Сеченовский Университет

Федеральное государственное автономное образовательное учреждение высшего образования Первый Московский государственный медицинский университет имени И.М. Сеченова Министерства здравоохранения Российской Федерации (Сеченовский Университет)

TUTORIAL

INTRODUCTION TO DENTISTRY

Edited by A.V. Sevbitov

Министерство образования и науки РФ

Рекомендовано Координационным советом по области образования «Здравоохранение и медицинские науки» в качестве учебного пособия для использования в образовательных учреждениях, реализующих основные профессиональные образовательные программы высшего образования по направлению подготовки специалитета по специальности 31.05.03 «Стоматология»

Регистрационный номер рецензии 313 ЭКУ от 19 апреля 2018 года

Москва
ИЗДАТЕЛЬСКАЯ ГРУППА
«ГЭОТАР-Медиа»
2018

Lesson 3

Equipment of the dental office. Types of dental units and handpieces

EQUIPMENT OF DENTAL OFFICE

To equip the dental office you need a lot of equipment that can be assigned to the following groups for the purpose.

- Equipment and instruments necessary for the direct performance of medical procedures.
  - The main equipment is a dental unit, dental chair, doctor's chair, assistant's chair, doctor's dental desk.
  - Auxiliary equipment includes equipment designed to perform specific medical or diagnostic manipulations for example: electrodontodiagnostics device, diathermocoagulator, apex locator, photopolymerization lamp, amalgam mixer, etc.
- Equipment for sterilization and disinfection: dry-heat sterilizer for sterilisation of instruments, glass bead sterilizer for sterilization of small tools, table for sterile instruments, quartz lamp to disinfect the room air, fume hood when working with amalgam.
- Equipment for the nurse: writing desk, computer (for electronic records), chair, strongbox to store records and electronic backup copies.
- Equipment for hand treatment and pre-sterilization treatment: hand wash basin, sink for washing instruments (the instruments and hands are washed in separate sinks!), containers with disinfectant and detergent solutions.
- Medical furniture: a multi-tiered cabinet for storing medicines, tools, filling, bandaging materials; cabinet for poisonous (A) and powerful (B) substances (always locked!). First Aid Kit, couch, patient chairs, cabinet for sanitary inventory.

All equipment in the office should be placed so that the doctor and the assistant make no unnecessary movements, and the nurse could quickly follow the dentist's instructions. In addition, the furniture and equipment should be arranged so that there are distinct sterile and non-sterile areas, without overlapping, for example: patients approaching the chair should not pass past the sterile table, etc.

DENTAL UNIT

The dental unit is the most important piece of equipment in providing qualified dental care.

The dental unit is a hardware complex that allows you to perform basic dental procedures.

Currently, the term unit refers to a complete set comprising: the actual unit, dental chair, compressor, doctor's desk, doctor's chair and an assistant's chair.

The dental unit consists of functional units, each of which has its own function. Depending on the configuration of the installation, the set of blocks can be changed.

Basic units

- Tool unit: the basic unit has tools for manipulation in the mouth. It can be complete with a lighting unit for instruments with fiber optic illuminators.

Fig. 3.1. Dental unit with block of tools combined with the control unit, monitor and hydroblock

- Low-speed motors provide the rotational speed of the rotary tool from 10 000 to 30 000 rpm.
- High-speed rotary (turbine) tools provide a rotational speed of the rotary tool of 300 000 to 500 000 rpm; they usually have tips of two types: therapeutic and orthopedic ones.
- Other tools include a scaler (a tool for removing dental deposits), polymerization lamp (for the polymerization of photopolymers), etc. The complete set of these tools is mostly optional («to order»).
- Control unit consists of a pedal and control panel; it serves to control all systems of installation (chair position, tool rotation speed and other parameters).
- The hydroblock.
  - Spittoon is designed for disposal of saliva and other liquids in the sewage system; it is equipped with a flushing system.
  - The glass sink is designed to fill the glass with rinse water and is equipped with a filter for cleaning the incoming water.
  - Saliva ejector is designed to flush saliva and other fluids directly from the patient's mouth to the sewer system.
  - Suction is intended for utilization of an aerosol mixture formed in the oral cavity during when high-speed (turbine) tips are working. They are equipped only with high-speed instruments.
  - Air-waterspray handpiece is designed for drying and irrigating the mouth with water or water-air mixture.
- Lighting unit consists of a halogen lighting lamp to illuminate the working field allowing you to raise, lower, turn in a horizontal plane and hold the lamp in the desired position. Surgical units can be equipped with shadowless lamps.
- Dental chair is designed to accommodate the patient. It moves in a vertical plane (up and down) to provide a height that is convenient for the dentist's work. The back of the chair is also able to go up and down (to give the patient the desired tilt or reclining position). Headrest provides positioning of the patient's head in horizontal and vertical planes.
- Compressor is designed to supply compressed air to the turbine lugs and water-air gun.
- Dentist's table is designed to accommodate tools, instruments and materials during work; it has wheels for easy movement. Recently, the «table-stand», which has several drawers with sets of tools for various manipulations, has become very popular.

