. The key to describing or constructing an ensemble of four incisors and two canines is the smallest part of the dental arch — the transverse dimension of the lateral incisor. This value is taken as one (1.0). Starting from the transverse dimension of the lateral incisors, according to the golden ratio formula, it is possible to determine the size of the central incisors and canines, as well as the length of the anterior part of the dental arch. Conversely, knowing the length of the anterior part of the dental arch, using the magic number of the golden ratio ( $0.618 / 1 / 1.618$ ), it is possible to determine the transverse dimensions of all anterior teeth for an ideal aesthetic situation. To accurately measure the size of teeth, you can use a dental caliper with a 0.1 mm accuracy and the possibility of sterilization (manufactured by “Dental-Liga”, Germany).

An increase and a reduction of teeth crowns are the main types of changes in the shape of teeth in the reconstruction of the dentition with diastema/tremas and crowding (Fig. 23).



*Figure 23.* Elimination of the diastema:  
*a* — the initial situation; *b* — preparation; *c* — reconstruction of dentin; *d* — reconstruction of the enamel

### ELIMINATION OF TEETH CROWDING

In the initial clinical situation, when the total width of the teeth is greater than the length of the alveolar process, the close position of the teeth, as a rule, is combined with their rotation along the axis, vestibular or oral inclinations. In this situation, in addition to reducing the size of the crown part of the teeth, the dentist faces a serious problem of the effect of the reconstruction on the periodontal condition: first, in such cases localized gingivitis is associated with increased retention of plaque and difficult hygienic cleaning of closely located teeth is often observed; Secondly, the proximal surfaces of the neck of the teeth are so close to each other that wedging is possible only with very thin wedges (manufactured by “Hawe Neos”, Switzerland). With this wedging, the wedge often slips too deeply and causes damage to the interdental papilla. Third, the problem of the different heights of the visible necks of the teeth, which before the reconstruction were located at different angles, stands out. Operational preparation is carried out by removing the enamel to the estimated size of the crown and, if the enamel-dentine junction is opened, the dentin is additionally excised to a depth of 1 mm to create a space for artificial enamel.

In the case of such a reconstruction, there is no need to increase the volume of dentin, and therefore at the stage of its reconstruction only adhesive preparation with preliminary total etching and sealing of the surface by the adhesive system is carried out. The reconstruction of the enamel consists of its restoration along the oral and vestibular surfaces (neck, body, edge of the tooth) and the proximal surface with a transparent shade. To preserve the correct outline of the crown, an additional portion of the composite should be displaced laterally to the zenith of the tooth neck (zenith of the tooth’s neck is the highest point of the gingival curvature of the tooth crown. Its localization should be determined in an intact periodontium. Ideally, the zenith of the necks of the central incisors are located along the vertical axis of the tooth, and the zenith of the necks of lateral incisors are slightly displaced from the vertical axis in the lateral direction).

The main problem in the reconstruction of the anterior part of the dental arch is to know the degree of the increase (decrease) in the teeth crowns.

What size should the teeth have to correspond to the anterior part of the dental arch? To determine it, you need to perform the following steps.

1. To determine the length of the anterior part of the dental arch by any landmarks.

2. To determine the width of the lateral incisor according to the formula.

3. To determine the width of the central incisor according to the coefficient.

4. To check the correctness of the dentition calculation in the oral cavity.

Calculation of the dentition must begin with the definition of the length of the anterior part of the dental arch on which the four incisors must be located. For this, four measurements are usually carried out (by the number of incisors). The reference points can be any known landmarks: the preserved tooth edge, the root edge, the contact point on the proximal surface, etc. It is important to remember that the incisors are located with a small vestibular inclination, and if measurements were taken along the edges of the roots, the size of the crowns at the level of the contact points will be greater. Much depends on the determination of the starting points for determining the length of the dental arch — the medial contact points of the canine teeth. If the contact points of the canines are destroyed by a carious process or the canines are located at different distances from the center of the dentition, the reference points should first be determined, for example, to restore the contact points of the canines. In complex cases (lack or excess of space, significant asymmetry) the immaculacy of the incisive ensemble can be ensured due to asymmetry or a difference in the size of the canines. When the length of the anterior part of the dental arch is known, using the formula  $X = L / \sum kn$  we can determine the key dimension — the lateral incisor dimension (in formula X — the transverse dimension of the lateral incisor, L — the length of the anterior part of the dental arch, kn — the coefficients of proportionality of 4 incisors) based on the proportionality of the incisors. If the size of the lateral incisors is taken as X, the central incisors size will be 1.3X, and the sum of the coefficients of the four incisors will be 4.6X. Consequently, the denominator of the formula for calculating the dentition will always be equal to 4.6. It should be emphasized that the ratio of incisors 1.3 is obtained in most people with a visually proportional dentition. The transverse dimension of the lateral incisor found by the formula must be multiplied by a proportionality factor of 1:1.3 to obtain the transverse dimension of the central incisor. The sum of the transverse dimensions of the four incisors in millimeters (due to rounding in the calculations) should be approximately equal to the length of the anterior part of the dental arch, which was determined by four measurements by caliper along given reference points.

