1.1. classification of ceramic masses.

Dental porcelains can be classified according to many characteristics.

I. According to the material for the manufacture of a ceramic frame

artificial crown:

a) based on yttrium glass;

b) based on zirconium oxide;

c) aluminum oxide ceramics;

d) ceramics based on polymers (ceramers);

e) ceramics based on lithium disilicate (feldspathic ceramics).

II. According to manufacturing technology:

1. Traditional powder ceramics

a) vacuum firing of ceramics on platinum foil:

Vitadur, Vitadur N (“Vita”, Germany); Flexoceram (Elephant, Netherlands);

b) firing of ceramic frames on a refractory model followed by cladding (ceramics based on strengthened aluminum oxide frames): In-Ceram (Vita, Germany), Screening+EX-3 (Noritake, Japan), Optec (Jeneric/Pentron ", USA);

2. Cast ceramics:

a) production of ceramic prostheses using lost wax models followed by firing (sitallization): CeraPearl (“Kyocera”, Japan); Dicor (Dentsply, USA);

b) casting ceramic frames using a wax model, followed by firing and veneering: Cerestor (“Johnson/Johnson”, USA);

3. Pressed ceramics:

a) pressing molten ceramics using a wax model followed by firing: IPS-Empress 1.2 (“Ivoclar”, Liechtenstein); ORS (“Jenerik/Pentron”, USA); Vitapress (Vita), Finesse (“Dentsplay”), Evopress (“Wegold”), Authentic (“Ceramay”), Carrara (“Elephant”), Cerogold (“Degussa”);

4. Impregnated (infiltrated) ceramics:

a) slip manufacturing technology: Turkom-Cera (“Turkom-Ceramic (M) Sdn. Bhd”, Malaysia), Top-Ceram (“Global Top Inc.”, South Korea);

5. Machined ceramics:

a) computer milling of the frame when copying a wax model, followed by firing and veneering: Cercon (“Degussa”, Germany);

b) production of a ceramic frame using electrophoresis followed by firing and lining: WolCERAM (“WDT”, Germany);

c) scanning the model (impression), milling the frame from “hard” ceramics using a computer program: Cerec (“Sirona”, Germany); Duret (Sopha Bioconcept, USA); DCS Precident (“DCS Production”, Switzerland); Cad. Esthetics (Ivoclar, Liechtenstein, and Decim AB, Switzerland); digiDent (“Girrbach”, Germany); Dental CAD/CAM-GN1 (Japan); Everest (“Kavo”, Germany);

d) scanning the model (impression), milling the frame from unfired ceramics using a computer program, followed by firing: Lava (“ZM ESPE”); Everest (“Kavo”, Germany);

e) scanning of the model (impression), computer modeling of the prosthesis, pressing, firing of the ceramic frame, veneering: Procera All Ceram (Nobelpharma, Sweden); Decim (Switzerland); Cicero (“Cicero and Elephant+”, Netherlands); Cynovad (Dental-matic and Cortex Machina, Canada).

III. Based on the general custom algorithm and CAD/CAM hardware layout:

a) centralized macrosystems (Procera, Decim);

b) individual mini-systems (DigiDENT, Cerec);

c) individual microsystems (Dental CAD/CAM-GN1).

IV. By purpose:

o only for cladding solid frames of metal prostheses (IPS-classic compound from Ivoclar, Liechtenstein; paste from Vita, Germany);

o only for the manufacture of all-ceramic single dentures (Vitadur, Vitadur N, NBK 1000, OPC and its subsequent modification Optek; Hi-Keram and its subsequent modifications);

o for lining solid-cast frames of metal prostheses and for the manufacture of all-ceramic single fixed prostheses (for example, Dutzeram mass from Dutsera, Germany).

V. According to the configuration:

o packaged powder that requires subsequent mixing with liquid;

o ready-to-use material – in the form of a paste, packaged in special syringe containers.

VI. According to the color scale: Chromascope, Vita-Lumin-Vacuum, Biodent. [7,22,31]

1.2. The nature of the bond between ceramics and metal.

There are four forces that ensure the connection between the ceramic and the metal part of the prosthesis:

1. mechanical retention

2.compressive forces

3. van der Waals forces

4. chemical compound

The essence of mechanical retention of ceramics is that microcracks remain on the metal part of the prosthesis after it has been treated with discs. Also, after air treatment, mechanical retention is enhanced due to increased surface wettability and an increase in the contact area. [22]

Compressive forces are observed after the metal-ceramic crown has cooled. Ceramics “stretches” towards the metal part when cooling due to the difference in the thermal expansion coefficients of porcelain and metal; the latter has a higher coefficient. This is observed in conditions of precise manufacturing of the prosthesis frame.

Van der Waals forces are caused by the fact that the molecules of ceramics and metal attract each other. These forces are of little significance for the overall adhesion strength. [6.17]

Chemical forces act at the interface between ceramics and metal due to the formation of an oxide film during firing of the metal. Metals found in alloys, when fired in oxygen, move to the oxides on the surface of the metal, combining with the oxides of the opaque layer of ceramics. Through these forces, significant strength is achieved, so fractures practically do not occur at the boundary; they are observed more often in the ceramic layer. [10,12]

1.3. Indications and contraindications for the use of metal-ceramic crowns.

Indications for the use of metal-ceramic crowns:

1) Defects of the coronal part of the tooth of various etiologies:

a. Destruction due to carious process

b. Traumatic fracture of a significant part of the crown

c. Non-carious lesions (wedge-shaped defect)

If it is impossible to restore a tooth using a filling or inlay.

2) Anomalies in the development and shape of teeth (microdentia, spiky, etc.) [14]

3) Change in tooth color

• Associated with non-carious lesions (fluorosis, amelogenesis imperfecta, necrosis, hypoplasia)

• For other reasons (death of the pulp, loss of shine, white spots due to caries)

If it is impossible to use veneers, composites, or teeth whitening.

4) Anomalies in the position of teeth that cannot be eliminated using orthodontic appliances in adults.