- Dentist's chair consists of a soft seat, a semilunar backrest rotating around the axis of the chair, which serves as a support for the back, wheels for easy movement of the chair, a fixation device that does not allow the chair to move after the doctor has taken the working position.
- The assistant's chair is 15–20 cm higher than the dentist›s chair (the assistant looks at the working field without obstructing the view to the dentist).

DENTAL HANDPIECES

Dental handpiece (also known as dental drill) is a tool that is used to drill the tooth with a bur. It is a small, high-speed drill used during dental procedures. The dentist usually removes decay and prepares the tooth structure prior to inserting a filling or crown.

Uses of dental handpiece:

- elimination of caries;
- shaping the tooth prior to restoration;
- removing old or temporary filling or crown;
- cleaning the tooth surface;
- preparing root canals.

Types of dental handpieces

With regard to their speed: high speed dental handpiece and low speed handpiece.

High speed dental handpiece (fig. 3.2) can rotate at up to 500 000 rpm; it uses FG 16 mm burs.

Low speed handpiece is operated by air or electromotor; its working speed is up to 40 000 rpm.

Based on design, there can be air-driven and electric handpiece.

Fig. 3.2

Air-driven high-speed handpieces contain air-driven turbine inside which generates rotational motion. Electric handpiece contains an electric motor driving the device. An electric handpiece is designed as a whole entity.

Electric handpiece is more quiet while functioning; it does not produce a high-pitch sound. It has constant torque at any speed. An electric handpiece is more expensive but superior in operation.

Low-speed handpiece works with air — (fig. 3.3) or electric motor:

- can be of contra-angle or straight variety;
- speed up to 40 000 rpm;
- operates rotary instruments in either a forward or backward movement.

It is used for:

- removal of soft decay and finishing of a prepared cavity;
- finishing and polishing of restorations; polishing teeth and removing stains;
- trimming, contouring and finishing temporary crowns, dentures and orthodontic appliances.

Straight attachment uses a long straight bur (same as in dental laboratory). Contra-angle attachment receives latch type rotary instruments and mandrel

Contra-angle handpieces can have different gear ratio.

Fig. 3.3

Fig. 3.4

- Standard 1:1 marked with blue spot or line: preparation of a tooth and finishing (fig. 3.4).
- Reduced 6:1, 20:1 marked with green spot or line: endodontic manipulations and surgery. Less speed but more torque.
- Increased 1:5 marked with red spot or line: reparation of a tooth. Uses same FG burs as turbine handpieces.

Ultrasonic and sonic handpieces

Used for prophylactic cleaning and bone surgery. Ultrasonic tip can easily remove tartar. Diamond tips can be used for tooth or bone preparation. Nowadays it is common practice to stir irrigation solutions with an ultrasonic tip during endodontic treatment.

Laser handpiece

We have different lasers in dentistry.

- Healing laser is part of physiotherapy. Mostly used after surgery.
- Diode laser for soft-tissue surgery. It cuts excess gingiva in case of inflammation or for esthetic purposes. No-bleeding technology is more acceptable for patients.
- Er-YAG lasers for tooth preparations and bone surgery. Extremely expensive but we can prep teeth without anesthesia.

Air abrasive handpiece

Prophy or operative. The prophy variety is for cleaning plaque. A powerful jet of soda powder and water cleans the surface of the teeth from plaque. Operative air abrasive handpiece can prep teeth with Al-oxide powder.

