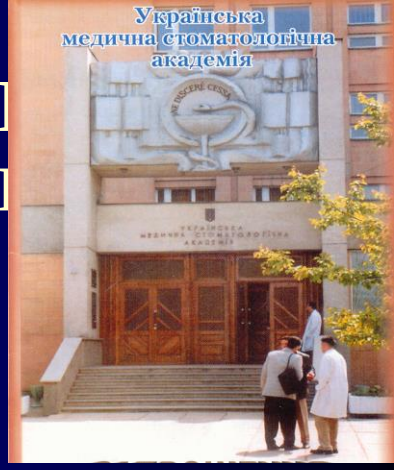
POLTAVA STATE MEDICAL UNIVE
THERAPEUTIC STOMATOLOGY PROPAEDEUTI



Filling materials

Lecture for 2-nd year students
of international faculty

The lecturer: PhD in Medical Sciences,
Associate Professor
Marchenko Iryna Yaroslavovna

Filling materials

Development history of filling materials

- Roman Avl Kornely Tsels (30– 45 y.A.D.) (the author of the treatise «De medicina») recommended to fill the big cavities in a teeth with leaden slices that a teeth did not break at removal;
- The main doctor of Baghdad hospital Abu-Bakr Muhamed ibn-Zakarija al-Razi (841-926y.) practised filling of cavities in a teeth for their preservation by a mix of alum, mastic and honey;
- In 1480 Jovani Arkolani in Bologna (Italy) has put the first gold filling;

Development history of filling materials

- Pierre Foshar (16 centuries) recommends filling of cavity in teeth by gold, tin and lead. The preference is given to slices of lead because of its plasticity;
- Darse (18 centuries) offer for teeth filling powder from tin, lead and bismuth, got mixed up on mercury;
- 1819 – Bell has offered silver amalgam;
- 1832 – Osterman has created the first phosphatic cement;

Development history of filling materials

- 1859 – Lipold has offered a copper amalgam;
- 1903 – Asher for the first time has made silicate cement;
- 1944 – beginning of use of acrylic resins;
- 1962 – occurrence of the first composite;
- 1973 – occurrence of light - polimerised composites;

Classification of filling materials

1. Temporal – for time closing of a cavity in a tooth;
2. Constants – for restoration of the anatomic form and tooth function;
3. Medical – treatment linings;
4. For filling of root canals;
5. Adgesive;
6. Hermetics.

Systematisation of filling materials from material technology position

1. Cements
2. Metal filling materials
3. Composite materials
4. Stomatologic hermetics and adgesives
5. Compomeres

The international classification of cements

1. Zinc-phosphate
2. Bactericidal
3. Silicate
4. Silica-phosphate
5. Zinc-oxide eugenolic
6. Carboxylate
7. Glassionomeric
8. Polymeric

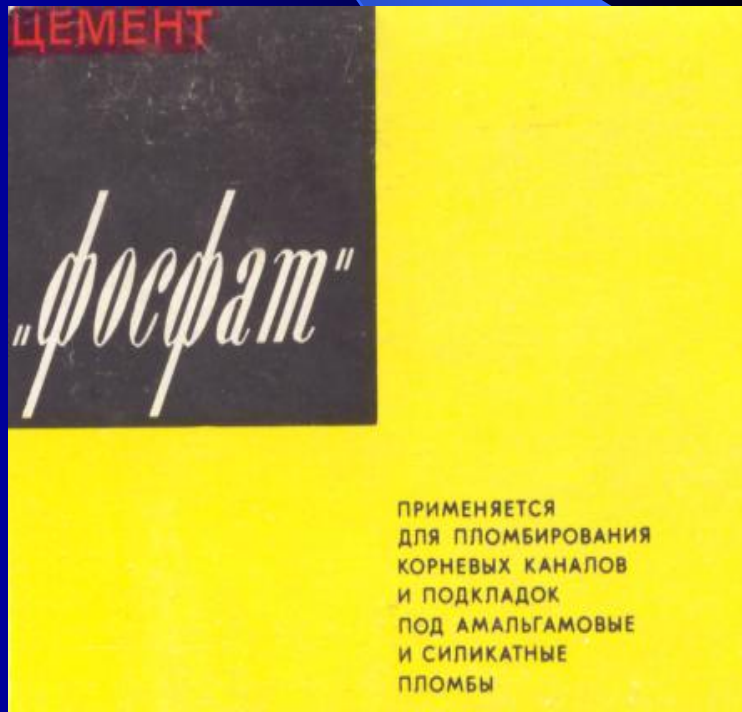
Zinc-phosphate cements

Унифас, Висфат, Фисксодент, Adhesor, Adhesor Fine, Phosphacap,Tenet, Harvard

- **Structure:**

Powder - zinc oxide– 75-90 %,
magnesium oxide – 10 %,
silicium dioxide 0,05 5 %,
dyes

Liquid - 45-64 % solution of
orthophosphate acid,
which is neutralized by
hydrates aluminium oxide



Zinc-phosphate cements

Properties:

Positives	Negatives
Small heat conductivity	The big porosity
Plasticity	Solubility in an oral liquid
Low toxicity for pulp	Small durability
	Absence of an aesthetics
	Volume change at hardening
	Poor marginal adjoining

- **Testimonies to using (application):**
  - For filling of deciduous teeth;
  - For fixation of the crowns;
  - As insulating (isolating) lining.

Bactericidal cements

Argil, phosphate cement with silver, Kron-Fix N
Harvard Kupferzement

- For added of antiseptic properties into phosphates cement enter copper, iron, silver, salts of mercury and other substances;

- The main lacks – coloring of tissues of a tooth and bad chemical-physical properties

Silicate cements

Силицин-2, Fritex, Bio-trej, Silicap, Алюмодент

- **Structure:**

Powder - the thin crushed glass (silicium dioxide, aluminium oxide, calcium, fluorides).

Liquid – ortophosphoric acid similar applied in phosphate cement

Silicate cements

Properties

Positives	Negatives
Chemical firmness (insolubility in mouth liquid)	Toxicity for pulp
In cosmetic properties surpass phosphate cement (7 colours)	Bad adhesion
	Insufficient durability
To render anticaries action (F – has cariostatic effect)	Big shrinkage
Cheapness	Fragility
	Bad polishing

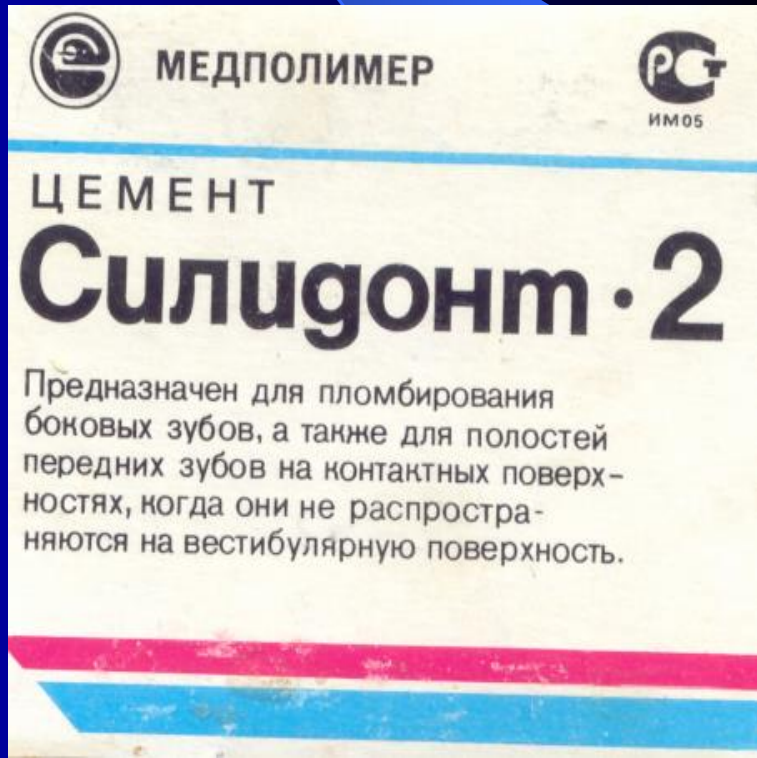
- **Testimonies to using (application):**
  - For filling caries cavities of 3 and 5 classes by Black;
  - For filling caries cavities of 1 class by Black in area of bland fosse in incisors.

