ANNOTATION TO THE LESSON № 8

MODERN DENTAL UNITS AND DEVICES PROVIDING ROTATION OF THE INSTRUMENTS

A stationary dental universal unit - a set of the interconnected, integrated elements or blocks and knots providing application in specific conditions of various dental instruments and devices (fig. 1). Modern dental unit represents a difficult complex of pneumatic, electric, hydraulic and electronic knots.

The unit includes a block of the doctor (amodular block), a dental chair with an automatic control, a dental lamp, a hydroblock with a spittoon, an assistant's block with a saliva ejector and a vacuum cleaner, a pedal of the management. Units are equipped with a compressor and an aspiration system, connected to the power supply network, plumbing and sanitary. The universal dental unit can be equipped with additional devices (a photopolymerization lamp, a negatoscope, a radioviziograph, a monitor, etc.).

Fig. 1. A stationary dental universal unit

One of the main knots of the dental universal unit is the medical (modular) block (fig. 2) which is turning on the control panel and dental handpieces - the devices intended for the transfer or transformation of the rotary movement to the instrument. The modular block of the dental unit has 2-3 hoses
(sleeves) for the micromotor and turbine handpieces. Micromotors can be electric or pneumatic. In the turbine handpiece bur is set in motion by means of compressed air which moves on the turbine rotor located in the handpiece head.

![Fig 2. Medical (modular) block](image)

Along with stationary universal dental units there are also simple devices which are called portable (figurative) drills (micromotors) (fig. 3).

![Fig. 3. Portable drills](image)

For dental laboratory work dental micromotors with the electric motor providing rotation of the instrument by transfer of rotation to the instruments through a special dental handpiece (fig. 4) are used.

For ensuring rotation of special instruments (grinding wheels, detachable disks, brushes, polishers, etc.) grinding motors with nozzles for fastening of instruments (fig. 5) are used in dental laboratories.
Types and principles of modern dental handpieces work

In dental practice the wide nomenclature of handpieces is applied. In dependence on the principles of their work turbine and they are classified into turbine and mechanical handpieces.

Turbine handpieces are the devices intended for rotation of the instrument by means of giving an air stream under pressure of 2.1-4 Bar directly on the rotor part in which the instrument (fig. 6) is fastened.

Mechanical handpieces are the devices intended for transfer of a rotary motion on the instrument from a shaft of the electric or pneumatic (air) motor (micromotor) with use of reducers, shafts and transfer gear wheel system (fig. 7).

Mechanical dental handpieces are classified by a device axis ratio to a tool axis. If the axis of the dental handpiece coincides with the direction of the rotational instrument axis, they are called straight dental handpieces (fig. 8). In so-called angle dental handpieces the axis of the dental handpiece settles down at the angle to the rotational instrument axis (fig. 9).
In dental practice, along with the listed handpieces, dental handpieces of a special purpose are applied (endodontic for processing and filling of the root channel, for professional hygiene of the teeth, for maxillofacial surgery, etc.).

**Fig. 8.** Straight mechanical handpiece  **Fig. 9.** Angle mechanical handpiece

**Fig. 10.** The rotational systems applied in dentistry

**Characteristic of handpieces:**

*High speed handpiece*
- >200,000 rpms (high pitch sound)
- air driven turbines
- most efficient at removing tooth structure
- sprays water coolant to avoid tooth damage (heat)
- type of angled handpiece

*Low or slow speed handpiece*
- rotates <12,000 rpms
- less efficient more controlled removal
- used to refine preparation,
  – controlled caries removal
  – finishing and polishing
- causes vibration (patient discomfort)
- can be used as an angled or straight.
- Air or electric driven (no water)
**Intermediate speed handpiece**

- >12,000 and < 200,00 rpm
- We use 20,000 rpm motor
- Similar characteristics to slow speed
- Air or electric powered
- Water or no water coolant

**GENERAL CHARACTERISTIC OF THE INSTRUMENTS AND MATERIALS APPLIED FOR TEETH PREPARATION AND CONSTRUCTIONAL MATERIALS PROCESSING**

For the teeth preparation, processing of filling and constructional materials special instruments which principle of action is based on the cutting (scratching-out) rotational movement on the processed surface are used (fig. 11). The cutting properties of instruments depend on a number of factors among which the most important is the type of the material they are made of.