Lesson 4

Dental instruments for examination and basic treatment

Learning objective: to study basic tools and devices used for examination of the oral cavity and subsequent therapeutic sanitation.

CLASSIFICATION OF DENTAL INSTRUMENTS

Classification of dental instruments:

- for examination;
- for preparation of hard tooth tissues;
- for tooth filling;
- for finishing of fillings;
- for removal of plaque;
- for endodontic treatment.

Hand instruments can be made of metal or plastic. They are usually named according to their shape or use. Also, they can be named after the designer of the instrument.

Hand instruments may be single- or double-ended. Double-ended ones are more preferable: two sizes of the same instrument, two different instruments, or two directions of use in one instrument (right/left).

There are three parts to a hand instrument.

- Working end. The design determines the function.
- Shank. It connects the handle and the working end. The shank may be straight or angled to provide better access to different areas of the mouth.
- Handle or shaft. Rounded or hexagonal in different diameters and materials for better fit and grip.

INSTRUMENTS FOR EXAMINATION

Dental mirror (fig. 4.1).

- The mirror used by the dentist can be of two types: concave, magnifying, and flat, giving a true display.

Fig. 4.1

- The dental mirror consists of a circular mirror surface (2 cm in diameter) in a metal frame and a rod that is screwed onto the handle.
- This tool is designed for:
  - additional workplace lighting;
  - inspection of inaccessible areas of the teeth and mucous membrane in the oral cavity;
  - protection of lips, cheeks, and tongue from injuries during treatment;
  - fixing of the lips, cheeks, and tongue during examination;
  - a certain increase in the examined area of the oral cavity.

Probe or explorer (fig. 4.2).

- The dental probe can be angular (the working part is bent at an angle) and straight (bayonet). The working end is of pointed shape.
- This tool is used for:
  - detection of carious cavities;
  - determining the condition of fissures (depth, tenderness), the nature of softening in dental tissues;
  - determining the presence of caries signs in the tooth cavity;
  - refining the topography of root canals.
- Note: when examining pockets, a blunt probe with linear cuts (bell-shaped) is used.

Tweezers (fig. 4.3).

- Tweezers used by the dentist for examination and treatment are different from other types of tweezers. The ends of this tool are bent at an obtuse angle.

Fig. 4.2

Fig. 4.3

- Dental tweezers are used for:
  - retention and transfer of cotton swabs to the oral cavity (isolation against saliva, drug treatment of carious cavity and tooth cavity);
  - determining the degree of mobility of the tooth;
  - retention and transfer of small tools;
  - assisted manipulation during treatment.
- Note: during surgical manipulations use surgical tweezers.

Instruments for tooth preparation

The main requirements for burs are:

- diameter of the rod — 1,60±0,05 mm;
- total maximum length — up to 25 mm;
- diameter of the working area of the bur head — up to 2 mm.

Depending on the material of the working part of the bur, they can be made of steel (of hardened steel as well), carbide or diamond coated (fig. 4.4).

Standard steel burs can effectively cut only the dentin and only at low rotational speeds. At high speeds (more than 10 000 –12 000 rpm) and when preparing enamel on the cutting edges of boron, very high temperatures are created, leading to their melting and total loss of efficiency (Petricas A.Zh., 1994).

The working part of carbide burs is made of tungsten carbide. It cuts 6–8 blades with sharp working edges. The head is soldered to a stainless steel rod. Soldering is the weak point of carbide burs, so when handling them, you should avoid lever-like movements. These burs have a high cutting ability, can withstand large thermal overloads and effectively process enamel, dentin, amalgam, composites and other materials at high speeds, including turbine drills. The cutting efficiency of carbide burs is greater than that of diamond, but they are less durable.

Along with traditional types of carbide burs, polyhedral burs are produced, whose number of faces varies from 12 to 32. These faces are of low height, so

they are less aggressive when cutting. Such burs are used for finishing edges of enamel, grinding and polishing fillings from composites and amalgams (final or finishing). The more faces a bur has, the less its cutting ability and the higher the polishing quality.