5) Pathological abrasion, when treatment is carried out to prevent its progression and/or increase the height of the bite.

6) As supporting teeth when choosing a bridge to eliminate defects in the dentition.

7) As supporting teeth when choosing a removable denture with a clasp fastening system, if it is impossible to apply a clasp to a tooth.

8) As a splinting structure for mild to moderate periodontitis.

9) For fixing medical devices that are used only during treatment.

10) Previously manufactured fixed structures in the oral cavity that do not meet medical, functional or aesthetic requirements. [4,9,10]

Contraindications to the use of metal-ceramic crowns.

Absolute:

1. In children, it is unacceptable to use it on teeth without depulping; this is due to the prevention of pulpitis after crown preparation, which is associated with the size of the tooth cavity and its close location to the outside.

2. A focus of chronic inflammation near the apex of the tooth root, if it is not filled or insufficiently filled.

Relative:

A. Brookxism

B. Bite pathology

C. Periodontitis and severe periodontal disease

D. The oral cavity is not sanitized

[9.13]

1.4. Clinical and laboratory stages of manufacturing metal-ceramic crowns.

When using metal-ceramic crowns for prosthetics, the manufacturing process consists of a series of clinical and laboratory stages.

Clinical stage (1 visit)

• collecting anamnesis, examination, objective research methods, diagnosis, drawing up a treatment plan, choosing a design and determining indications and contraindications

• preparation of abutment teeth

• taking impressions

• production of temporary crowns

Clinical stage (2nd visit)

• taking a working impression

• taking an auxiliary impression

• fixation of central occlusion

• fixation of temporary crowns

Laboratory stage

• casting models (working - collapsible and auxiliary)

• plastering of models into the articulator

• sawing of the working model

• applying compensation varnish to abutment teeth

• production of caps (wax or adapta)

• modeling of the wax frame of a metal-ceramic structure

• creation of a gating system

• installation of the wax structure with the gating system into the cuvette

• mixing the molding mass and packing the wax structure

• metal melting and casting

• removal of the finished casting from the cuvette and processing of the frame

• removal of oxide film in a sandblasting machine

Clinical stage (3rd visit)

• checking the metal-ceramic frame in the oral cavity

• determination of the color of the future crown veneer

• strengthening temporary crowns

Laboratory stage

• application of an opaque layer of ceramics and firing

• application of a dentinal layer of ceramics and firing

• applying an enamel layer of ceramics and firing

Clinical stage (4 visit)

• checking the design of the prosthesis in the oral cavity

Laboratory stage

• applying a glaze layer and firing

Clinical stage (5th visit)

• fitting of the prosthesis design in the oral cavity

• permanent fixation of the structure in the oral cavity [13,28]

1.5. Errors at clinical stages.

Clinical examination methods.

Anamnesis collection, examination, objective research methods, diagnosis, drawing up a treatment plan, choosing a design and determining indications and contraindications.

Examination of an orthopedic patient plays a vital role in quality treatment. Its purpose is to diagnose the function of the oral organs and determine the degree of anatomical changes, since the result of treatment should be maximum restoration of both components. [1.18]

The examination begins with collecting an anamnesis. It is important to conduct it carefully, not limiting yourself to stingy questions. A history of the present illness is collected, listing all complaints and their nature, and then a life history. At this stage, doctors make the following mistakes: incomplete detailing of complaints, incomplete collection of information about concomitant and past diseases, which, one way or another, may be associated with the underlying pathology, incomplete collection of information about place of birth, life, working conditions, nutrition, medication use funds, allergy history, close relatives, place of birth, prenatal period, childhood period, physical development, current pregnancy. [6.21]

During an examination of the oral cavity, it is important to pay attention to the degree of opening of the oral cavity, otherwise the doctor may not notice some pathology associated with difficult opening, and in the future this will affect when performing manipulations in the oral cavity; the doctor must also assess the nature of the movements of the lower jaws.

The condition of the oral mucosa is assessed. Ignoring this stage or a “superficial” assessment can lead to the fact that inflammatory processes during prosthetics begin to intensify, leading to various complications and poor-quality prosthetics or the impossibility of its implementation. [8]

Next, the dentition is examined. The color, shape of teeth, their position, stability, intra-alveolar and extra-alveolar parts, position to the occlusal surface of the dentition, presence of structures, fillings, relationship to antagonists, neighboring teeth, type of bite, shape of arches are assessed. Next, the marginal periodontium is examined in more detail, attention is paid to the condition of the gums and the presence of pockets, and the presence or absence of tooth mobility is noted. Incorrect diagnosis at this stage can lead to functional overload of the periodontium during prosthetics, the occurrence of traumatic occlusion, the development or progression of inflammation, as well as tooth loss. [9,10]

Paraclinical examination methods.

Each patient needs to have a survey radiography of all teeth, targeted radiography, computed tomography, and arthrography if indicated. This is necessary to analyze the structure of the periodontium, assess the quality of endodontic or surgical treatment, clarify the location of the roots of abutment teeth, and assess the condition of the TMJ. If this stage is carried out incorrectly or incompletely, an exacerbation of chronic inflammation near the root apexes may occur after crown placement, which will lead to the need for re-treatment. A fracture of part of the tooth, its pathological mobility, and dysfunction of the joint may also occur. [9]

Making a diagnosis and drawing up a treatment plan is important. If placed incorrectly, this will lead to the wrong choice of design, poor preparation for prosthetics, and subsequently to re-treatment. [16]

Preparation of abutment teeth

When using a metal-ceramic structure, special features are taken into account during preparation.

During preparation, a fairly large amount of enamel and dentin is removed (up to 2 mm), which requires anesthesia if the tooth pulp is alive. [21]

When performing local anesthesia

When performing local anesthesia, local and general complications are observed.

Local complications.

Local complications during anesthesia include violation of the technique, which can lead to needle breakage or damage to oral tissue. Such complications can arise when the patient moves suddenly, which occurs as a result of a pain impulse. The causes of pain may be an increase in the amount of solution, its irritating effect, the speed of administration, tissue damage, the psychological state of the patient in the absence of premedication, or the lack of topical anesthesia by a doctor. [15]

Using high concentrations of anesthetic or injecting it directly into a nerve can lead to paresthesia, including facial nerve paresis. This complication can also occur due to nerve injury.

