Preparation of teeth during fabrication of fixed dentures – is an operative technique of removal of hard tooth tissues, which is done to create space for a denture, provide its comfortable insertion into prosthetic tissues and following stabilization.

Preparation of teeth is the most complicated, time-demanding manipulation of a dentist, and is one of the main stages of prosthodontic treatment with the help of fixed dentures.

**PREPARATION OF TEETH DURING INLAYS FABRICATION**

*Sequence of tooth preparation for an inlay consists of following stages* (S. D. Arutyunov, 2007):

- Anesthesia.
- Opening of caries cavity.
- Necrectomy.
- Forming the cavity.
- Finishing of cavity edges.

**Main principles of forming the cavity:**

At the stage of opening a caries cavity, all hanging edges and enamel without underlaying dentine. It’s necessary to provide free visualization of the whole cavity. All necrotic tissues should be removed until solid unpigmented dentine. Walls of the cavity are sheer without undercuts. If cavity is formed with undercuts, modelling works and insertion of inlay will be hardly possible. To make vertical sheer walls dental rotating instruments with a working part longer than depth of a caries cavity should be used (fig. 1).

Divergence angle – is the angle, created by a cavity wall and a perpendicular line towards the cavity bottom (fig. 2). The divergence angle of cavity walls should be $3-6^0$. In small cavities it can be minimal, in deep ones – should increase. Diverging walls prevent deformation of modelling material during its recovery out of the cavity and simplifies fixation of the microdenture. Fixation of the ready denture in a cavity with diverging walls allows easy exit for luting agent during cementation.

The cavity should have sufficient depth and dip into dentine (fig. 3). When forming a cavity, special rate between its width and depth should be considered. The wider is the cavity, the deeper it should be. In shallow and wide cavity inlay is hardly fixated. In a narrow and deep cavity its hard to prepare sheer walls. When walls are diverging at too big angle, the denture stability decreases (S. D. Arutyunov, 2007).
Besides removal of necrotic softened tissues at the stage of necrectomy, cutting of fragile and weakened enamel edges is made. In big defects thin enamel wall is excised. Separate defects may be kept separate, if the distance between them is at least 1 mm (fig. 4). Neighbouring defects, with the distance between them less than 1 mm, should be unificated into a single cavity.

To provide stability of an inlay, the bottom of the cavity should be flat and perpendicular towards masticatory pressure direction. In deep cavities with unequal dentine lesion, forming of a flat bottom is complicated. To straighten the bottom, a filling material can be used. With the help of filling material (GIC, composite cement) forming of the bottom is performed until the desires flatness is reached (fig. 5).

In II class cavities during forming of the main cavity which is located on proximal surface, an additional retentive cavity is made on the occlusal surface (fig. 6). Additional cavity is shaped as a “dove-tail” or narrowed sphere. Additional cavity provides retention of an inlay and prevents its dislodgement.

Cavity in tooth tissues, prepared for an inlay, should be asymmetrical (fig. 7). Symmetrical cavities often become a reason for wrong fixation of an inlay in the tooth crown. For example, in I class defect (on occlusal surface of the tooth) a cavity shouldn’t be shaped as a circle, rectangle or two symmetrical connected triangles (B. Boyanov, T. Hristozov, 1962). The cavity should be irregularly shaped (asymmetrical, complicated shape).

Stability of an inlay is much influenced by the angle, which is created with side walls and the bottom. If the angle is significantly rounded, the denture doesn’t have sufficient stability (S. D. Arutyunov, 2007). Nevertheless, when cavity walls are thin, it is recommended to make spherical transition from the wall to the bottom (fig. 8), which prevents stress concentration and fracture of the thin wall. On the fig. 9 there is presented comparative characteristic of internal tensions in the models, made from optically active material (method of photoelasticity), according to the design of cavity (N. M. Poloneychik, 1982).
Analyzing comparative characteristic of tensions in the optically active models, we can conclude that fracture of a thin wall will occur with less power if its transition into the bottom was formed with a $90^0$ angle, and with bigger power if there was formed a spherical transition (fig. 9.4).

Differences during forming of cavities for inlays from various constructional materials basically are leading to presence or absence of a bevel. At the stage of forming the cavity (for any type of planned constructional material) enamel walls should be prepared in such a way, that internal ends of enamel prisms which form the wall, should be located in sound dentine (fig. 10.2). In integrity of enamel prisms from the surface until dentine border is broken (fig. 10.1), the prisms which are not supported by dentine, are chipping and creating a gap at the connection edge between restoration and tooth tissues.