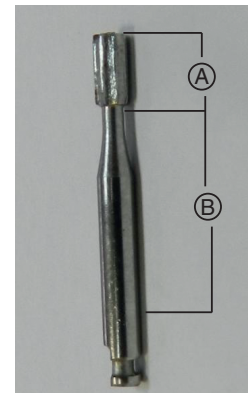

Fig. 4.4

Color marking of carbide (carbide-tungsten) burs:

- green burs with high cutting ability (6 blades, E-shaped, notching on cutting edges);
- no ring 8 blades;
- 16 yellow blades;
- 30 white blades.

Finishers are of diamond and hard-alloy, they are designed to give a finished shape to the relief and polish the restoration. The spirally designed shape of the head of the fin provides a closer contact with the tooth tissues throughout its entire length.

Hard carbide fins have lower abrasive properties than diamond ones. The heads of carbide fins are produced in two types, with 12 or 30 working faces, so they take less material compared to standard burs.

Depending on the form of the working part, each group of instruments is used to solve a particular aesthetic task.

The finishers are:

- needle-shaped: contouring and final processing of restorations for II, III (interproximal areas), IV and V classes;
- ovoid: contouring and grinding of chewing and lingual (palatine) surfaces — restorations according to the first class;
- round: contouring and grinding of chewing and lingual (palatine) surfaces — restorations according to the first class;
- peak-like: contouring and grinding of occlusal surfaces, as well as treatment of subgingival areas of restored dental tissues;
- candle with a rounded end: contouring and polishing the occlusal surfaces of restorations made in all classes;
- candle with a pointed end: formation of contours and grinding of the cervical region;
- long candle: forming contours and grinding the cervical region in situations where a longer tool is required;
- fissure: contouring and grinding of the occlusal surfaces of restorations made in all classes.

ISO coding of burs cutting ability.

- Black — super rough 150–210 μ — initial preparation.
- Green — rough 125–150 μ — preparation.

- Blue — medium 62–120 μ — shaping preparation, universal.
- Red — fine 20–61 μ — finish preparation, shaping.
- Yellow — extra fine 10–27 μ — finishing.
- White — ultra fine 4–14 μ — polishing.

Diamond burs are used for preparation of carious cavities, finishing of tooth tissues and contouring of hard (i.e., non-viscous) filling materials. Diamond instruments are designed for no more than 5–6 operations. After that, it is almost inevitable to erase and partially break the contours of the working area of the bur, which is manifested by a decrease in abrasive ability, leads to overheating of the instrument and causes a burn of the tooth pulp.

Depending on the shape of the working part (head), each group of instruments is used to solve a particular clinical problem.

There are burs of the following shapes:

- round head: preparation of medium-sized cavities, correction of occlusal surfaces, opening of pulp;
- ball-shaped with a collar: opening and preparation of the cavities in «one-touch», i.e. with a single instrument;
- inverted cone: incision and removal of old fillings (especially amalgam fillings), preparation of occlusal surfaces;
- diamond-shaped: preparation of occlusal surfaces, final processing and correction of the occlusal profile;
- wheel: creation of retentive punches;
- fissure: expansion and preparation of retention points and contouring of the side walls of the cavity;
- pear: opening and shaping cavities in classes I and II, preliminary treatment of cavities in V class on the occlusal surfaces of molars, formation of cavities in class III;
- cone: contouring of the inner walls of the cavity, opening and contouring of the interproximal space, treatment of subgingival space, formation of ledges and steps;
- oval: contouring of occlusal surfaces of restorations made of composite filling materials;
- flame: formation of the fold (slant line) along the cavity border, preparation of the lingual (palatine) surface in frontal teeth, final processing of the interproximal and subgingival spaces.

Instruments for tooth filling

- Smoother (one-sided, two-sided, combined with a stopfer) – used for inserting a filling material.

- Stopfer (round, pear-shaped, cylindrical) – used for tamping the filling material.
- Spatula – used for mixing dental material.
- Excavator – used to remove softened dentin, surplus material, plaque, temporary fillings.

Instruments for removing dental plaque

Curettes.

The working part of these tools is made in the shape of a straight or curved spatula, as well as in the shape of a sickle with pointed ribs.

Dental curettes are designed to remove plaque and tartar.