Also, the most significant complications during anesthesia include: trismus (the negative effect of the anesthetic on muscle tissue, their injury), hematoma (when a blood vessel is damaged), infection (especially with ligamentous anesthesia when the stage of cleaning the tooth from plaque is ignored), soft tissue necrosis. [15,20]

General complications.

The main complications of a general nature include the toxic effect of the anesthetic when using high concentrations, using solutions without a vasoconstrictor, allergic reactions upon repeated contact with an antigen to which there is sensitization, and a disturbance in the psycho-emotional state of the patient.[15]

Tooth preparation must be carried out under air-water cooling; this prevents tissue overheating.

During preparation, traumatic pulpitis may occur; this can occur as a result of the technique itself, when a low-quality instrument is used and the bur is not centered. Burns can occur if continuous processing is too long, or if there is not sufficient cooling (50 ml/min, 35 degrees Celsius (Petr Ottl). [2]

Also, traumatic pulpitis can occur due to deep preparation, so after 50 minutes persistent circulatory disorders begin to occur in the vessels of the dental pulp. Severe arterial hyperemia, focal hemorrhages, and edema are observed. All these changes can be leveled out after 2 weeks, but under unfavorable conditions, alterative changes increase, which leads to the occurrence of traumatic pulpitis.

To prevent the occurrence of pulpitis in teeth with vital pulp, you need to follow the preparation algorithm without violating all the rules, thanks to which the risk of tooth overheating is reduced, and it is also important to take into account the safety zones of the tooth, which will ensure the optimal depth of preparation. [5]

Preparation sequence:

• separation of proximal surfaces

• preparation of the cutting edge or occlusal surface

• preparation of vestibular and oral surfaces

• creation of a cervical ledge

An abrasive disc or thin diamond head is used to separate one tooth from another. The formation of the stump begins at this stage in order to prevent injury to adjacent teeth. Then they begin to prepare the occlusal surface or cutting edge. [2.29]

Abolmasov believes that safety zones are located at the cutting edge, at the level of the equator and neck of the incisors of the upper and lower jaw. They are prepared no more than 0.5-0.8 mm.

Fig. 1. Thickness of the walls of the anterior teeth (Abolmasov N. G.)

The incisors of both jaws have thinner walls on the contact sides, so preparation in these areas is carried out with the greatest care.

The safest zones of the fangs are the cutting edge, the equator, the neck (vestibular, lingual sides, for the maxillary canines it is also distal) [1]

The thickness of the walls of the cavity of chewing teeth has been most fully studied by B.S. Klyuev.

\* - thickness is not measured, since the tooth cavity is below the level of the equator

Figure 2. Thickness of the walls of the chewing teeth at the level of the equator and neck (B.S. Klyuev)

It is necessary to prepare the tooth while preserving the hard tissue of the tooth above the pulp chamber of at least 0.7 mm (optimally 1 mm). This is necessary to prevent the occurrence of pulpitis and tooth fracture.[4,15]

It is necessary to prepare the anterior group of teeth by 1.5-2 mm in the area of the cutting edge, taking into account the location of the pulp chamber in each specific tooth. The chewing surface of the lateral group of teeth in the area of fissures is prepared by 1 mm, in the area of cusps – up to 2 mm.

0.5-1.3 mm of tooth tissue is prepared from the lateral surfaces of the teeth, because their layer here is thinner, there is a high probability of accidentally “falling” into the pulp chamber. [2.24]

Other features during preparation.

The second feature of creating a stump of an abutment tooth is that it is necessary to create a taper of the side walls of the tooth to the occlusal surface or cutting edge, the angle should be 5-8°. This will reduce the stress that may occur in the prosthesis frame and will also help ensure optimal retention.

Preparation of teeth with the creation of a conical stump, convergence of the walls with an optimal angle allows you to freely Place a metal-ceramic crown, this reduces the stress in the prosthesis and prevents the occurrence of ceramic chips. [29]

An increase in the convergence angle to 20° can lead to decementation of the crown and traumatic pulpitis.

If the tooth stump is short, then the walls are made as parallel as possible (the angle is small 5°); with long supporting teeth, the angle is usually increased (10°). This will reduce the negative impact on the tooth under functional loads. [5]

Too much shortening of the tooth stump can lead to poor fixation of the crown and its decementation, as well as to chipping of the ceramics.

If the length of the supporting tooth is insufficiently ground, functional overloading of the periodontium, chipping of the ceramic coating, excessive abrasion of the antagonist tooth, and unsatisfactory aesthetics may occur.

The occlusal surface of the tooth stump after preparation should follow the anatomical shape of the tooth. [4.11]

The third feature of stump preparation is the formation of a cervical circular ledge.

The greatest aesthetics is achieved when a ledge is formed at an angle of 135°; also, with such a ledge, the likelihood of periodontal injury from the edge of the crown is reduced. [3]

The width of the ledge differs for different teeth (from 0.2 to 1.3 mm), it depends on the safety zones that need to be taken into account. The shoulder symbol (the narrowest shoulder) is prepared on the lower incisors. [2,5,29]

In the upper central incisors, upper and lower canines, a ledge of no more than 1.3 mm is formed. For the upper lateral incisors it is 0.7 mm due to their anatomical features. In the area of the lateral teeth, the width of the ledge can vary, but not exceed 1 mm.

The ledge is created at the level of the gum edge; in rare cases, in the absence of periodontal disorders, to improve aesthetics, the ledge is deepened halfway into the gingival sulcus. The depth is determined by a graduated probe.[3,10,11]

Also, on the oral side, it is better not to leave part of the metal frame without ceramic lining, because this can lead to plaque retention in this place and the occurrence of an inflammatory process in the periodontal tissues.