The dimensions obtained should be checked in the oral cavity by setting the transverse size of the checked tooth on the caliper and comparing this distance to the corresponding area of the dental arch. Such a check will allow



the dentist to model the future dentition and avoid random arithmetic errors. The reconstruction of the dentition is carried out symmetrically from the known medial contact points of the canine teeth (Fig. 24).

1. Reconstruction of lateral incisors and proximal contacts with canines.
2. Correction of lateral incisors to the calculated width.
3. Reconstruction of the central incisors and proximal contacts with lateral incisors.
4. Reconstruction of the central line.

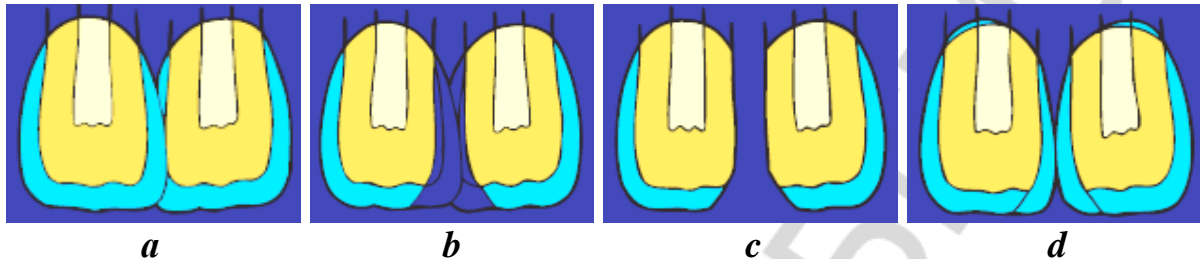


Figure 24. Elimination of crowding of teeth:

*a* — the initial situation; *b* — preparation; *c* — reconstruction of dentin; *d* — reconstruction of the enamel

S. Radlinsky [6] suggested applying the term the transformation of teeth to transferring of the crown of one tooth into the crown of anatomically different tooth using an adhesive or other technique.

#### TRANSFORMATION OF THE CANINE INTO A LATERAL INCISOR

*Initial situation.* The canine is distinguished from the lateral incisor primarily by the size: topographically greater thickness and dentin mass with insignificant differences in enamel thickness, which gives a distinct difference in the appearance of the canine from the incisors and premolars. The shape of the canine is characterized by a more or less pronounced tearing cusp, pronounced convexity of the vestibular surface, a practical absence of the palatine fossa, greater height of the zenith of the crown and a much larger neck size.

*Preparation.* Representing the topographic structure, the vertical, transverse dimensions and thickness of the lateral incisor, we can perform the following preparation: dissect virtually the entire enamel (you can keep the enamel on the neck from the vestibular and oral surfaces to form a better marginal fit), excise the dentin from all sides along the equator until a cylinder is formed and further excise the dentin to the thickness of the artificial enamel along the vestibular and proximal surfaces.

*Reconstruction of dentin.* The entire reconstruction of the dentin is reduced to adhesive preparation of the obtained topographic form of dentin and protection of its surface. It is possible to apply the technique of total etching with phosphoric acid and impregnation of dentin with an adhesive system of the fifth generation.

*Reconstruction of enamel.* The oral and vestibular surfaces of the crown are restored with the shades of the restorative material, imitating the main and surface layers of the enamel in the topographic boundaries of the lateral incisor. Then with transparent shade the lateral and medial proximal surfaces with the formation of optimal contact points and marginal fit are restored. It is necessary to try, as far as possible, to the minimum width of the crown in the neck area (Fig. 25).