When ceramic inlay is being made, the bevel of 10-15$^0$ is formed only in the enamel part of the wall to remove unsupported enamel prisms. For metallic inlay this angle can be 30-45$^0$ (S. D. Arutyunov, 2007).

Methodic of forming the cavity depends on the destruction degree of the crown and type of an inlay (fig. 11).

![Fig. 9.](image1) Comparative characteristic of internal tensions in the models, made from optically active material (method of photoelasticity), according to the principle of cavity forming: 1 – converging cavity walls; 2 – parallel cavity walls, perpendicular to the bottom; 3 – spherical transition of walls into the bottom; 4 – combination of spherical transition (at the right) with $90^0$ angle (at the left)

![Fig. 10.](image2) Unsupported enamel prisms (1); 15-20$^0$ bevel is formed in enamel comparing to horizontal plane (2) (from the book «Одонтопрепарирование при восстановлении дефектов твердых тканей зубов вкладками», С. Д. Арutyunov и соавт., 2007)

![Fig. 11.](image3) Cavities for inlays, formed according to the degree of crown destruction: 1 – inlay, restores deficient tissues with a partial reproduction of triangular ridges of cusps at their base (II class by Black, MO type by Boyanov); 2 – onlay, fully restores internal triangular ridge of a cusp (vestibular), without overlapping its tip; 3 – overlay, fully overlaps lingual cusp with transition onto the lingual surface (Rosentel S. F. and all. «Contemporary Fixed Prosthodontics», 2001).
PREPARATION OF TEETH DURING FABRICATION OF ARTIFICIAL CROWNS

During planning and preparation of teeth for artificial crowns a doctor should consider biological, mechanical and esthetic factors (fig. 12).

Biological factors include 1) protection of the pulp during removal of hard tissues of the tooth for creation of necessary space to be filled with future constructive material of the denture, 2) maintenance of healthy periodont, and 3) providing of functional occlusal relations.

Mechanical factors suppose forming of optimal geometry of tooth stump, providing trustable fixation of the denture and its stability towards functional loads.

Esthetic factors suppose creating during preparation such conditions which will provide esthetic adequacy of the denture (color and optic properties of the denture corresponding to the surrounding tissues, stability of the color etc.). Grinding of hard tissues should be done within the volume which develops on construction of the denture and technological process used (fig. 13).

![Factors to be considered during planning of excised tissues volume and preparation of teeth for artificial crowns](image)

**Fig. 12.** Factors to be considered during planning of excised tissues volume and preparation of teeth for artificial crowns

![Comparison of prepared volume from the occlusal surface of teeth at making of: 1 – stamped crowns; 2 – full-cast crowns; 3 – ceramo-metallic crowns.](image)

**Fig. 13.** Comparison of prepared volume from the occlusal surface of teeth at making of: 1 – stamped crowns; 2 – full-cast crowns; 3 – ceramo-metallic crowns.

Preparation of tooth for metallic stamped crown (fig. 13.1) supposes grinding of occlusal surface within 0.35 – 0.5 mm (thickness of the pattern for stamped crown makes 0.3 mm). Afterwards separation is done – grinding of proximal surfaces and making them parallel. Then preparation of facial and lingual surfaces of the tooth is performed, and giving a cylinder shape to the tooth with diameter equal to the diameter of the tooth cervix.

![Creation of converging walls during preparation of tooth for full-cast metallic crown](image)

**Fig. 14 Creation of converging walls during preparation of tooth for full-cast metallic crown**

Preparation of tooth for full-cast metallic crown supposes grinding of the occlusal surface within 1.0 - 1.5 mm (fig. 13.2). Then grinding of proximal, facial and lingual surfaces and giving to tooth stump tamper with 3–5% convergence of the walls. In result tooth receives a conoid shape, when diameter of cervical preparation line is more than diameter of the stump in occlusal third (fig. 14).
Preparation of tooth for combined (ceramo-metallic) crowns supposes grinding of occlusal surface within 1.5 – 2.0 mm (fig. 13.3). Then grinding of proximal surfaces, facial and lingual surfaces are done with giving to the tooth stump taper shape and 3-5% converging walls (fig. 15).