The ledge itself is also necessary in order to ensure the full aesthetics of the crown, since when creating it, space is created for a sufficient layer of porcelain, which ensures that the metal part does not show through, and the color of the ceramic in the cervical area satisfies all requirements. At the same time, the metal frame also has sufficient thickness, which reduces the likelihood of its deformation and chipping of the cladding in this place. The edge of the crown, being on the ledge, does not injure the surrounding tissues. [11.26]

Obtaining a two-layer print

When prosthetics with metal-ceramic crowns are made in the laboratory by a technician, the doctor must take an impression of the prepared teeth in the patient’s oral cavity. The most commonly used technique is to obtain a two-layer impression, consisting of a base layer of silicone and a corrective one. This technique has greater accuracy due to the fact that the corrective layer of a two-layer impression displays the tissues of the prosthetic field in more detail than a single-layer one. [11.25]

When using silicones, the likelihood of creating an incorrect design is reduced because this material has low shrinkage. But an important condition for making a high-quality impression is strict adherence to the ratio of materials and catalysts, as well as time for mixing the mass. [26]

When taking impressions, gum retraction is also important to more accurately depict the border of the tooth stump. Retraction provides space for the correction layer to flow between the soft tissues and the tooth.

The least traumatic method of retraction is the mechanical method. In this case, the doctor places a retraction thread in the gingival groove, which can be soaked in a special liquid. First of all, the doctor selects the desired diameter of the thread, then he impregnates it with a solution that may contain hemostatic drugs, an antiseptic, or a vasoconstrictor. Vasoconstrictor substances are not added if the patient has concomitant pathology of the cardiovascular system. The retraction thread is inserted very carefully so as not to injure the periodontal tissue and tooth ligaments. [25]

Next, the doctor removes the first layer of the impression with base silicone, then he removes the thread to prevent necrosis of periodontal tissue and removes the second layer with corrective material. [14]

Gum retraction is not performed by a patient with periodontal tissue pathology, as it can lead to the spread of infection or aggravation of the process. When forming a ledge at the gum level, retraction is not performed. [18.26]

At this stage, detachment of the corrective mass from the base layer may occur. To prevent peeling and for better penetration of the material, you can remove the first layer before preparing the tooth, and the clarifying layer is removed after preparing the tooth. In this situation, the excessive pressure of the orientation layer will be reduced, since the doctor leaves a gap in the first layer to the depth of the prepared tissue, and there is also no inflammatory change in the gums during preparation, which can lead to distortion of the cervical area. [11.30]

Deformations of the print are caused by improper mixing of materials, poor drying of the base layer, and incomplete polymerization. If thermoplastic impression compounds are used, the impression should not be stored near a heat source. [26]

Strengthening temporary crowns on prepared teeth.

After the stage of taking an impression, it is necessary to cover the tooth with a temporary crown, since failure to comply with this stage can lead to caries, pulpitis, and stump injury. Such teeth react sharply to chemical and thermal irritations.

residents. [19]

To cover the tooth stump, temporary crowns are used, which are included in standard sets; they are made of plastic and come in different sizes and colors. Moreover, after placing a crown on the supporting tooth, the doctor can adjust the boundaries directly in the oral cavity using quick-curing plastic. [thirty]

If the doctor does not have a standard set of plastic crowns, then they are made in advance by a technician in the laboratory or by a doctor in the office. [16]

In the clinic, the doctor selects a suitable plastic tooth, then prepares its lingual (palatal) surface, then fits it into the oral cavity and covers the wall defect with quick-hardening plastic. In the same way, this manipulation can be carried out on a plaster model of the jaws. Due to the toxic effects of plastic components on dental odontoblasts, it is necessary to isolate the tooth stump with petroleum jelly or inert plastic. [21]

Next, the resulting crown is fixed to the tooth stump using dental cements. It is recommended to use materials containing calcium hydroxide, which has anti-inflammatory properties.

To create temporary crowns and prevent the negative effects of plastic on odontoblasts, you can use the inert material “scutane”. [15]

First, the doctor takes an impression before preparing the abutment tooth, then introduces the mixed material into the impression in the area of the tooth and places the impression in the oral cavity for 7 minutes. The cutaneum in the impression hardens and takes the shape of the tooth before preparation. Then the impression with a spoon is removed from the mouth, and the doctor begins processing the artificial crown. After this, the crown is fitted and fixed on the supporting tooth with cement. [15,16]

At this stage, the technology for making the crown in the clinic may be disrupted, an allergic reaction to the crown may occur, trauma to the edge of the marginal periodontal crown, or an overestimation of the bite height, which leads to improper closure of the teeth. If you leave teeth without crowns, this can lead to their displacement due to lack of contact with the antagonist, damage to the dental pulp due to exposure to chemical and thermal irritants on the tooth. [11.30]

Determination of central occlusion

Determination of central occlusion plays a key role in the clinical stages of prosthetics with metal-ceramic crowns. By correctly following this step, the need to adjust the occlusal surface of the crown is reduced, thereby ultimately improving the aesthetics of the crown. [24]

The method for determining central occlusion is chosen by the doctor, and the number of teeth for which crowns are planned to be made and their relative position are important. [25]

If there are single defects in the dentition in the oral cavity, a fixed interalveolar height, and a sufficient number of interocclusal contacts, then the doctor simply asks the patient to bite the base silicone roller in the position of central occlusion.

It is applied to the prepared teeth, then the patient closes the jaws in the usual position of the dentition, or the doctor adjusts the position of the lower jaw to suit the patient’s bite. [15]

If the patient has multiple dentition defects in the oral cavity and three pairs of antagonists are missing, central occlusion is determined and fixed using wax rollers. [15.30]

Fitting a solid metal prosthesis frame

The doctor begins checking the metal frame of the crown with an examination. This step should be carried out carefully, because the presence of defects can lead to subsequent chipping of the ceramic coating. The doctor pays attention to the presence of pores and surface irregularities. The frame must follow the anatomical shape of the tooth. Next, the doctor fits the frame onto the plaster model. The design should be applied smoothly, fit exactly to the model, and be easily removed. [1,4]

Then the doctor places a frame on the tooth stump. The doctor checks the ability to be applied just as easily without any additional effort and to “sit” completely, ensuring tight contact with the tooth tissues without any gaps. Poor fit of the frame on the abutment tooth can occur due to insufficient tooth preparation, poor-quality impressions, or violation of casting technology. [eleven]

You can check it using articulating paper or after placing the frame on the tooth after adding a small amount of corrective silicone.