Instruments for endodontic treatment

Modern endodontic instruments are divided into the following groups:

- tools for root canal orifice enlargement;
- tools for the root canal passage;
- tools for the enlargement and preparation of root canals;
- tools for root canal filling.

Control questions

1. Name the main groups of dental instruments for examination and therapeutic sanitation of the oral cavity.
2. List the dental instruments for examination and indicate their purpose.
3. What dental instruments are used to prepare hard dental tissues? Name the main groups of burs, their difference and purpose.
4. List the instruments for tooth filling and indicate their purpose.
5. List dental instruments used for finishing the filling. Specify the order of their application.
6. What dental instruments are used to remove dental plaque? Specify their design features and indications for use.
7. List the main groups of dental instruments for endodontic treatment.

Lesson 5
Disinfection and sterilization

The main measures limiting the spread of the infection at a dental appointment are aseptics and disinfection with antiseptics closely related.

Key notions in this sphere are as follows.

Aseptic means the state of being free from disease-causing contaminants (such as bacteria, viruses, fungi, and parasites) or preventing contact with microorganisms.

Antiseptics means all you have to do in order to destroy microorganisms in injury, organs and tissues.

In 1890 at the Xth International Medical Congress in Berlin the basic postulate of asepsis was adopted: **all things that come in contact with injury must be sterile**.

There are high degrees of pollution and microbial contamination; besides, dental instruments are of rather complex configurations, lots of retention points and locking fasteners. Besides there is a great variety of dental instruments and each one of them has a specific function, structure of materials. That is why the choice of ways and methods of disinfection and sterilization requires a differentiated approach.

Disinfection means destruction of most pathogenic and other kinds of microorganisms (but not spores) by physical or chemical means.

Sterilization means a physical or chemical process that destroys all microorganisms, including spores.

In 1968 E.H. Spaulding suggested dividing all medical products into critical, non-critical and semi-critical items based on the degree of contact they have with patients and their risk of disease transmission. In turn, their risk of disease transmission indicates how they should be cleaned for reuse.

Critical items cut bone or penetrate soft tissue. These instruments carry the highest risk.

Clean and heat-sterilize critical dental instruments before each use.

Whenever sterilization is inaccessible, disposable instruments should be used.

Semi-critical items touch only mucous membranes. They have a lower risk of transmission.

- Clean and heat-sterilize semi-critical items before each use.
- For heat-sensitive critical and semi-critical instruments, reprocess using high-level disinfectants or low-temperature sterilization method (such as ethylene oxide).
- Single-use disposable instruments are acceptable alternatives if they are used only once and disposed of correctly.

Noncritical items only contact intact skin. They have the lowest risk of disease transmission.

Ensure that noncritical patient-care items are barrier-protected or cleaned (or if visibly soiled, cleaned and disinfected) after each use with a hospital disinfectant. If visibly contaminated with blood, use a hospital disinfectant with a tuberculocidal property (i.e., an intermediate-level disinfectant).

Processing of medical instruments consists of several stages:

- disinfection;
- pre-sterilization cleaning;
- sterilization.

There are two possible ways of disinfection: physical and chemical.

Physical disinfection is processing using strong heat (boiling in distilled water or water with an addition of sodium bicarbonate).

Chemical disinfection is processing instruments with chemical disinfectants. Chemical fluids have different basic active substances and different spectrum of action. Chemical disinfection is the method used most commonly nowadays.

Put the instruments put in the disinfectant tank immediately after use, so that they are covered completely.

Instruments of complex configuration are disinfected unassembled. Channels and cavities are filled with disinfectant solution so that they do not contain any air bubbles.

All chemical solutions should be used according to instruction (including the method of solution preparation and time of exposure).

After that you should wash the instruments under clear running water and dry them.

The next step is pre-sterilization cleaning. Do it to destroy residual blood, fat and protein contamination. There are two methods of pre-sterilization cleaning. The first is manual and the second one is mechanical.

Fig. 5.1

Manual pre-sterilization cleaning includes several steps: exposition in washing solution, then washing with a brush.

For mechanical pre-sterilization cleaning use automated cleaning equipment such as an ultrasonic cleaner with disinfectants.

Pre-sterilization monitoring should be done at least weekly.