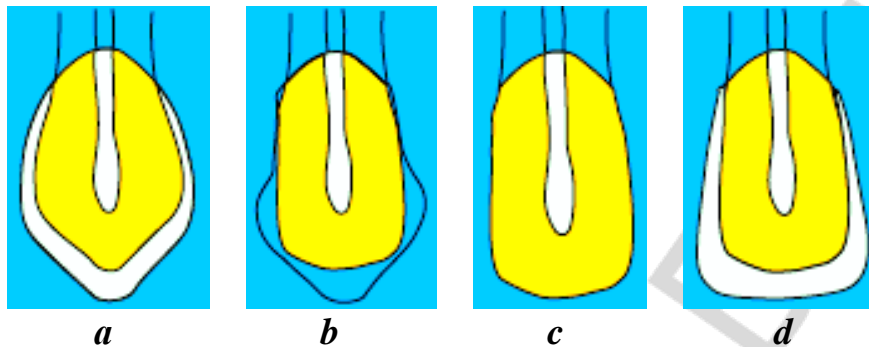


Figure 25. Transformation of canine into lateral incisor:  
*a* — initial situation; *b* — preparation; *c* — reconstruction of dentin; *d* — reconstruction of the enamel

#### TRANSFORMATION OF A PREMOLAR INTO A CANINE

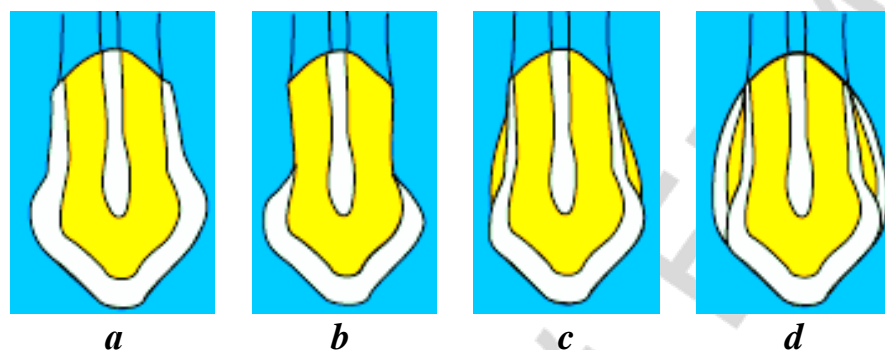
*Initial situation.* Premolars differs from canine primarily in their form. In the premolar, instead of one tearing cusp and an extensive palatal surface, like a canine, there are two cusps — a vestibular one and an oral one of a smaller size, which prevents the usual trajectory of the lateral occlusal path. The crown of the premolar has a pronounced “waist”, passing into the recess on the proximal surfaces of the neck, the size of the crown is smaller and, more importantly, the neck has a smaller height.

*Preparation.* If you simply increase the vestibular surface of the premolar crown by changing the curvature of the premolar to the curvature of the canine, a layer of enamel will appear in the depth of the dental tissues of the proximal surfaces. Canine does not have this layer, and this discrepancy will manifest itself in the appearance of the crown in the form of more gray and dark areas. Therefore, it is necessary to remove the bulk of the enamel along the proximal surfaces, and also to grind the oral cusp, creating a flat oral surface.

*Reconstruction of dentin.* After adhesive preparation with an opaque shade of the restorative material, dentin is restored along the proximal surfaces, leaving a space of about 0.5 mm for artificial enamel.

The natural and artificial dentin must form a single, low translucent mass of dentin of considerable volume, which is characteristic for the canine. On the proximal surfaces of the crown, an opaque shade can come out to the surface of the restoration.

*Reconstruction of enamel.* The oral surface of the crown is restored with semitranslucent and translucent enamel shades the with the maximum possible repetition of the shape of the palatine fossa. At this stage, if necessary, you can lengthen the vestibular cusp. When reconstructing the vestibular surface of the enamel, attention should be paid to the convexity of the profile and the localization of the “neck-body-edge” transitions of the crown. Complete the transformation by reconstructing the proximal surfaces with a translucent hue (Fig. 26).



*Figure 26.* Transformation of a premolar into a canine:

*a* — initial situation; *b* — preparation; *c* — reconstruction of the dentin; *d* — reconstruction of the enamel

## OPTICAL ILLUSIONS

The optical effects used in the restoration include shaping, contouring and staining.

*Formation and contouring:*

1. Vertical lines emphasize the height (length) of the crown of the tooth.
2. The horizontal lines emphasize the width.

*Staining:*

1. Shadows create depth.
2. Light creates an effect of visibility.

With only three anatomical landmarks of the vestibular surface of the central incisor (points of the equator line, medial and distal facets, and also two angles of the crown), you can visually make them wide, narrow, oval, rotate them around the central axis of the root, etc.