In order to correct minor errors, the doctor can further prepare the stump or slightly polish the metal frame. If fairly extensive defects are observed, a new impression is taken and sent to the laboratory to make a new frame. [11,20,26]

The doctor also checks the distance from the occlusal surface of the metal frame to the corresponding surface of the antagonist tooth; this distance should not exceed 1.1 mm, it corresponds to the thickness of the future ceramic layer.

After this, together with the patient, the doctor chooses the color of the ceramic layer of the future crown. Natural light is used for this and a standard tooth color chart. The doctor compares the color of the patient’s teeth, taking into account his age and wishes regarding future aesthetics. [30.18]

Fitting a solid metal frame with ceramic lining

At this stage, final adjustments are made to the prosthesis, because after applying the glazing layer it is already problematic to make them.

The doctor pays main attention to the aesthetic component of the crown. Its color is checked to see if it matches the color of the patient’s neighboring teeth. If the color of the ceramics differs slightly, it can still be tinted. If the difference is strong, then the ceramics are re-fired in the laboratory. [25,30]

 Attention is paid to the anatomical shape of the crown, whether it repeats the shape of the tooth of the same name on the other side. The quality of the reproduction of the crown in the cervical area is also taken into account; the accuracy of the fit is very important. Next, the doctor checks the interocclusal contact with the antagonist. [26]

Again, the doctor checks the possibility of free application of the prosthesis. At this stage, you can grind off the interfering areas of the ceramic. If there is a shortage of ceramics, the application of ceramics is carried out only in the laboratory with repeated firing. [24]

Having checked the crowns according to the listed points and the patient has no complaints, the doctor sends them to the laboratory for glazing.

The doctor fixes the finished crown temporarily for up to 2 months. This is necessary in order to identify early complications and eliminate them without compromising the integrity of the crown. In the early period after prosthetics, the following may occur: caries, traumatic pulpitis or periodontitis, chipped ceramics. [7]

Cement can be used to temporarily strengthen metal-ceramic crowns. [10]

Strengthening metal-ceramic crowns on abutment teeth with glass ionomer cement

The doctor mixes the cement, which should be quite fluid, then applies it to the crown about one-third using a trowel or spatula, carefully coats the walls of the crown with cement and places it on the abutment tooth. The abutment tooth with living pulp is not degreased with ether, due to its toxic effect. [12,17]

The patient is then asked to close the jaws, checking that they are in central occlusion. Contact with the antagonists allows the crown to be advanced to its correct position. But it is important to remember that excessive pressure on the crown can create excessive stress in the prosthesis, which can lead to chipping of the ceramic. Then the patient does not move the lower jaw until the cement hardens, in order to prevent the crown from moving. [8]

Thus, having studied the literature, we came to the conclusion that the errors that arise at the clinical stages of manufacturing metal-ceramic crowns have not been sufficiently studied in the literature, the reasons for their occurrence and possible methods of prevention have not been fully described. This was the reason for further research in our work.

Chapter 2. Materials and research methods.

2.1 Research materials.

A survey of 45 patients of different age groups with metal-ceramic structures was carried out; the patients were also divided into groups of equal numbers according to the time after prosthetics (up to 3 months, from 3 to 6 months, from 6 to 12 months).

Criteria for inclusion of patients in the study: presence of metal-ceramic crowns in the oral cavity, informed consent of the patient, time after prosthetics no more than 12 months

Criteria for excluding patients from the study: smoking, severe somatic pathology, diabetes mellitus, the presence of tumors, tuberculosis and other infectious diseases, patient refusal to be examined.

Table 1. Distribution of patients of different genders by age

 Age

 Gender 25-34 years old

35-44 years 45-54 years Total

M 7 (15.5%) 9 (20.0%) 13 (29.0%) 29 (64.5%)

F 2 (4.5%) 5 (11.0%) 9 (20.0%) 16 (35.5%)

Total 9 (20.0%) 14 (31.0%) 22 (49.0%) 45 (100.0%)

When studying the structure of patients, it was revealed that the proportion of men is 65%, the proportion of women is 35%. When distributing patients by age, the proportion of patients aged 45-54 years prevails (49%), the proportion of patients aged 25-34 years is 20% (the smallest proportion), the proportion of patients aged 35-44 years is 31%.

Table 2. Distribution of patients of different genders by time after prosthetics

 Time

 Gender up to 3 months

3-6 months 6-12 months Total

M 11 (24.4%) 8 (17.8%) 10 (22.2%) 29 (64.5%)

F 4 (8.9%) 7 (15.5%) 5 (11.1%) 16 (35.5%)

Total 15 (33.3%) 15 (33.3%) 15 (33.3%) 45 (100.0%)

According to the time after prosthetics with metal-ceramic crowns, all patients were divided into three equal groups: those examined up to 3 months, those examined from 3 to 6 months, and those examined from 6 to 12 months after prosthetics. The largest number of examined men is observed during the first 3 months (24.4%), the smallest – in the period from 3 to 6 months (17.8%). The smallest and largest number of women are observed in the same periods (8.9% and 15.5%, respectively).

Diagram 1. Distribution of the number of examined metal-ceramic crowns by age

A total of 64 metal-ceramic crowns were examined for 45 patients examined. In the first age group, 14 crowns were examined, in the second – 21, in the third – 36.

Diagram 2. Distribution of the number of examined metal-ceramic crowns over time after prosthetics

The figure shows that in the period after prosthetics up to 3 months, 21 crowns were examined, from 3 to 6 months, 20 crowns were examined, from 6 to 12 months, 23 crowns were examined.