Silico-phosphate cements

Силидонт, Аристос, Теллурий, Лактодонт, De-Trej, Белодонт, Infantid

Structure:

- *Powder* - 60-90 % of silicate and 20-40 % of phosphate cement
- *Liquid* - solution of orthophosphate acid modified by oxide of zinc and aluminium



Silico-phosphate cements

Properties

Positives	Negatives
Mechanical durability	Toxicity for a pulp, but less than silicate cement
Low chemical solubility	Absence of an aesthetics
Cheapness	Bad polishing
	Bad adhesion
	Big shrinkage

- **Testimonies to using (application):**
  - For filling caries cavities of 2 classes if the cavity does not transfer on a chewing surface;
  - For filling small caries cavities of 1class by Black.

Zinc – eugenol cements

Evgotsent, Кариосан, Temp Bond, Eugenol Cement, Эвгодент

- **Structure:** a mix of zinc and eugenol

Properties

Positives	Negatives
Antiseptic	Bad physicomechanical and handling properties
	Bad adjoins to cavity walls
Low heat conductivity action	Break polymerization of composites
	Paint a tooth crown

Application: for temporal filling;
thermo isolating and medical linings;
temporal fixing of artificial prosthesis;
filling of root cans.

Zinc - sulphate cements

Dentin-paste, artificial (water) dentinum, виноксол

Structure: zinc oxide–70 %, sulphate of zinc–25 %, kaoline–5 %

- For preparing artificial dentinum use water, for dentin-paste – various oils

Properties:

- Bad mechanical durability;
- Bad chemical firmness (solubility in an oral liquid)
- quickly erased
- fragility

Application:

- for temporal filling and hermetic bandages;
- for temporal filling of crowns and bridges.

Calcium-hydroxide cements

Гликодент, Кальцидонт, Life, Reocap, Dycal

Structure: solution hydroxide of calcium in the water or polymeric carrier

Positives	Negatives
Mineralization of dentine of caries cavities;	fragility
Stimulate of odontoblasts to produce substitutional (tertiary) dentine;	High solubility in an oral liquid
Possess antimicrobic and anti-inflammatory activity because of alkaline reaction (pH >12 and it can make lower pH in pulp cavity and normalize pulp blood circulation	Do not possess adhesion properties to dentine

Application:

- As medical (treatment) linings

Polycarboxylate cements

Adhesor-Carbofine, Selfast, Carboco,Durelon, Poly-F Plus

- Are created in 1968 by D. Smith and R. Mortimer as alternative to the phosphates cements.

Structure

- *Powder* – zinc oxide, magnesium oxide and calcium oxide. Can contain small amount of aluminium oxide and tin fluoride
- *Liquid* –polyacrylic acid

Polycarboxylate cements

Properties

Positives	Negatives
Improved adhesion to hard tissues of teeth (chemical adhesion !)	Insufficient durability Absence of an aesthetics
Practically do not irritate a pulp	Instability to a moisture during 1 day (24 hours).
Possess anticaries action	Bad polishing

Testimonies to using (application):

For filling of deciduous teeth;
For fixation of the crowns, bridges;
As insulating (isolating) lining.

Glassionomer cements

- Are developed in 1971 by A.D.Wilson and B.E.Kent

Structure:

- *Powder* - the thin crushed alumosilicate glass with considerable quantity of calcium and fluorine. Contains also dioxide of silicium, aluminium oxide, calcium fluoride. For radiopaque baric glass are added.
- *Liquid* - 50 % polyacrylic acid.

Systematisation of Glassionomer cements

- 1 type – fixing
- 2 type – restoration
  - The first subtype – for aesthetic restorations
  - The second subtype – for loading restorations
- 3 type – lining
- 4 type – for filling of root canals

Glassionomer cements

Positive properties:

- 1. Chemical adhesion to hard tissues of a tooth;
- 2. Cariostatic effect based on allocation of fluorine
- 3. Antibacterial action
- 4. Biocompatibility
- 5. The coefficient of thermal expansion ≈ to tooth tissues;
- 6. High durability on compression
- 7. The low module of elasticity
- 8. Shrinkage is 40 % in compare with composites
- 9. Good aesthetic properties

Glassionomer cements

Lacks

- Duration of "maturing" of filling (24 hours);
- Sensitivity to presence of a moisture at hardening (therefore it is necessary to cover filling with varnish) ;
- Dry up of surfaces of hardening cement conducts to deterioration of its properties and can be the reason of postoperative sensitivity;
- Danger of irritating action on a pulp in deep cavities

Polymeric cements

Polymeric cements

Comstan, Panavia

Structure:

• *Powder* is modified inorganic fillers type of a carbonate of calcium, silicon oxide.

• *Liquid* - monomeasures methacrilic.

Differ from cements on an inorganic basis presence of polymeric acids instead of the phosphoric. On the mechanism of hardening and the chemical nature these cements are closer to traditional acrylics.

Application:

fixing of crowns, orthodontic devices.

Application because of high toxicity is limited.

New generation of GIC – hybrid glassionomers

Vitremer, TC Fuji-2, Photac-Fil

Hybrid glassionomers

Structure: to a traditional powder of glassionomer it is added copolymerisate.

Liquid – solution acids with joining satiated metacrylic groups.

Photoinitiator is campharochinonum.

- **Properties:**

Positives	Negatives
High adhesion	Low stability to erasing
cariostatic effect	Big shrinkage
Durability	
Low sensitivity to a moisture	
The best aesthetic properties	

New generation of GIC – glassionomers modified by metal (cermets)

Medstar Silver, Miracle mix, Chelon-Silver Intropack Argion

- Introduction in cement of particles of silver has considerably raised wear resistance and anticaries ability.
- Alternative to an amalgam and composites on durability. Possess the raised fragility that limits sphere of its application.
  It concern to the materials of 2 types of 2 subtype.

Compomers

New generation of materials on a basis glassionomers and composites

Dyract, Compoglass, Magic Fil

Metal filling materials

Amalgam GK Alloy (Czech), Tytin slow (“Kerr”), Amalkap plus (“Vivadent”), Amalgam Non-Gamma 2

An amalgam is an alloy of mercury with another metal or metals

Structure of amalgams

Chemical element	Element	Positive properties	Negative properties
Silver	Ag	Gives durability and protects from corrosion, anticaries action	Causes volume expa-nsion of an amalgam
Tin	Sn	Slows down hardening and increases plasticity	Reduces durability
Copper	Cu	Durability, protection against corrosion, antibacterial properties	Increases volume expansion and accelerates hardening
Zinc	Zn	Raises wet ability mercury during alloy preparing	
Mercury	Hg	The basic agent, causes of chemical reaction	Reduces durability, causes toxic and allergic reactions