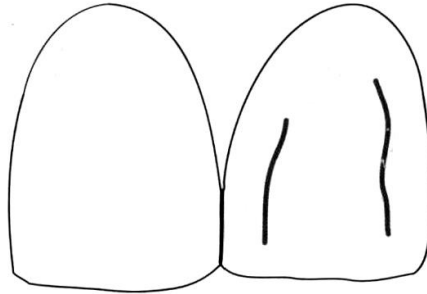
The shape of the embrasure affects the appearance of the teeth. In the case of narrow embrasures the teeth seem wider. With wide embrasures, teeth seem narrower.

Changing the configuration of the reflection zone we can create optical illusions of perception of the tooth shape. A flat tooth looks broad, and excessively convex one looks narrow. Too short teeth for the illusion of elongation should be narrowed in the mesio-distal direction in the gingival third.

To strengthen this illusion, the middle third of the vestibular surface must be flattened vertically.

If the teeth are too long, it is necessary to increase the lingual inclination of the cervical and cutting parts of the teeth. If you want to reduce the length of two adjacent teeth, you can grind their cutting edges so that they converge in the proximal contact area.

The formation of the vertical relief to the vestibular surface visually narrows the tooth (Fig. 27).



*Figure 27.* Vertical relief on the vestibular surface visually narrows the tooth

The tooth of a darker shade is perceived as being located orally, and a more light one as located vestibularly.

## **FINISHING**

Surface treatment includes the removal of excess composite, the final modeling of the tooth shape (macro and microrelief), grinding and polishing the surface. Burs with a red color code of pear-shape can be used for macro- and microcontouring of anterior and contact surfaces, burs with a bud-form are used for palatal surface. For the treatment of the subgingival part of the composite veneer and the border of the restorative material with the tooth tissues, an 8-fluted fin with a working part of a peak-shape and a non-aggressive tip is used. To reproduce the microrelief, it is necessary to use diamond or carborundum burs at low speeds. When creating a vestibular convexity, transitional lines, Retzius lines you can put landmarks on the surface of the tooth with a graphite pencil to facilitate this stage. Approximal surfaces are finished with abrasive metal or polyester strips, with an abrasive applied to them.

Polishing heads with a flame-shaped and a wheel-like shape are used for polishing the surface. There are polishing systems, including two or three pastes and polishes or other polishing tools. For example, in the polishing system applied to the Enamel plus HFO composite, a diamond paste is applied to the goat bristle wheel, 3 microns (Shiny A), then a 1 micron paste (Shiny B) is used. To give gloss to the surface, an aluminium paste (Shiny C), is applied with a felt wheel.

## Quality control of restoration.

1. Correspondence of the restoration form to the anatomical form of the restored tooth:

- a) visually, using a mirror;
- b) when restoring anterior teeth, take into account the patient's opinion;
- c) with the help of articulatory paper, check the presence of uniform occlusal contacts on the restoration, on the tissues of the restored tooth and on the adjacent teeth. The occlusion points should be the same intensity;
- d) evaluation of the contact point. The contact point should begin where the interdental papilla ends; inflammatory changes in the gingival papilla should be absent. The density of contact between the teeth is determined by means of a floss: *the floss should be inserted with an effort into the interdental space and be removed from the interdental space with a characteristic click.*

2. Marginal seal of filling is characterized by:

- a) a sharp probe should slide without hindrance across the border of the filling-tooth;
- b) the floss should not tear and get divided into fibers during flossing;
- c) absence of inflammation of the gingival margin in the area of restoration;
- d) lack of coloring of the "filling-tooth" border with dye solutions;
- e) absence of a white (gray) line along the margin of the restoration;
- f) absence of postoperative sensitivity.

3. Correspondence of the color of the restoration to the color of the restored tooth:

a) color matching is checked after 2–3 days, since during the restoration process due to overdrying the tooth becomes more light and less transparent, the restoration of optical properties occurs gradually, after several days;

b) determination of color consistency is carried out at a distance of 0.5 m from the patient;

c) when evaluating the color match, various light sources should be used: natural light, general artificial lighting of the office, local artificial lighting of the dental unit, if possible, soft ultraviolet light in a darkened room ("Black Light" lamp, "discotheque light"), etc.

d) when assessing the correspondence of the color of the anterior teeth, take into account the patient's opinion.

4. Presence of "dry" shine of restoration. Over time, a "dry" shine disappears due to abrasive wear on the surface of the restoration. Therefore, it is recommended to grind and polish restoration made of microhybrid every 6 months, restoration made of nanofilled composites — once a year.

5. Homogeneous structure of restoration:

a) the absence of pores is checked by "enlightening" the restoration with the light of a polymerization lamp or other light source. In case of detection of

surface and subsurface pores, their elimination is necessary (grinding and sealing with a composite);

b) the absence of white lines in the thickness of the restoration.