Table 3. Distribution of detection of errors and complications after prosthetics in patients (metal-ceramic crowns) by time after treatment

 Time

Complications Number of patients (crowns) examined up to 3 months

Number of patients (crowns) examined after 6 months Number of patients (crowns) examined after 12 months Total

Not identified 12 (15) 7 (9) 5 (7) 24 (31)

identified 3 (6) 8(11) 10 (16) 21 (33)

Total 15 (21) 15 (20) 15 (23) 45 (64)

Based on the data obtained, patients were divided into main and control groups to evaluate the results. The main group consisted of patients with identified complications after prosthetics - 21 people (46.7%), they accounted for 33 metal-ceramic crowns, the control group consisted of patients with metal-ceramic crowns without identified errors and complications - 24 people (53.3%), they There are 31 metal-ceramic crowns.

2.2 Research methods.

2.2.1. Clinical methods.

Clinical methods included history taking, examination, and palpation.

During the survey, complaints related to chewing, speaking, and brushing teeth were recorded.

The observation began with an external examination, then moved on to an examination of the oral cavity. Attention was paid to the bite, the position of the teeth in the dentition, the quality of the prosthesis and its fixation, the relief of the chewing surface of metal-ceramic crowns, the fit of the crown to the tooth stump, and the level of hygiene.

The condition of the mucous membrane of the gingival margin was also assessed, and staining was performed using the Schiller-Pisarev method.

During the examination, special attention was paid to assessing the condition of the supporting teeth, their periodontium, as well as detailed characteristics of the prostheses and long-term results of prosthetics.

Inspection of a metal-ceramic crown.

Using a binocular loupe and a dental mirror, the artificial crown was examined from the vestibular side below the equator level (in the cervical region), at the equator level, and above the equator level. Then we moved on to examining the cutting edge or occlusal surface. After this, the lingual (palatal) surface was examined, and then the approximal ones.

During the examination, the shape of the crown, the severity of anatomical formations, adherence to the tooth stump, the presence of cracks, and chips of ceramics were assessed.

Next, the metal-ceramic crown was assessed in terms of color matching. Standard Vita colors and ambient light were used. The patient was at a distance of 1-1.5 meters from the window.

Characteristics:

• color tone – determines the location of color in the spectrum;

• saturation is the degree of expression of a tone; it depends on the amount of pigment of this tone. Its degree increases with increasing amount of pigment;

• lightness depends on the position of a given tone on the scale between white and black (the amount of gray in a given tone).

• Translucency is the ability of hard dental tissues to transmit light.

In modern Vita colors, colors are divided into four groups: A, B, C, D. Color A is orange with a brown undertone, color B is also orange, but turning into yellow, C is gray-brown, D contains gray orange pigments.

In the groups presented, certain colors may predominate, so the colors in the groups are divided by numbers.

When examining a tooth, it is important to know that the cervical area has a more intense color, due to the fact that the enamel in this area is the thinnest. Moreover, the color of this area may belong to a different group than the rest of the tooth surface.

In the aesthetics of tooth color, brightness is very significant. An inconsistency in the degree of brightness can clearly highlight the crown in the dentition. Even an error in the first two indicators does not stand out so much in the oral cavity.

Translucency is most important when creating the incisal edge of the incisors, since in this area, especially in young patients, the dentin shows through the translucent enamel. If this feature is not observed in the restoration, adjacent teeth will differ greatly, and the aesthetics of the smile will be impaired.

Schiller-Pisarev test and indices

The essence of the method is that the gums are stained with Schiller-Pisarev solution to indicate its inflammation. The inflamed gum undergoes a process of keratinization, and glycogen accumulates in it. When stained, it reacts with iodine contained in the solution (positive test), due to this, the areas of inflammation have a brighter color in relation to healthy areas of the gums, which are not normally stained (negative test). The degree of coloring is

I am directly dependent on the intensity of inflammation.

Methodology: isolate the area under study from oral fluid, then dry this area, apply the Schiller-Pisarev solution on a cotton ball to the mucous membrane, evaluate the gums after 7-10 minutes.

Composition of the solution: potassium iodide – 2 g, crystalline iodine – 1 g, distilled water – 40 ml.

Determination of the numerical value of the Schiller-Pisarev test (Svrakov iodine number)

After staining, the condition of the gums is assessed using points: 0 - the mucosal epithelium is not stained, 2 - the epithelium of the papillae is stained, 4 - the marginal epithelium is stained, 8 - the alveolar part of the gums is stained.

The sum of points for each tooth must be divided by the number of teeth examined:

Iodine value = Sum of ratings for each tooth

Number of teeth examined

Next, the resulting Svrakov iodine number is assessed:

• weak process of gum inflammation - up to 2.3 points;

• moderate process of gum inflammation - 2.67-5.0 points;

• intensive process of gum inflammation - 5.33-8.0 points.

Denture Hygiene Index

Denture hygiene index by E. Ambjornsen (1982) and A. B. Klimova (2006).

The vestibular and lingual (palatal) surfaces of metal-ceramic crowns were stained using Lugol's solution, which was washed off after 1-2 minutes. Next, the area of staining that was observed in areas of plaque deposition and in veneer damage was assessed.

• from 0 to 10% - high level;

• over 10%, up to 30% - satisfactory level;

• over 30%, up to 50% - low level;

• over 50%, up to 100% - a very low level.

The calculation was carried out separately for the outer and inner surfaces, after which they were averaged.

Determination of the papillary-marginal-alveolar index (PMA)

The papillary marginal alveolar index (PMA) shows the condition of the gums, namely the presence of gingivitis, and its prevalence throughout the oral cavity. The gums around all teeth are examined, the examination is carried out after staining with an iodine solution, or without staining.

The condition of the gums is assessed in points:

• inflammation of the papilla (P) - 1 point;

• inflammation of the marginal gum (M) - 2 points;

• inflammation of the alveolar gum (A) - 3 points.

The index is expressed as a percentage (according to Parma):

Gingivitis index (GIA) = sum of indicators in points x 100%

3 x number of teeth of the subject

Index values:

• for mild gingivitis - 30%;

• with moderate severity of gingivitis, it approaches 60%,

• in severe cases - from 61% or more.