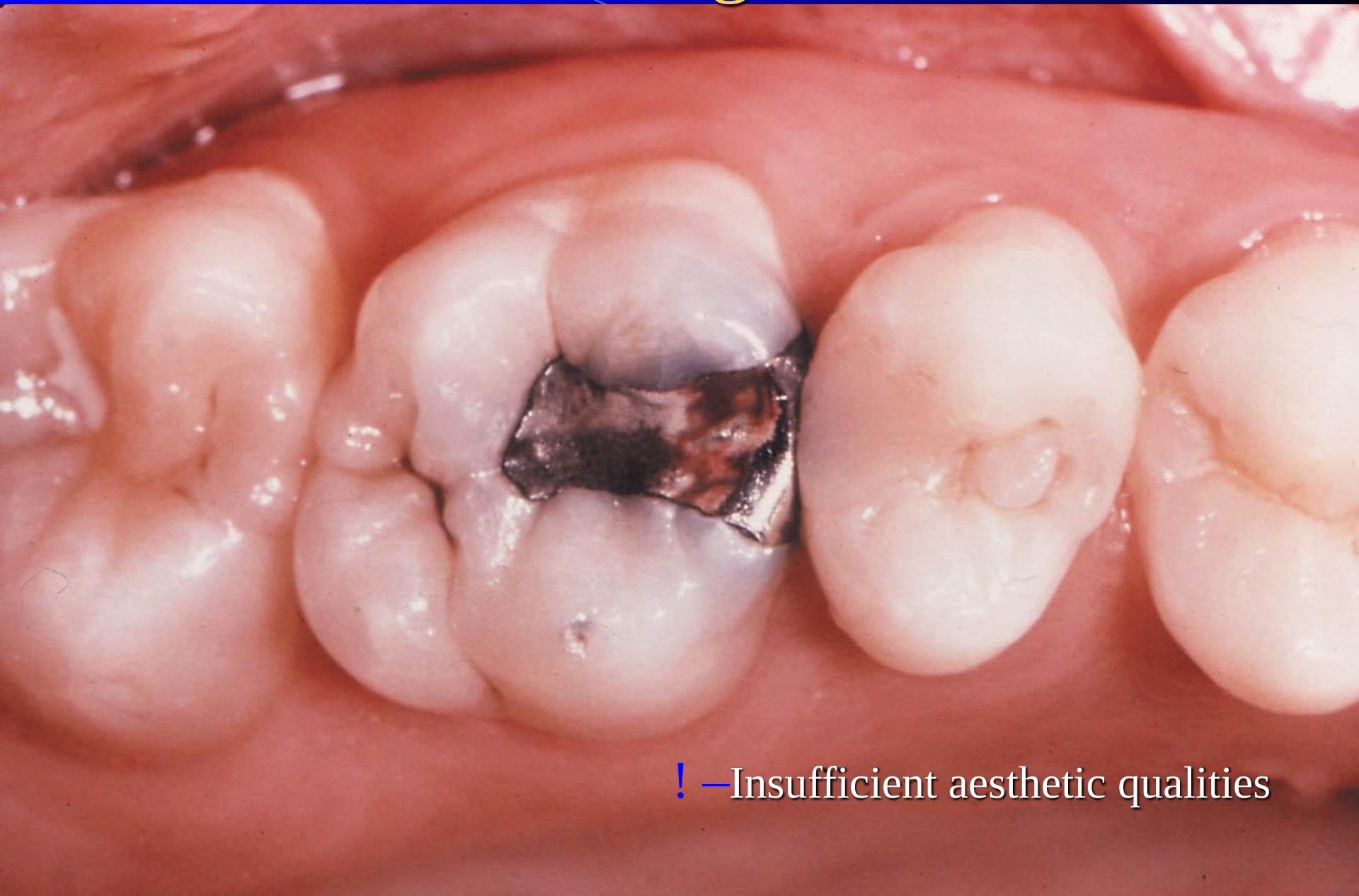
Positive properties of amalgams :

- High hardness and durability
- Plasticity
- Hardening at temperature 37
- Stability in the damp environment of an oral cavity
- Long service life

Negative properties of amalgams

- High heat conductivity
- Big shrinkage (volume change)
- Bad adhesion
- Insufficient aesthetic qualities
- Bad corrosion resistance (particularly if is present another metal in oral cavity)
- Big marginal leakage because of high of coefficient of lining expansion
- Painting of hard tissues of a tooth
- Harmful and toxicity during preparing (evaporation of mercury), so special conditions for work is demanded.

Amalgams



! –Insufficient aesthetic qualities

Application of amalgams:

- For caries cavities of 1 class by Black;
- For caries cavities of 2 class by Black;
- For caries cavities of 5 class by Black in molar and premolars.

Composite filling materials

Composites consist of three phases:

- ✓ Organic (matrix)
- ✓ Inorganic (filler) – disperse phase
- ✓ Connecting substance (copolymers)

Structure of composite :

- *Organic matrix* – monomers, initiators of polymerization, pigments (dyes), antimicrobic additives.

The first liquid matrix for composites – **BIS-GMA** (bysphenol A and glycidildimetacrylates), later have appeared **UDMA** (uretindimetacrylates), DMA (dipandioldimetacrylates), **TEGDMA** (threlaethilenglycoldimetacrylates.

Structure of composite

Disperse phase. To make resin matrix more stable mechanically and physically inorganic fillers are added. The silicate particles which are a part of glass (baric, zinc), quartz, porcelain, silicate strontium can be them. For the best connection crystal polymeric threads are added.

Connecting substance. Connection of the filler and matrix depends on the silanization of the filler. As silanization agent 3 metacrylol-oxipropyl-trimetixi-silan is used.

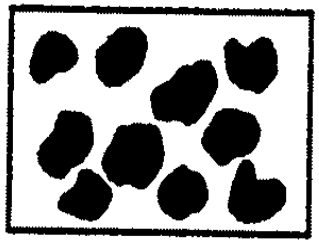
Classification of composite materials

- 1. On a way of hardening:
  - 1) chemical polymerization
  - 2) light polymerization
- 2. On the size of particles of fillers:
  - 1) the macrofilled
  - 2) the microfilled
  - 3) the hybrid
- 3. On fullness degree:
  - 1) strongly filled
  - 2) media filled
  - 3) low filled
- 4. On a consistence:
  - 1) low viscosity
  - 2) media consistence
  - 3) improved viscosity (packed, condensed materials)

Composite filling materials

1. Макронаполненныкомпозиты

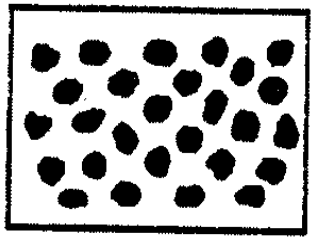
Adaptic
Concise
Evicrol
Prismafil



8-12 мк
и больше

2. Мининаполненные композиты

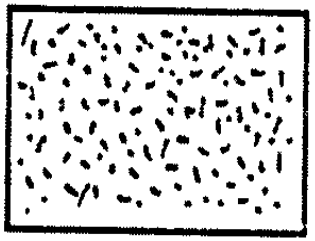
Microrest
Estilux



1 -5 мк

3. Микронаполненные композиты

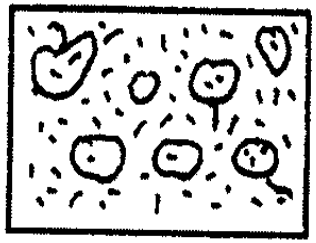
Multifil VS
Durafil VS



0,04-0,1 мк

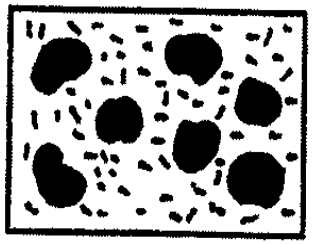
а) негомогенные микронаполненные композиты

Helioprogress
Heliomolar



4. Макрогибридные композиты

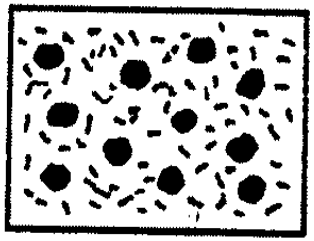
Prismafil



8-12 мк
0,04-0,1 мк

5. Микрогибридные композиты

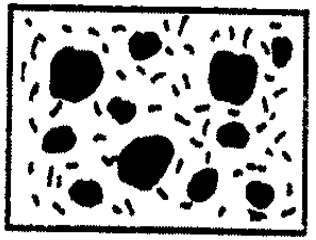
Prisma T. P. H.
Charisma
Brilliant
Herculite
Tetric