1% of all items processed during a dental shift are subject to checking the quality of cleaning. Tests are made to detect residues of various contaminations: contamination with blood and proteins — (azopiram/amidopirim test), residual alkali of washing solutions — phenolphthalein test, residual fat — Sudan III test.

The results of inspection should be entered in the journal of checking the quality of pre-sterilization cleaning.

The third step is sterilization proper. Although the instruments have been cleaned to remove debris, they are not sterile.

Prior to physical sterilization the instruments should be packed.

Heat sterilization cabinet (hot dry air).

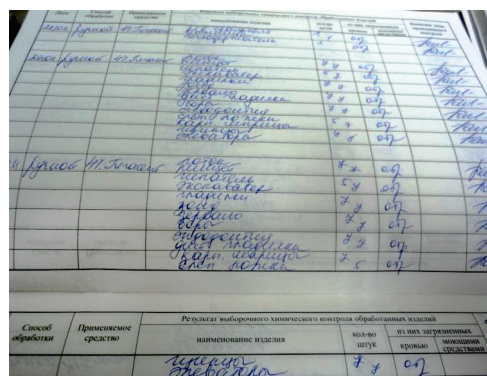

Fig. 5.2

Fig. 5.3

The most common mode is for 60 minutes at 180 degrees or for 150 minutes at 160 degree . However, dry heat sterilization has its advantages and disadvantages. On the one hand, the hot dry air does not permit any moisture to cause corrosion of instruments. On the other hand, this method is time-consuming; besides, strong heat can damage instruments so you should not use it for handpieces, mirrors and cutting instruments.

Steam sterilization is sterilization within an autoclave. In dentistry we commonly use automatic machines with a rather small working chamber. The working mode for dental instruments is at 132 degrees at a pressure of 2 atmospheres for 20 minutes, or at 120 degrees, pressure of 1.1 atmospheres for 45 minutes.

Due to its high efficiency, this method is widely used in medical practice. The method is quite cost-effective and least harmful for the environment. Autoclaving dental instruments and materials is the most reliable and sometimes the only possible way of sterilization. However, it also has some disadvantages: steam can transform to condensation which leads to corrosion of instruments; besides, it can moisten the materials which increases the risk of reinfection of sterilized products.

Sterilized and packed instruments should be stored in wardrobe cabinet or desk. Storage time is indicated on the package.

There is one more type of physical sterilization: glass bead sterilization. The time of exposure is 3–20 seconds and the temperature is 240 degrees Centigrade.

This method is used for quick sterilization of metal instruments as well as for express sterilization of burs, endodontic instruments, metal matrix, inner canal pins. Do not use it to sterilize other dental instruments.

Chemical sterilization of dental instruments uses aldehyde solutions and oxygenates. Chemical sterilization should be done strictly according to instructions. All instruments should be absolutely dry in order not to reduce the concentration of active ingredients in the working solution. All boxes should be sterile. Sterilized products are put to use immediately or placed in storage in a sterile filter sterilization box, lined with sterile sheets, for a period of no longer than 3 days.

If infection has begun to develop, we are talking about antiseptics. This term was proposed in 1750 by a Scottish physician John Pringle, who found that mineral acids possess antiseptic properties.

Types of antiseptics: mechanical, physical, chemical, biological.

- Mechanical (manual) antiseptics:
  - removal of foreign body from the wound;
  - necrectomy (removal of dead tissues which can also be the cause of infection).
- Physical antiseptics:
  - providing a passive (with a rubber drain) or active (dressings or bandage with hypertonic solution) outflow from the injury;
  - aeration of injury (providing access of air to the injury to reduce the propagation of anaerobic bacteria);
  - UV irradiation;
  - decontaminaitng equipment in combination with ultrasound;
  - microbicidal agent (causing bacteria to die): beta-lactam antibiotics, aminoglycosides, glycopeptides, metronidozol;
  - bacteriostatic agents suppressing bacterial reproduction: macrolides, tetracyclines.
- Biological antiseptics:
  - bacteriophage is a virus selectively infecting bacterial cells, multiply inside bacteria and causing their lysis;
  - antitoxin means harmless toxin derivatives that retain its antigenic and immunogenic properties. It is used to build active immunity against related infections (vaccination).