Errors in the creation of the form of the vestibular surface [2]:

a) incorrect formation of the tooth neck zenith. The displacement of the cervix zenith with respect to the vertical axis of the tooth visually changes the inclination of the tooth (Fig. 28, *a*);

b) incorrect formation of the “waist” of the tooth leads to a visual extension of the tooth (Fig. 28, *b*).

To form the zenith of the neck and waist of the tooth, a vestibular contour matrix and interdental wedges of suitable size can be used, then the zenith position and waist size will be determined automatically;

c) modeling of an excessively convex vestibular surface devoid of relief leads to the fact that the tooth looks unnaturally wide (Fig. 29);

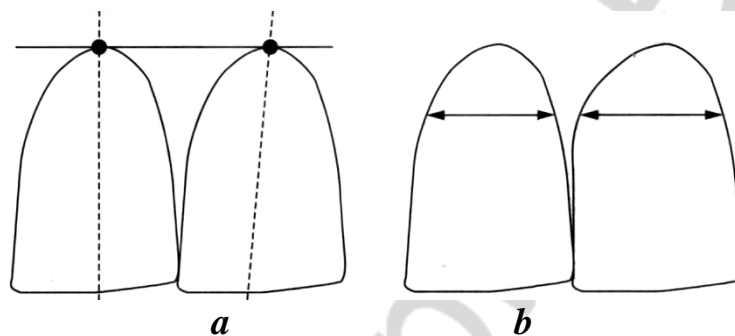


Figure 28. Changing the inclination of the tooth when the zenith of the tooth's neck is displaced (*a*) and the visual expansion of the tooth with improper formation of the “waist” of the crown part (*b*)



Figure 29. Influence of the convexity of the vestibular surface on the visual width of the tooth

d) smooth, convex vestibular surface creates an optical effect of increasing the width of the tooth;

e) modeling the macrorelief of the vestibular surface optically preserves the natural width of the tooth.

f) neglecting the contouring of the cutting edges. Rounded cutting edges of the anterior teeth make the smile more youthful, which is especially important for women. It is recommended for men to form more straight angles of anterior upper incisors;

g) incorrect formation of the contact point. Normally, it should begin where the interdental papilla ends (Fig. 30, *a*). If the contact point is formed closer to the gingival margin, the composite will press on the interdental papilla (Fig. 30, *b*). When the contact point is located only in the region of the cutting edges, patients usually complain about spattering of the saliva during the conversation (Fig. 30, *c*).

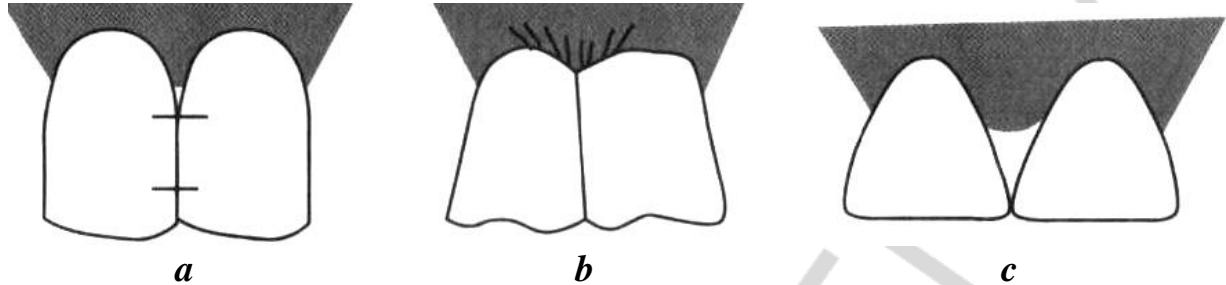


Figure 30. Options for the location of the contact point when restoring the anterior teeth

## CONCLUSION

Modern dentist have a wide choice of methods for restoration of anterior teeth, which enables them to satisfy the aesthetic demands of patients, using the appropriate restoration method for the clinical situation.

The emergence of new concepts of restoration and related materials offers a wide choice in clinical practice for the creation of highly aesthetic, author's works. Dentists have also begun to carry out the final processing of restorations in a more detailed way, forming the microrelief of the tooth surface. To facilitate the modelling of the palatal surface of the teeth, the technique of using silicone templates has been suggested. Thus, the knowledge of modern achievements in aesthetic dental will help make dentistry work more efficient.

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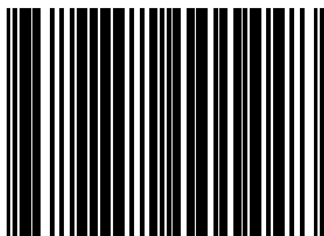
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