1-5 мк
0,04-0,1 мк

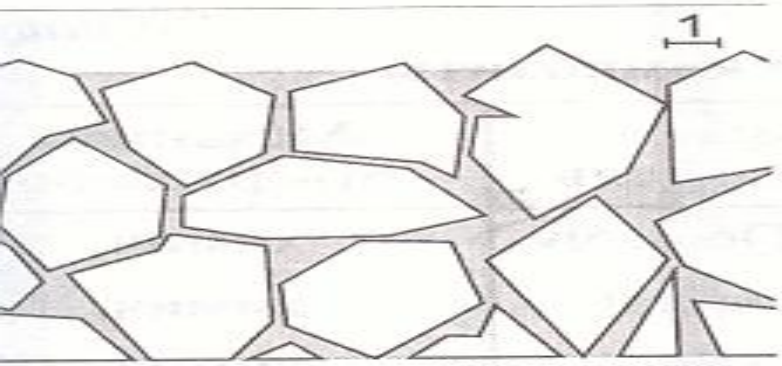
6. Тотально выполненные композиты

Prisma Spectrum
Valux Plus

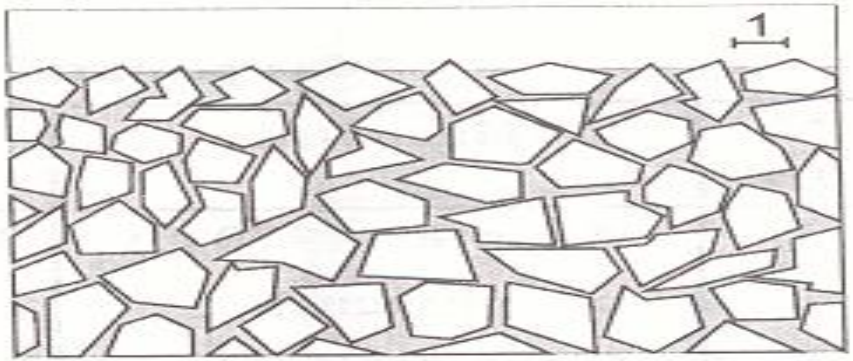


5-8 мк
1-5 мк
0,01-0,1 мк

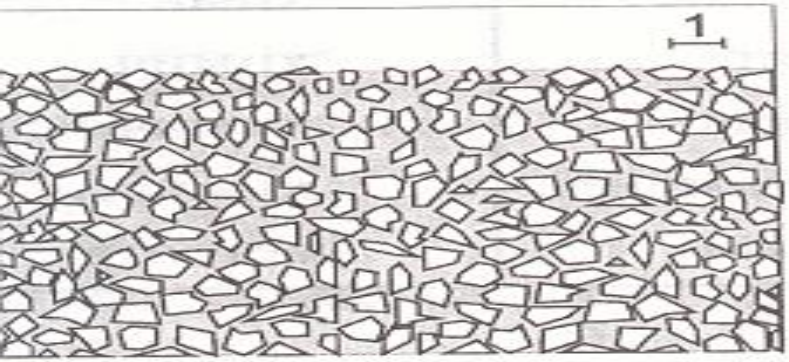
Structure of different composites



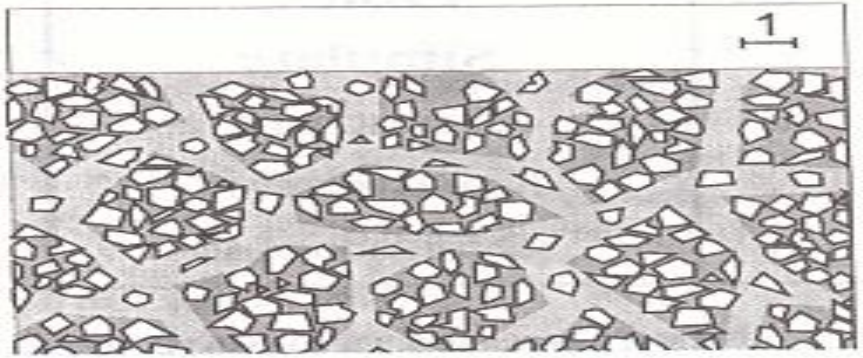
макронаполненный композит



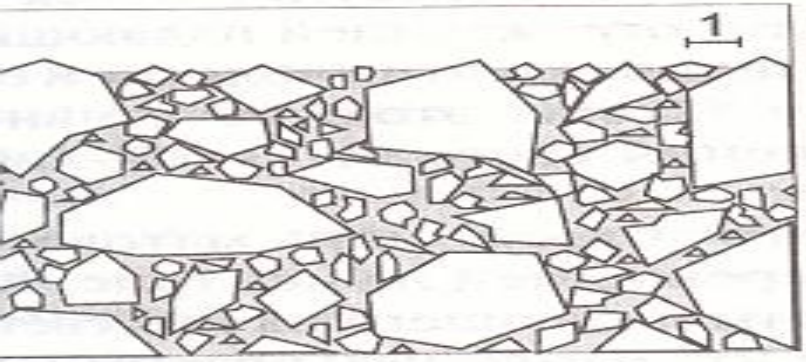
мининаполненный композит



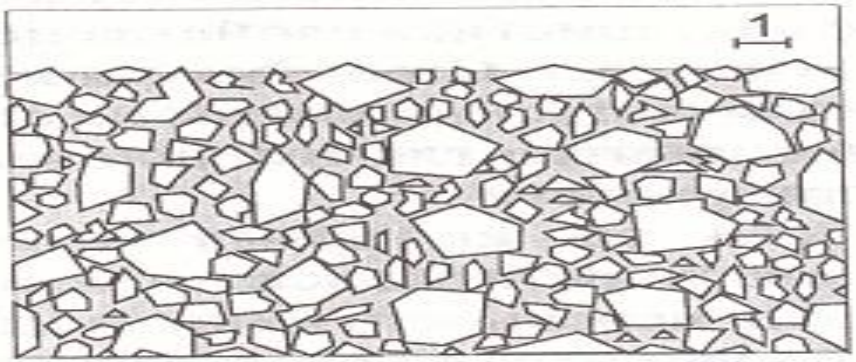
гомогенный микронаполненный композит



негомогенный микронаполненный композит



гибридный композит



микрогибридный композит

Positive properties

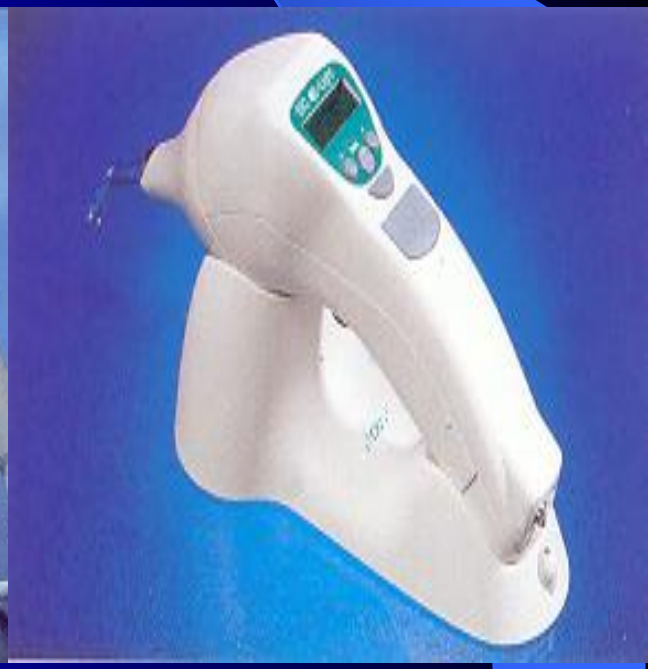
light-hardening composites in relation to materials chemical hardening

- Do not demand mixing of components
- Do not change viscosity during work
- Allow to combine different colours and a transparency
- Long time of modeling
- Polymerization is carried out "on command" the doctor
- Allow to work without a waste, to take exact quantity of material
- Do not darken because of chemical transformations of components entering into them
- Higher polymerization is reached by photopolymerization