Fig. 15 The amount of grinded hard tissues of anterior (1) and posterior (2) teeth during manufacturing of combined (ceramo-metallic, metallo-acrylic) crowns.

Tapered stump with 3–5° converging walls provides maximal retention of artificial crowns and makes cementation of the crown more easy due to good conditions for excessive cement to go out.

For tapering of abutment tooth stump

The conoid burs with 2.5-4° convergence angle are used. Bigger convergence angle of the prepared stump depresses retention properties (fig. 16).

Fig. 16. Influence of tapered converging walls degree onto retention parameters of artificial crowns (Schillinburg, H. et al., 1991)

Preparation of the tooth should be done in such a way that the shape of tooth stump will partly mimic its original anatomical shape (fig. 17.1). The shape of the tooth stump should provide possibility for inserting of the crown and maintain denture space during occlusion and movements of the mandible (fig. 17.3; 17.4).

Fig. 17. Preparation of the tooth and shaping of the stump: 1 – correct shape repeating main contours of the original anatomy; 2 – wrong shape with errors in anatomical original shape; 3 – maintaining of the space for the denture during transversal movements of the mandible; 4 – maintaining of the space for the denture during sagittal movements of the mandible.

During preparation of the tooth for artificial crown, the removal of hard tissues should be controlled and anatomical shape should be maintained, which can be achieved with the help of the following methods:

Marking of the crown with marking burs;
Using of previously received silicone impression (so called “occlusal key”) 
Using of silicone strips of different thickness. 
Marking is provided by creating in the hard tissues of the grooves with specific deepness. For this reason special marking burs are used (fig. 18.1, 18.2, 18.3) or round burs (fig. 18.4) and other burs, which have working part of the known diameter.

Fig. 18 Placing of marking grooves onto the tooth surface with the help of different instruments

After placement of marking grooves, doctor has their bottom as a control level and removes main volume of the tissues at the deepness corresponding to the deepness of marking groove (fig. 19)

Fig. 19 Preparation of tooth tissues at the deepness, corresponding to the deepness of marking groove

Silicone impression (“occlusal key”) method is represented as periodical placing of silicone impression which was cut at the level of prepared tooth onto this tooth. Visually the gap between inner surface of the impression and the surface of tooth stump can be seen and its value can be determined.

Method of silicone strips with 2 mm thickness is represented by periodical placing of the strip, covered with special colourant, onto occlusal surface of prepared tooth and valuing of the occlusal gap during teeth contact. At this time colourant paints sites which are not enough prepared, and have to be processed more.

During preparation of teeth always a preparation line (margin) is formed. It is the line where the crown margin lays (fig. 20). 
Clear preparation line is a main condition to provide tight marginal adaptation of the crown, and prevent mechanical irritation or traumatic lesion of periodontal tissues by excessive length, sharp or underhanging edge of the crown.

During preparation of teeth the following types of preparation lines (margins) are made: knife (feather) edge, shoulder, beveled shoulder, champer and bevel (fig. 21, 22).
The level of margin placement also has variants (fig. 23). There is subgingival location of preparation line (fig. 23.1), location at the level of gingival margin (fig. 23.2) and supragingival location (fig. 23.3) of preparation line.

![Fig. 23 Topography of preparation line (shoulder): 1 – subgingival; 2 – at the level of gingival margin; 3 – supragingival toponography of preparation line.](image)

The choice of shoulder topography is done considering clinical case: periodont condition, depth of dentogingival groove, place of the tooth in dental arch, condition of the hard tissues of the tooth etc. If it’s a molar, hard tissues are healthy, there is no discoloration there is no need to perform subgingival preparation.

When a highly esthetic result is expected, in anterior teeth area, it’s recommended to place shoulder 0,2 – 0,5 mm under gingival margin.

On the figure 24 there is shown topography of subgingival preparation line during making of crowns.
Fig. 24. Topography of subgingival preparation line.

Steps of preparation of anterior and posterior teeth are shown on the figures 25 and 26.

Fig. 25. Steps of preparation of anterior tooth (Rosentel S.F. and all., “Contemporary Fixed Prosthodontics, 2001)

Fig. 26. Steps of preparation of posterior tooth (Rosentel S.F. and all., “Contemporary Fixed Prosthodontics, 2001)

Preparation is ended by final processing of tooth stump and shoulder. During final processing of the stump and the shoulder all sharp edges should be smoothed and finishing of the stump surface should be done with the help of burs of fine abrasive grain.