![Fig. 11. The principle of the cutting action of metal bladed (a) and abrasive (b) rotational instruments](image)

**General classification of dental instruments used for preparation of the teeth and processing of basic materials:**

1. Metal rotating instruments – metal burs, mandrels
2. Abrasive rotating instruments – diamond burs, diamond polishers
   Mounted stones, diamond discs, etc.
3. Instruments for polishing - prophy brush, felt polisher, polishing brush, etc.
STEEL BURS
Dental bur (from german Bohrer) – the cutting instrument representing a metal core with a notch on a working part. Bur is brought to rotation by means of a dental handpiece.
Burs are made of the tempered stainless instrumental steel that doesn't oxidize. At first instruments are processed on the lathe, and then are exposed to the heat treatment that provides increase of a firmness at the tension and a strength on the break. At final processing they are polished to get accuracy of a form and a smooth spherical surface. Quality and processing of the steel guarantees resistance to different disinfectants and a low coefficient of the beating at the rotation. It is very important as it increases operation term, both bur and rotor group of handpieces.
In the instrument there are three main components: the shank for fixing in the handpiece (fig. 12a), working part (head) (fig. 12c) and the neck connecting the shank and working part (fig. 12b).

Fig. 12. Main parts of a bur: a shank (a), a neck (b). a head (c)

Diameter of a head of steel burs is usually 0,5 - 3,1 mm. The right-side or left-side notches that are situated on the head of the bur provide the cutting (scratching-out) operation of the rotating instrument at its contact with the processed surface. Formation of blades on the working surface is created usually by method of stamping or cutting by means of special hard-alloy cutters and diamond heads.

Types of blades in the head of instruments are very various. Their quantity is defined by those tasks for which this or that tool is intended. In fig. 13 some of blades types of the steel bur working surface are presented.
Fig. 13. Some of the dental bur head blades type: straight (a), straight with left-side cross spiral cutting (b), spiral right-side (c), spiral left-side (d), spiral right-side with thin left-side cross spiral cutting (e)

The form of the head is characterized by the geometrical figure that it makes during its axial rotation.

- Round
- Inverted cone
- Straight fissure
- Tapered fissure
- Pear

Fig. 14. Bur head shapes

Depending on purpose of use of bur the number of blades vary from 6-8 (universal – for preparing the tooth and hard processing of filling materials) to 12-40 (finishing burs - for polishing).

**CARBIDE BURS**
Carbide burs have kinds of forms and sizes (fig. 16), similar to steel burs. At the same time, they are distinguished by a high hardness and in some cases a special character of a notch on blades of working part that allows to use these instruments to prepare enamel, process composite materials, amalgams and alloys of metals.

![Carbide burs](image)

**Fig. 15. Carbide burs**

Carbide instruments ("two piece carbide") is made by agglomeration or hot pressing of the tungsten carbide powder and cobalt in the conditions of vacuum. After agglomeration carbide preparations (a head and a neck) solder to steel shanks made of high-quality spring steel of the high durability (fig. 16a). After connection of two parts in the uniform instrument a preparation of the head is given part a demanded form by a diamond disc. At the cutting sides creation the special diamond milling head operated by the computer program is applied.

Along with bimetallic burs the kinds of carbide burs made of one tungsten carbide preparation are known (fig. 16b). Such carbide burs ("one piece carbide") are very precisely centered and have high strength characteristics.

![Carbide burs](image)

**Fig. 16. Types of carbide burs: a bimetallic ("two piece carbide"), b - carbide ("one piece carbide")**

**STEEL CUTTERS FOR THE PLASTIC PROCESSING**

The special cutting instruments called cutters are used to process plastic. Cutters, as well
as burs, are made of stainless steel. A working part of the cutter differs from bur in sizes, a form and a nature of cutting. Diameter of the head of the metal cutters applied to plastic processing is 4.5 - 9.5 mm. In fig. 17 some kinds of steel cutters applied for the plastic processing are presented.