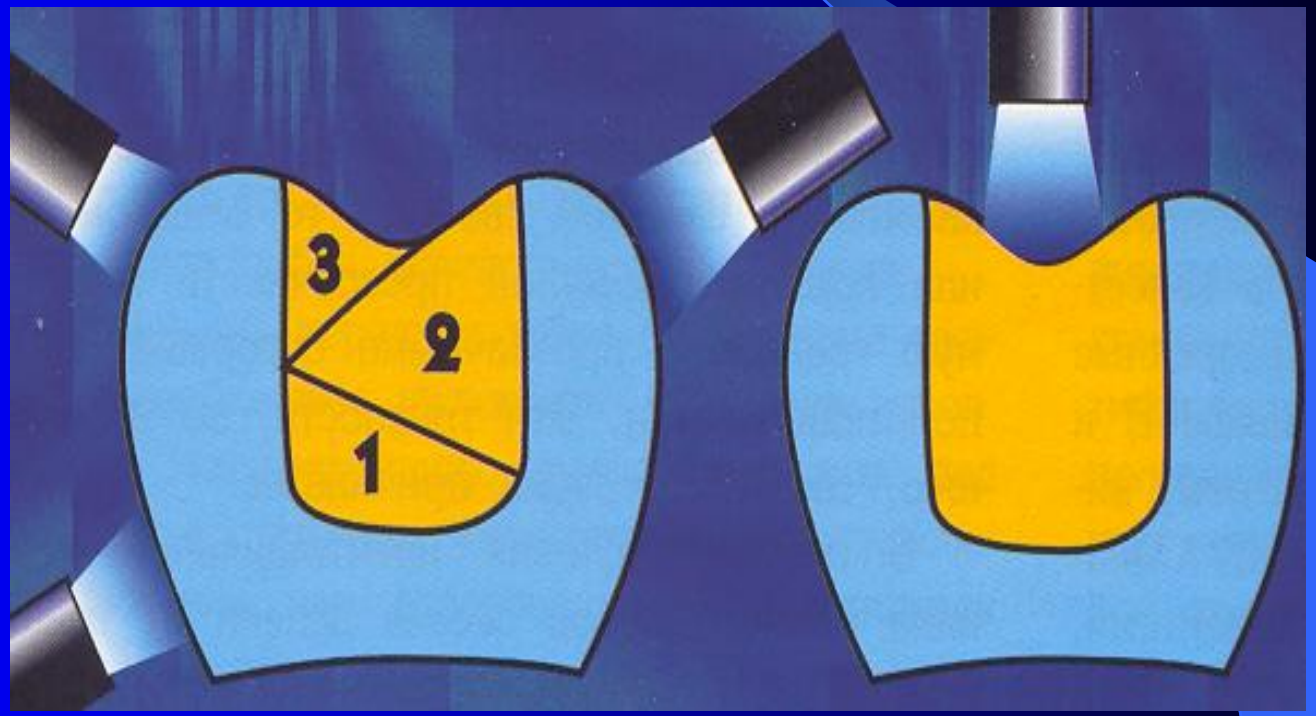
Photopolymerization

Activation of the initiator of polymerisation in a material by light stream of visible blue light in a range of 450-500 nanometer

Devices for polymerisations



The directed polymerisation



New possibilities of microhybrid composites

New possibilities

# of hybrid composites

Lacks of light-hardening materials:

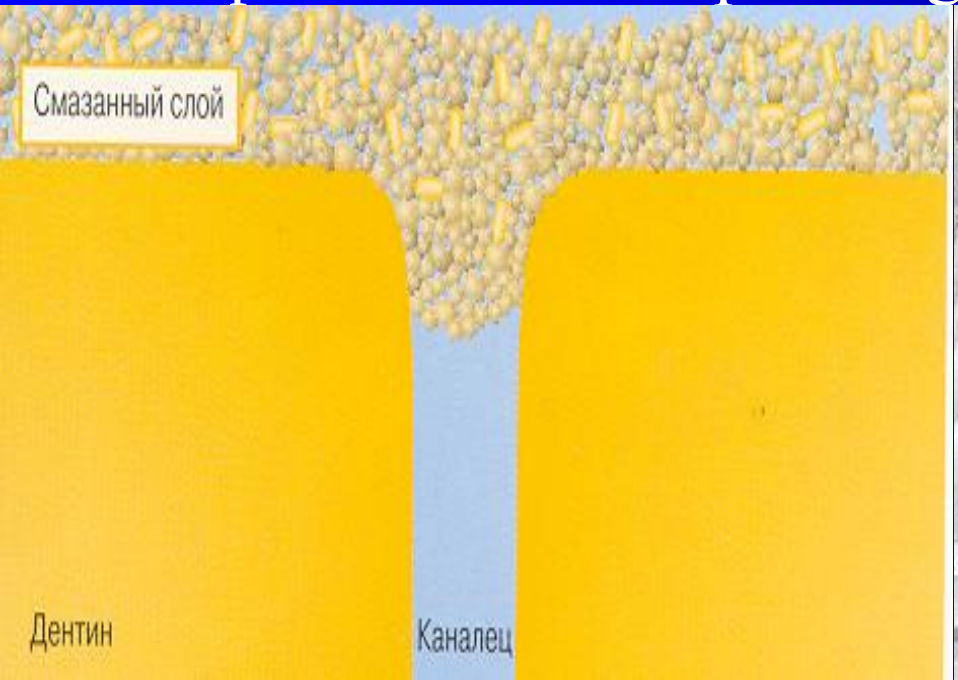
- A big expense of time (40-60 minutes on 1 filling, while at chemical hardening – 25-30 minutes);
- Increase of cost as the lamp is necessary;
- Light photopolymerization lamps is harmful for eyes;
- It is impossible to apply at patients with the susceptibility to light and presence cardiostimulator.

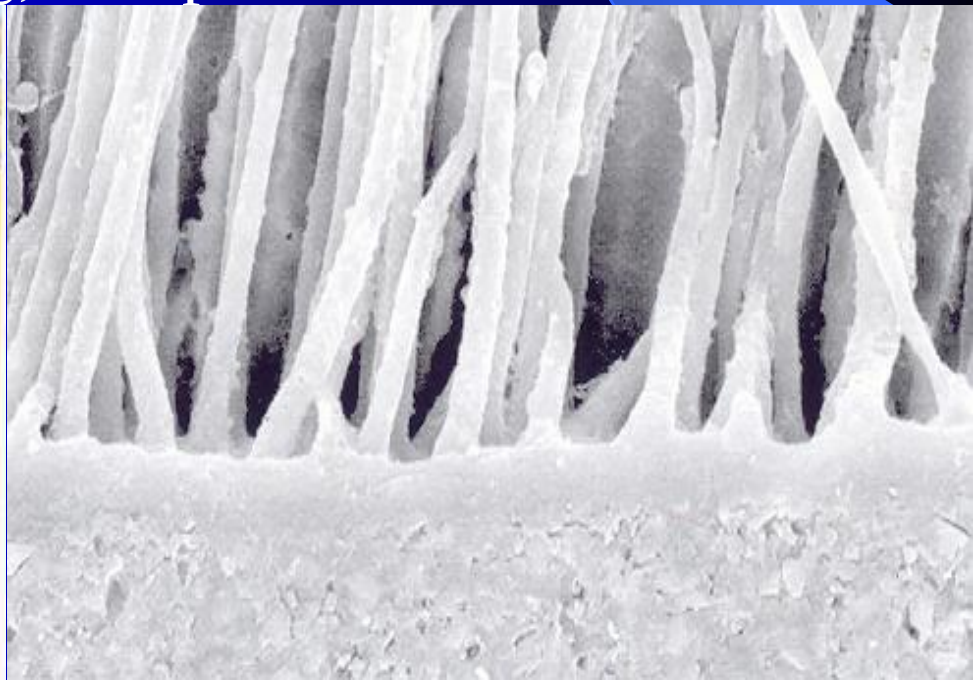
Adhesive

Adhesion – connection material with surface of tooth. Distinguish: chemical, mechanical, micromechanical adhesion and nanoretention. There are 6 generations of adhesive systems. First three generations of adhesive don't have practical application now. These adhesive have low force of adhesion (till 5 MPa). Adhesive systems of 4 and 5 generations carry out bounding with enamel, dentin, metals, ceramics. Before applying adhesive first full or partial removal of the polluted "smear" layer and demineralization of dentin is made.