Assessing marginal fit

The assessment of the marginal fit of the metal-ceramic crown was carried out according to the method of A. N. Ryakhovsky (2005), an examination was carried out at the crown-tooth border, as well as an instrumental examination using a dental probe.

Marginal fit was assessed using the following codes:

• 0 – there is no violation of the marginal fit (the boundary of the crown and tooth is not determined)

• 1 – the boundary is detected, but the probe does not get stuck

• 2 – the boundary is detected, the probe gets stuck.

It was also assessed using the Smith-Howe Method.

A finger was pressed on the crown; if the crown was not tightly seated on the tooth stump, then air bubbles appeared in the patient’s saliva, this indicates decementation of the artificial crown.

Assessment of interdental contacts

Assessment of proximal contacts was carried out using a Mylar strip and floss.

The strip and thread were inserted into the interdental space, the presence of a contact point and its shape (planar, point) were checked.

Fig.3. Assessing approximal contact using floss

Occlusal relationships were assessed using articulation paper.

Using tweezers, articulation paper was placed on the tooth under study with the crown with the coloring surface towards the antagonist, the patient closed his jaws, imitating movements during chewing.

Traces from contacts between teeth were assessed.

Rice. 4. and fig. 5. Assessment of occlusal relationships using articulation paper

2.2.2. Paraclinical methods

X-ray method

Using intraoral targeted (dental) X-rays and orthopantomograms (OPTG), the presence of a carious process in the roots, apical foci of chronic inflammation, and the condition of the periodontal fissure were studied. 45 photographs were examined.

Fig. 6. Orthopantomogram of patient I. with a metal-ceramic crown on tooth 4.7.

Chapter 3. Research results and discussion

Results of a clinical examination of patients in the main group and the control group.

An analysis of the complaints of the examined patients revealed the absence of such complaints in the control group. In the main group, the data are shown in Table 4.

Table 4. Distribution of complaints by type

Complaints Number of complaints from patients

Aesthetic failure of crowns 14 (50%)

Pain when biting 4 (14.3%)

Pain when brushing teeth 10 (35.7%)

Total 28 (100%)

The table shows that patients made the greatest number of complaints about the aesthetic failure of metal-ceramic crowns (50%), the least number of complaints were about pain when biting (

I am directly dependent on the intensity of inflammation.

Methodology: isolate the area under study from oral fluid, then dry this area, apply the Schiller-Pisarev solution on a cotton ball to the mucous membrane, evaluate the gums after 7-10 minutes.

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The table shows that patients made the greatest number of complaints about the aesthetic failure of metal-ceramic crowns (50%), the least number of complaints were about pain when biting 14.3%). The proportion of complaints about pain when brushing teeth is 35.7%. The control group had no complaints.

Analysis of data obtained during examination of examined patients.

Diagram 3. Distribution of identified visual defects by number in the main group

Rice. 7. Color mismatch of the crown of 1.3 teeth

Table 5. Distribution of identified visual defects by number in the main group

Defects in crowns Quantity

Anatomical shape 3 (9%)

Lack of adherence to the stump of tooth 7 (21%)

Cracks, chips of ceramics 5 (15%)

Discoloration 5 (15%)

No visual disturbances 13(40%)

Total 33(100%)

A visual examination of the control group revealed no violations. When examining the main group, a lack of adherence to the tooth stump was revealed in 7 crowns (21%), cracks/chips of ceramics and discoloration were present in 5 crowns (15 each), a violation of the anatomical shape was in 3 crowns (9%), and the absence of visual violations were detected in 13 crowns (40%).

Determination of the numerical value of the Schiller-Pisarev test (Svrakov iodine number).

Diagram 4. Average value of Svrakov’s iodine number in the main and control groups

Analysis of the numerical value of the Schiller-Pisarev test (Svrakov iodine number) showed that in patients of the main group the average value was 2.30±1.16, in the control group – 1.80±0.45. This means that in both groups there is a mild process of inflammation of the gums at the crowns; in the main group it is more pronounced than in the control group.

Denture hygiene index.

Diagram 5. Average value of the denture hygiene index in the main and control groups

In the main group, the average plaque area on the prosthesis in lobes was 0.17±0.14, in the control group – 0.08±0.09. In the main group, a high level of hygiene was observed in 11 patients, satisfactory in 6, low in 4 patients, in the control group – high in 20 patients, satisfactory in 4 subjects, a low level was not observed.

PMA index.

Diagram 6. Average value of the PMA index in the main and control groups

In the main group, the average value of the PMA index in shares is 0.1095±0.0960, in the control group – 0.0730±0.0544.

Assessment of the marginal fit of the crown according to Ryakhovsky.

Table 6. Ryakhovsky codes in the main and control groups

 Groups

Codes Main

Control

0 18 25

1 8 6

2 7 -

Total 33 31

Codes:

• 0 – there is no violation of the marginal fit (the boundary of the crown and tooth is not determined)

• 1 – the boundary is detected, but the probe does not get stuck

• 2 – the boundary is detected, the probe gets stuck.

As can be seen from the table, obvious violations of the marginal seal were observed in 7 patients of the main group; they were not detected in the control group.

Using the Smith-Howe method in combination with the visual method, decementation was detected in 2 metal-ceramic crowns.

Assessment of proximal contacts.

Table 7. Distribution of approximal contacts in the main and control groups by type

 Groups

View Main

Control

Planar 8 (24.2%) 9 (29.0%)

Spot 20 (60.6%) 22 (71.0%)

Missing 5 (15.2%) -

Total 33 (100%) 31 (100%)

When assessing approximal contacts in the main and control groups, approximately the same ratio of planar to point contact was revealed in both groups: planar in the main - 24.2%, in the control - 29.0%, point in the main -60.6%, in the control – 71.0%. There were no missing contacts in the control group. In the main group they accounted for 15.2%.

Assessment of occlusal contacts.

No violations were detected in the control group; in the main group, such violations were found in 2 metal-ceramic crowns.

Evaluation of radiographs.