![Image of cutters](image.png)

**Fig. 17.** Types of cutters head forms used to process the plastic: 1- round; 2- inverted cone; 3 - cylindrical; 4 – cylindrical with the rounded-off end; 5 – cone-shaped; 6 – cone-shaped with the rounded-off end; 7 – reniform; 8 – ellipse; 9 – paraboloidal; 10 – pear

Steel cutters for processing of plastic have the shanks intended for fixing only in straight handpieces.

**CARBIDE CUTTERS FOR PROCESSING OF METAL ALLOYS**

The manufacturing techniques of carbide cutters correspond to production of bimetallic ("two piece carbide") of carbide burs. Cutters are applied generally in dental laboratory to cut alloys of precious and base metals, to polish titanic alloys, plastic. The working part of carbide cutters can have different cutting of blades. About 20 kinds of cutting are known: extralarge, small, single-row, cross, spiral, etc. The quantity of cutters on a
working surface of the instrument is defined by those tasks for which it is intended. It is necessary to notice that than the quantity of blades is more, especially smooth is a surface after processing. Cutters with single-row cutting delete the bigger volume of material in comparison with cross cutting. At their use it is necessary to observe increased security measures. The large shaving with keen edges which is formed during material processing demands an application of goggles and masks. Diameter of cutters working part is from 2,3 to 6 mm (fig. 18).

Fig. 18. Types of the head blades and sizes of carbide cutters used for metal processing

For designation of a number of the cutting edges some producers of carbide cutters use the color marking applied on the shank of the instrument (fig. 19). Yellow marking characterizes very small cutting edges (fig. 19a), red - small cutting edges (fig. 19b), green - rough cutting edges (fig. 19c), black marking characterizes very rough cutting edges (fig. 19d). If the marking is absent or it is blue, such instruments are characterized as a cutters with the average cutting edge.
Fig. 19. Color marking on the cutters shanks: a – yellow (very small cutting edges), b – red (small cutting edges), c – green (rough cutting edges), d – black (very rough cutting edges)

Carbide cutters have the shanks for fixing only in straight handpieces.

ROTATIONAL INSTRUMENTS FOR ENDODONTICS
For disclosure of the root channels entrance of the teeth, their mechanical expansion and other purposes special rotational instruments called endodontal are used (fig. 20).

Fig. 20. Some types of rotational endodontal instruments

DENTAL DRILLS
Steel spiral drills have the working end and deep frequent screw flutes promoting removal of dust from the working area (fig. 23). Dental drills are used for creation small channels of identical diameter on all extent in the dentine for restorative retentional pins.

Fig. 21. A dental drill

SPECIAL BURS FOR SURGERY AND IMPLANTOLOGY
In maxillofacial surgery and implantology the special instruments intended for the bone tissue preparation are used. One of distinctive features of such instruments is a possibility of a cooling giving directly on the prepared fabric site by means of the tubules located in the shank and on the working surface of the instruments. In fig. 22 some types of the special cutting rotating instruments used in surgery and implantology are presented.
**AUXILIARY INSTRUMENTS**

Discholder, devices for fixing of polishing heads, adapters and bondholders (fig. 23) belong to the auxiliary instruments used for rotation of abrasive adaptations. Discholders (fig. 23a) are applied for fixing of grinding and polishing wheels. For fixing of polishing heads special devices (clamps) with screw cutting (fig. 23b) are used. Adapters are intended for the use of turbine burs on straight or angular handpieces (fig. 23c). For the purpose of fixing of an emery paper for denture polishing the special devices called by bondholders (fig. 23d) are used.

**Fig. 22.** Special rotary burs used in surgery and implantology

**Fig. 23.** Auxiliary instruments: a – discholders; b – clamps with screw cutting; c – adapters; d - bondholders