Adhesive

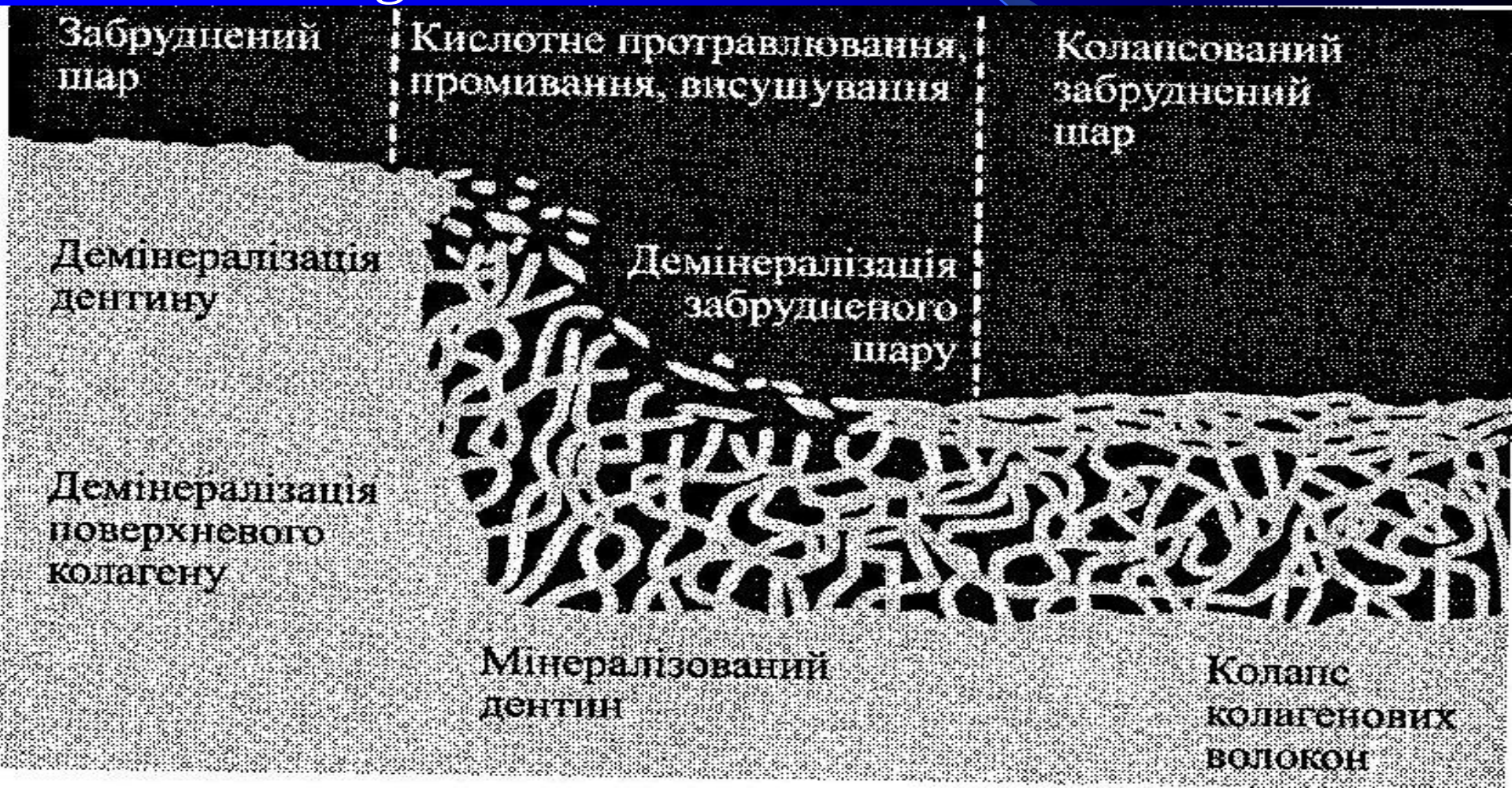
The "smear" layer is a layer of dentin, thickness 0,5 - 5,0 мк, which is formed on its surface at preparation, consists inorganic parts of dentin, apatites, scraps of collagenic fibres of dentin basic substance. Removal of this layer is spent by etching with acid (for the first time recommended in 1955 by M. G. Buoncore) then the dissolved layer watches off and dried up to so-called «sparkling, damp dentin».