In the control group, 24 radiographs were assessed, the presence of a carious process was not detected, the expansion of the periodontal fissure was not detected, or was detected, but insignificant. In the main group, 21 radiographs were assessed; the carious process and its complications were identified in 5 metal-ceramic crowns.

Rice. 8. Recurrence of caries under the crown of 2.5 teeth

Table 8. Summary table of all complications by time period after prosthetics

 Time

Complications up to 3 months

3-6 months 6-12 months Total

Cracks, chips 2 2 1 5 (15.15%)

Violation of marginal seal - 3 3 6 (18.20%%)

Deconsolidation 1 1 - 2 (6.00%)

Carious process and its complications - 1 4 5 (15.15%)

Violation of anatomical shape 2 1 - 3 (9.10%)

Violation of proximal contacts 1 1 3 5 (15.15%)

Violation of occlusal contacts - 1 1 2 (6.00%)

Discoloration 1 1 3 5 (15.15%)

Total 6 11 15 33 (100%)

In total, the entire main group, consisting of 21 people, accounted for 33 complications. The complication that has the greatest share is a violation of the marginal fit of the crown to the stump (18.20%), cracks/chips, the carious process and its complications, violation of proximal contacts, and discoloration have the same frequency - 15.15% each. The lowest frequency is due to violation of the anatomical shape of the crown (9.10%), decementation (6.00%), violation of occlusion

contacts (6.00%).

The incidence of these complications (based on a study of 64 metal-ceramic crowns of the main and control groups):

• Cracks, chips – 7.8%

• Violation of marginal seal – 9.4%

• Deconsolidation – 3.1%

• Carious process and its complications – 7.8%

• Violation of anatomical shape – 4.7%

• Violation of proximal contacts – 7.8%

• Violation of occlusal contacts – 3.1%

• Discoloration – 7.8%

Rice. 9. Crack of ceramics 2.1 teeth

Rice. 10. Chip ceramics

Rice. 11. Chipping of ceramics and violation of the anatomical shape

Rice. 12. Violation of the anatomical shape of the crown

Conclusion.

Orthopedic treatment using metal-ceramic crowns has remained one of the most common methods of prosthetics for quite a long time. With the help of such crowns, it is possible to achieve leveling of the defect with high-quality restoration of anatomy and function, while not forgetting about aesthetics.

The purpose of this work was to analyze errors at the clinical stages during orthopedic treatment of pathology of hard dental tissues with metal-ceramic crowns.

To achieve the goal, scientific literature was studied on the problem of manufacturing metal-ceramic crowns and the occurrence of errors at the clinical stages. The main methods for assessing the condition of metal-ceramic crowns and hard dental tissues were also reviewed. After this, an analysis of the occurrence of errors in the clinical stages was carried out.

During the analysis, 45 patients with metal-ceramic crowns in the oral cavity with a period after prosthetics not exceeding 12 months were examined. Complaints and anamnesis were collected, the oral cavity was examined, various tests and indices were calculated, and radiographs were examined.

The study revealed the following main disadvantages and complications after prosthetics with metal-ceramic crowns:

• Cracks, chips

• Violation of marginal seal

• Deconsolidation

• Carious process and its complications

• Violation of the anatomical shape

• Violation of proximal contacts

• Violation of occlusal contacts

• Discoloration

In conclusion, a quote from the famous Russian dentist Academician A.I. Rybakov should be given: “Prosthetics is the final stage of oral sanitation.” Thus, it should be noted that the preventive component prevails in the therapeutic and prophylactic effect of prostheses and other orthopedic devices on the patient’s body. Consequently, the entire orthopedic section of dentistry has an accentuated preventive focus.

Timely and adequate prevention, diagnosis and adherence to technological stages during prosthetics can significantly reduce the risks of complications in the immediate and long term. Based on the work carried out, we can draw the following conclusions.

Conclusions.

1. It was revealed that one of the most common methods of replacing defects in hard dental tissues are metal-ceramic crowns; indications and technological stages are described, knowledge of the techniques of which will prevent the occurrence of errors and complications.

2. Based on the examination of 64 metal-ceramic crowns of the main and control groups, the following complications and their frequency were identified: cracks, chips of ceramics - 7.8%, violation of marginal fit - 9.4%, decementation - 3.1%, carious process and its complications - 7.8%, violation of anatomical shape - 4.7%, violation of proximal contacts - 7.8%, violation of occlusal contacts - 3.1%, color disturbance - 7.8%.

3. When comparing the results of anamnesis, examination, determination of the Svrakov iodine number, PMA index of the main and control groups, it was revealed that there was a higher intensity of gum inflammation in the main group, which can be associated with the following complications: violation of marginal seal, chipped ceramics, violation of proximal contacts , root caries.

Violation of the anatomical shape, violation of approximal and occlusal contacts, violation of color, marginal fit, caries and its complications can be direct errors at the clinical stages, or indirect, since at the diagnostic stage, as well as at the stages of fitting and fixing the prosthesis, control examinations are not were noticed and not eliminated by the doctor.

4. Assessment of the level of hygiene of dentures indicates the need to use additional products for individual oral hygiene to extend their service life and improve the quality of life of patients.

5. Based on the study and the results obtained, it is possible to give recommendations for the management of patients at the clinical stages during prosthetics with metal-ceramic crowns, as well as in the long term of prosthetics in order to prevent complications.

Practical recommendations.

1. In order to prevent the occurrence of complications, the dentist needs to improve his qualifications and improve his knowledge, which will allow him to use a comprehensive and reasonable diagnosis at the planning stage.

2. It is necessary to explain to the patient the basic

basic aspects of individual oral hygiene, recommend products based on the individual characteristics of the patient. Motivate the patient to perform professional oral hygiene every six months.

3. Conduct regular control examinations every 6 months, including X-ray examination of supporting teeth to monitor the quality of prosthetics in the long term in order to timely eliminate complications.

4. The dentist must strictly follow the methods of preparation, taking impressions and other clinical stages, as well as control the laboratory stages at the clinical appointment.

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