

Fiber reinforced composites

FRC

Composite materials

- Chemically bonded combination of two or more components – final properties are much better than only the mixture.
- Natural composites (wood – combination of cellulosa and lignin, bone – combination of collagen fibres and hydroxyapatite etc.)

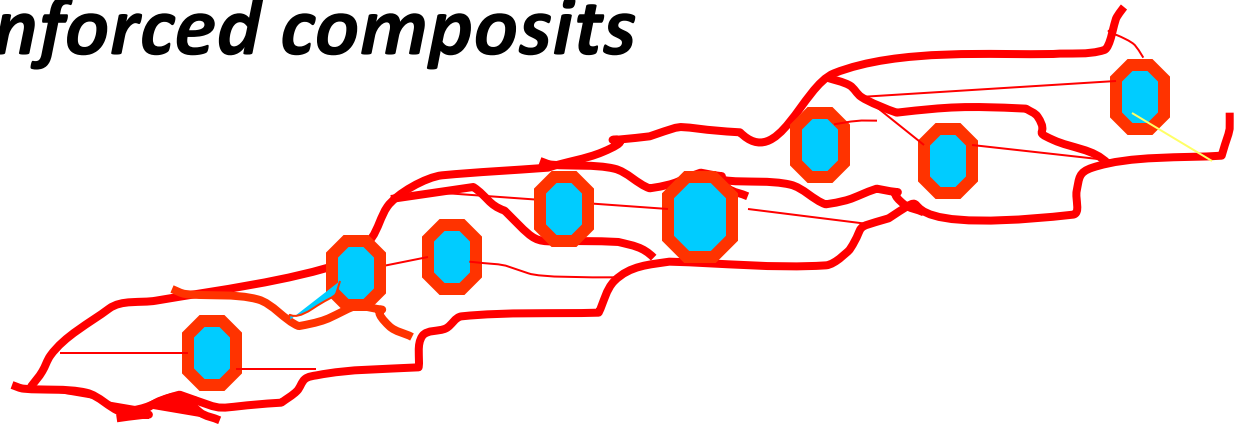
Composite materials in dentistry

Chemically bonded combination of polymer network and inorganic filler.

We recognize:

PFC – particles filled composites

FRC – fiber reinforced composites



PFC – isotropic materials

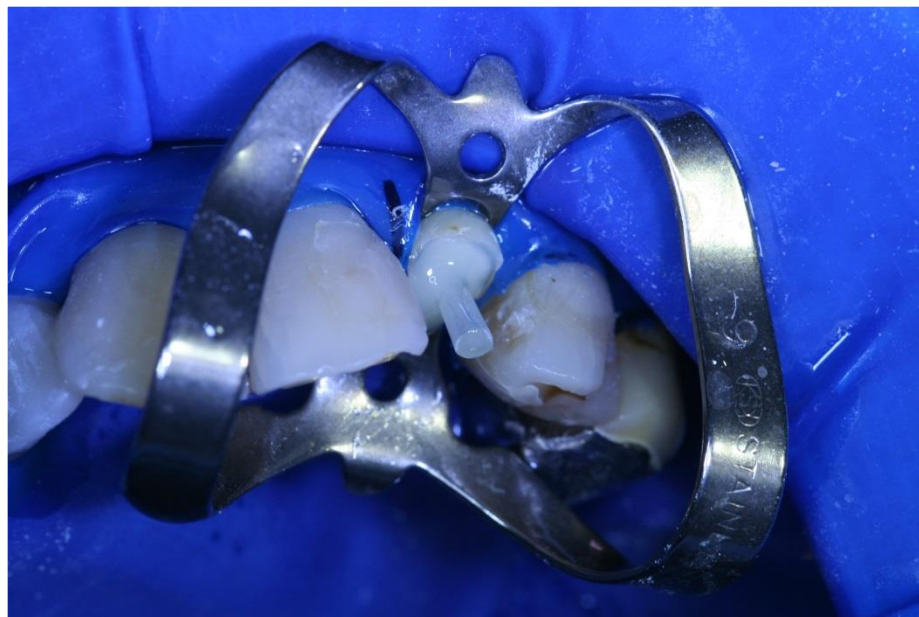
- These materials can be formed in all directions equally, their modulus of elasticity is the same in all directions.



Fiber reinforced composites

- The filler is of fibers (in dentistry usually glass fibers)
- Due to surface friction between organic matrix and inorganic filler the fibers overtake the loading – this is reinforcement.