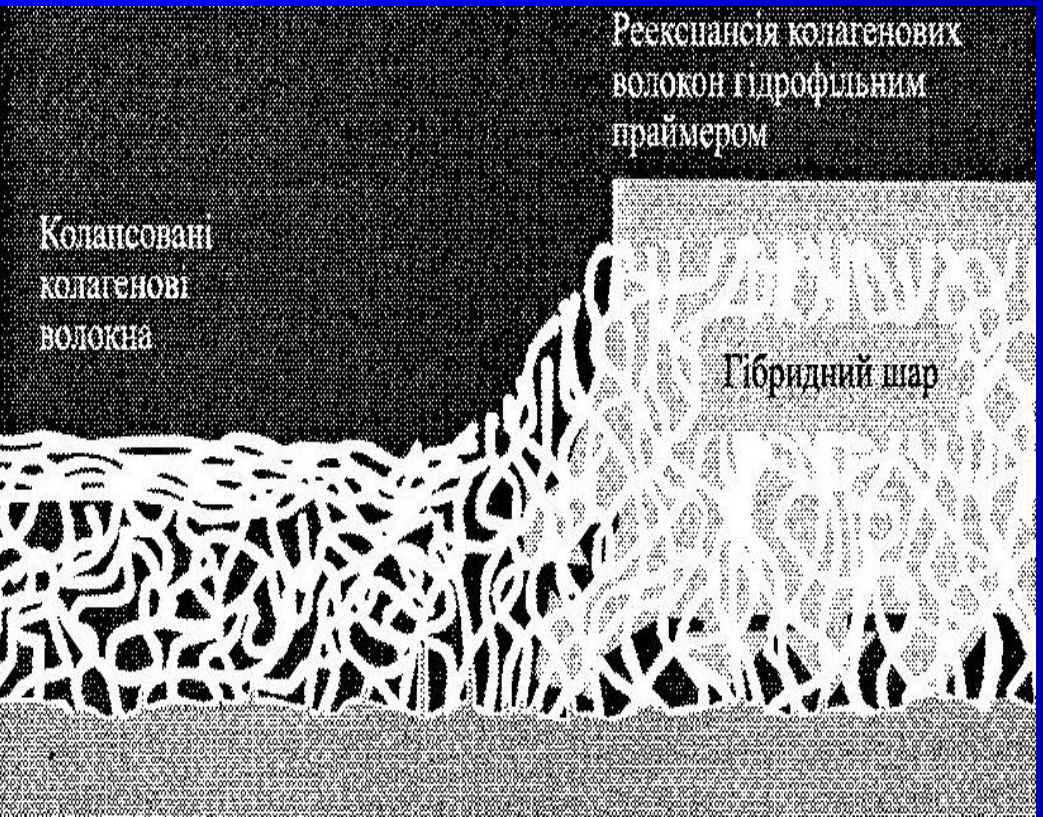
Adhesive

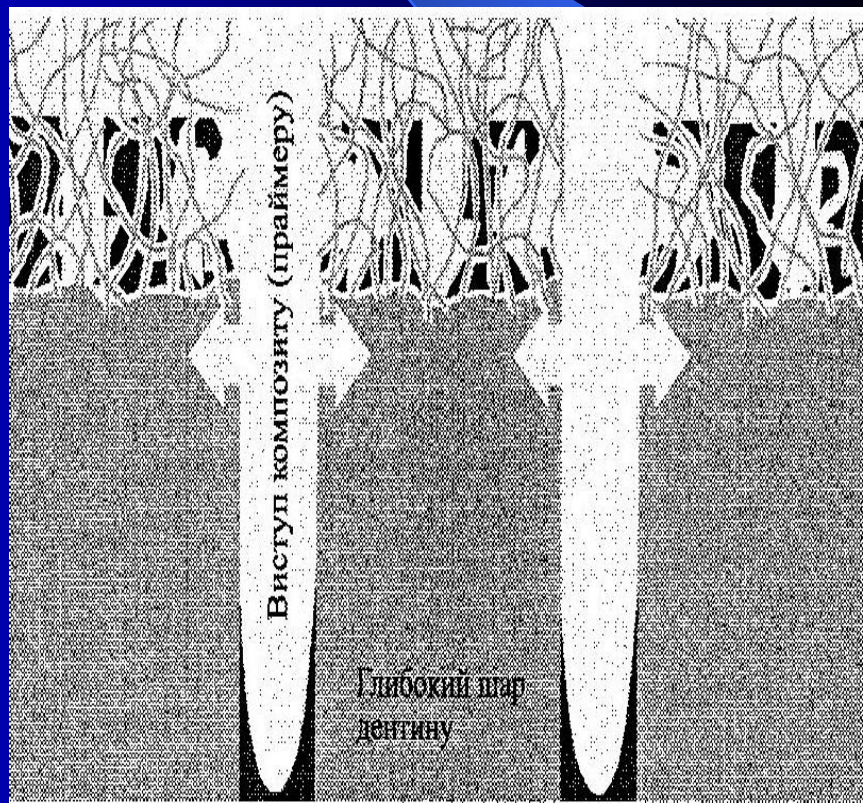
At overdrying of dentin **"collapse" of collagenic fibres** (falling off, their pasting) is possible, that will lead to closing of ostium dentinal tubules.



Adhesive

In opened dentinal tubules hydrophilic adhesive easily penetrates and after its polymerisation the **hybrid zone** is formed, which reliably isolates a pulp from toxic influence of components of composite material and provides strong (till 20-30 MPa) connection of a material with dentin and enamel.





The last adhesive systems

The 6th generation of adhesive systems is self- etching

Universal restoration systems


THANKS
FOR ATTENTION!

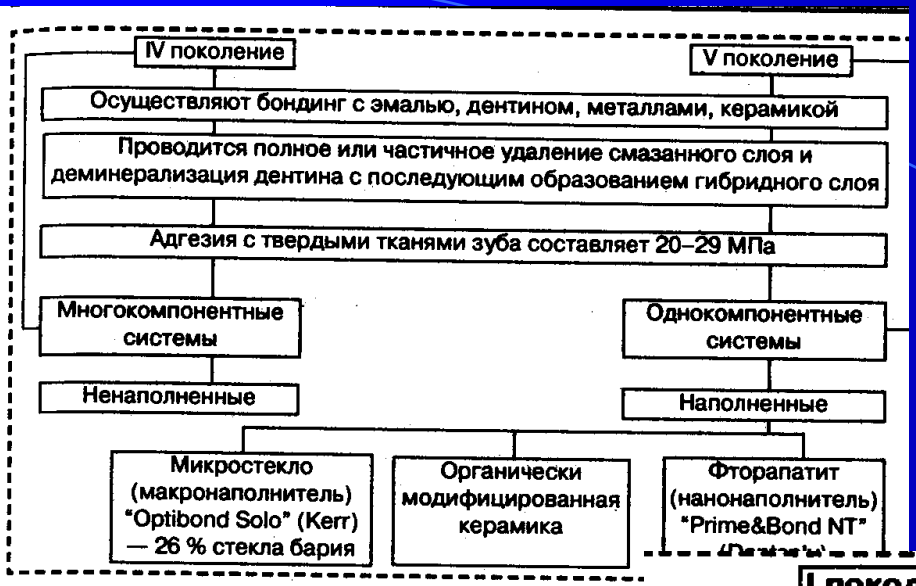


Схема 3. Современные ЭДАС IV и V поколений

Etching (air-conditioning)

M. G. Buoncore in 1955 has suggested to strengthen adhesion metacrylic filling by etching during 2 minutes by 85 % sol. of phosphoric acid

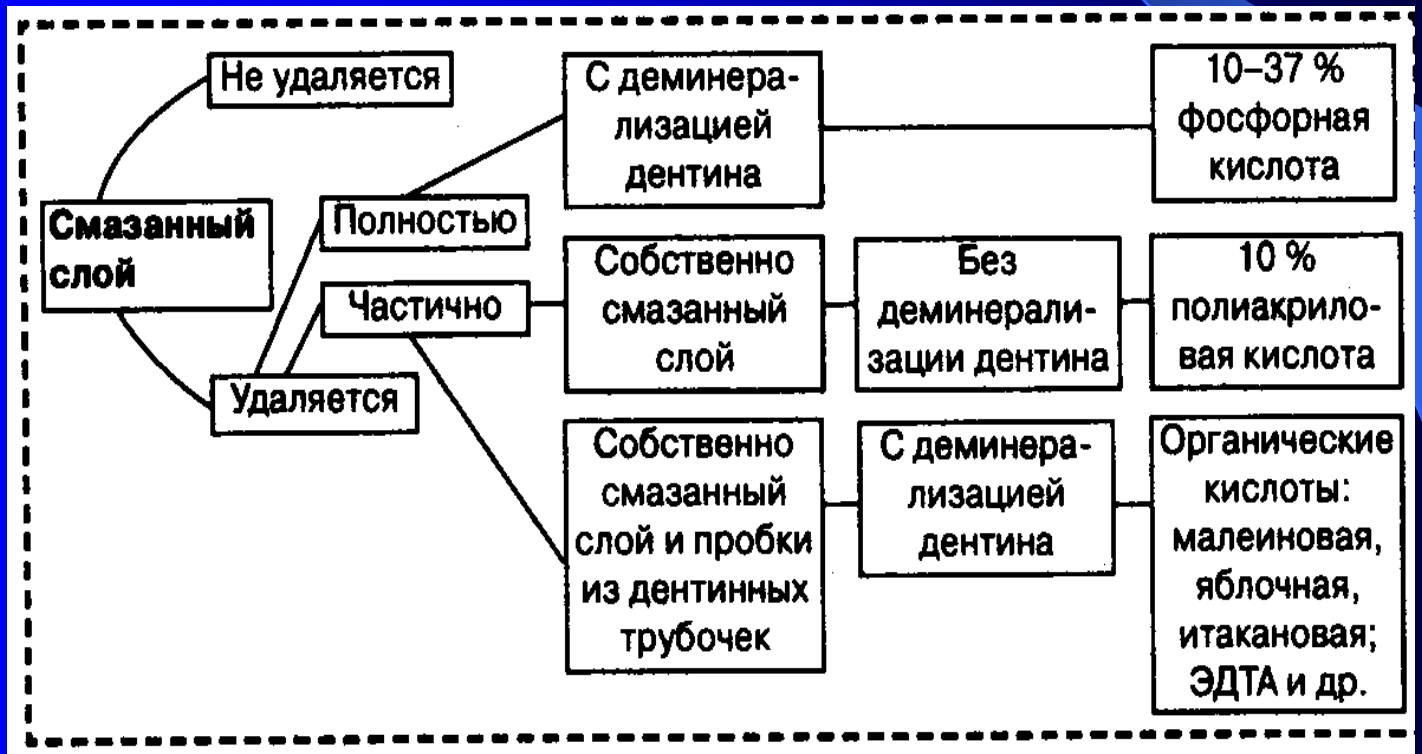


Схема 2. Методы подготовки дентина к нанесению адгезивных систем

Self-pickled adgesives

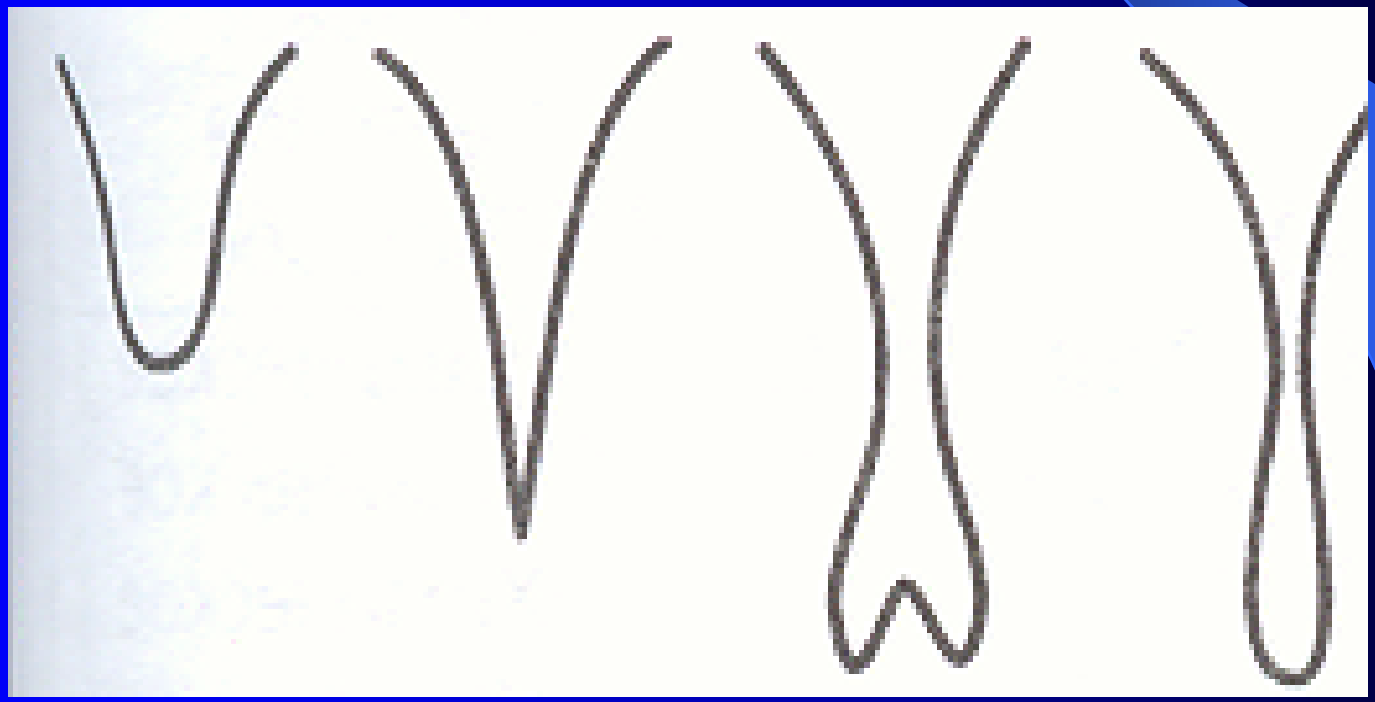
Xeno III Жидкость А	
Состав	**Функция**
HEMA	Праймер
Вода	Растворитель
Этанол	Растворитель
BHT	Стабилизатор
Акросил	Нанонаполнитель

Xeno III Жидкость В	
Состав	**Функция**
Пиро EMA-SK	Кислотный, полимеризуемый мономер Протравливающая и адгезивная функция
PEM-F	Полимеризуемый мономер, выделяющий фтор. Улучшает протравливающий эффект, удаляя ионы кальция
UDMA	Способствует когезивной прочности
BHT	Стабилизатор
Камфорохинон	Фотоинициатор

Forms of fissures:

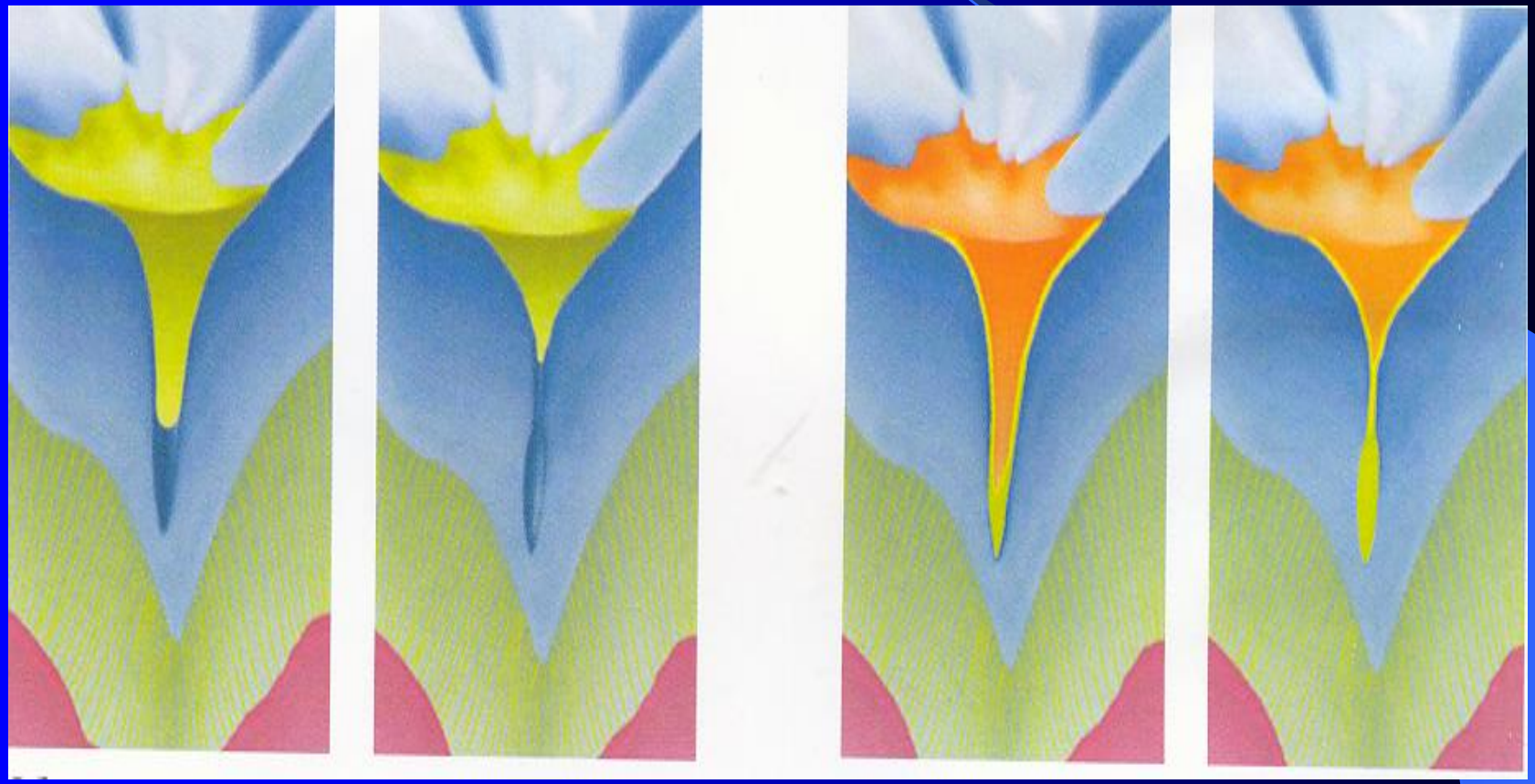
A – funneled; C – polyped;

B – cone-shaped; D – drop-shaped.



A B C D.

Scheme of filling of fissures by hermetic



Materials for closing of fissures (hermetics)

Since 1970 WHO was recommended to all countries to include in national programs of public health services hermetic sealing of fissures as a method of the prevention of development of caries

Классификация герметиков