FRC x PFC



Reinforcement (fibers)

No reinforcement

High strength in bending

Low strength in bending

Anisotropy

In many products silan is not present

Isotropy

Silan is always present

We use always FRc in combination with PFC

Contemporary application of FRC



Material of fibers – physical properties

| Material | Modulus of elasticity (GPa) | Tensile strength (GPa) | Colour |
|--------------------|------------------------------------|-------------------------------|---------------------------|
| Polyethylen | 0,1 – 0,5 | 4 | Celar |
| Polyester | 1,5 – 1,8 | 0,2 | White |
| Ceramics | 72 | 2,5 – 3,5 | White to yellowish |
| Carbon | Cca. 250 | 2,2 | Black |
| Kevlar | 90 – 150 | 2,2 | Yellow |
| E – glass | 72 | 2,5 – 3,5 | Clear |
| S - glass | 86 | 4 | Clear |

Size of fibers and content of the filler

Size of fibers

Thickness hundredths of mm

Length mm - cm (for dentistry)

Content of fibers

15 – 70 weight %

< 40% - low tex

> 40% - high tex

Organic matrix

Light curing resin

Mixture of PMMA and light curing resin

Heat curing resin

Interaction between matrix and filler

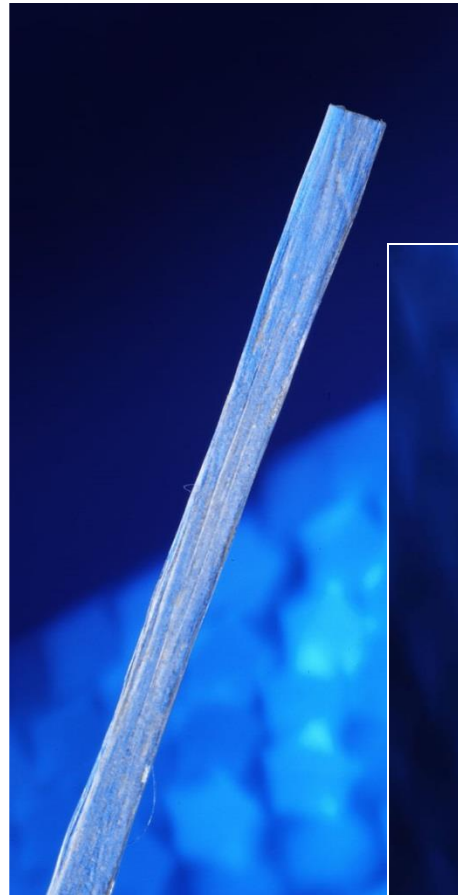
Silanization

or

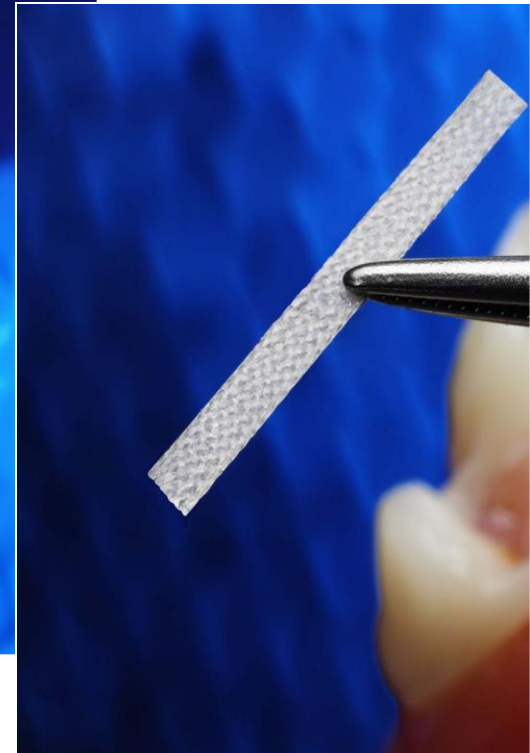
Plazma coating

Orientation of fibers

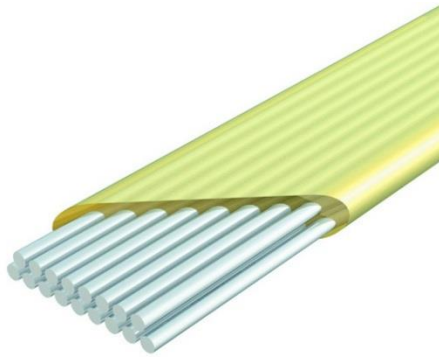
Unidirectional



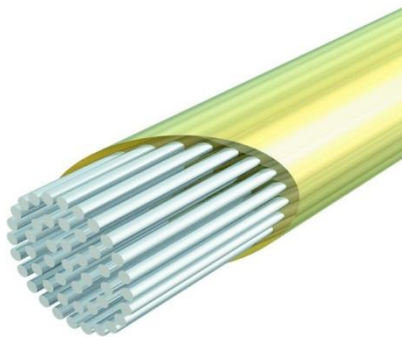
Multidirectional



Unidirectional FRC

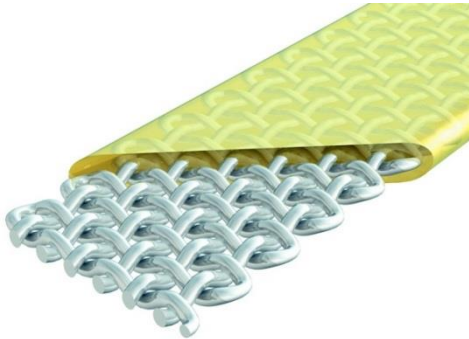


Good strength



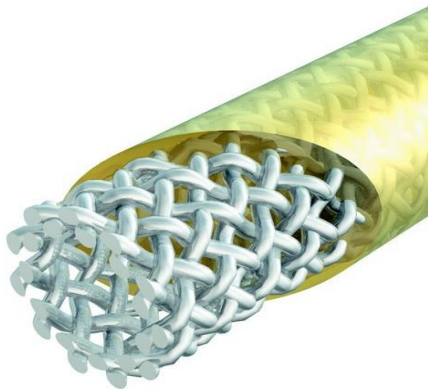
Susceptibility to fray

Multidirectional FRC



Better adaptation

Worse strength

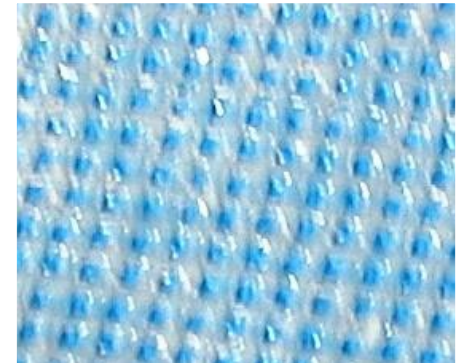


Forms of FRCs

Longitudinal elements



Planar elements



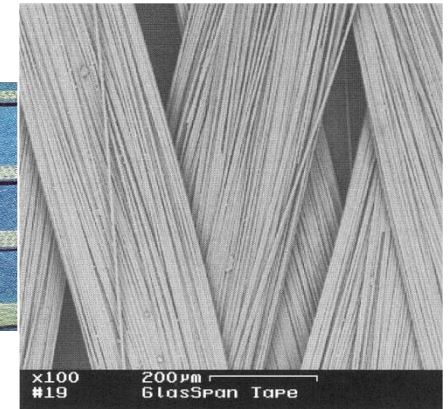
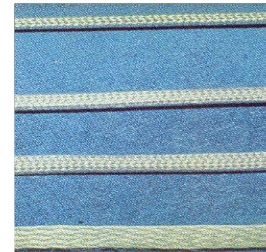
Root canal posts



Rate of preimpregnation (with matrix)

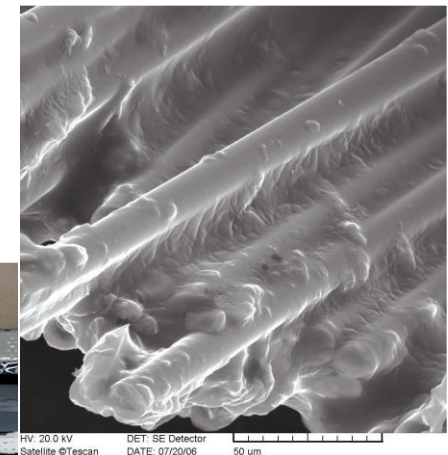
Dry framework

Fibers must be mixed with bond
before usage

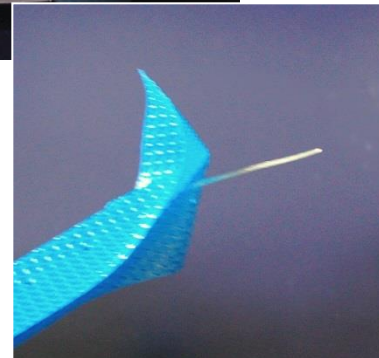
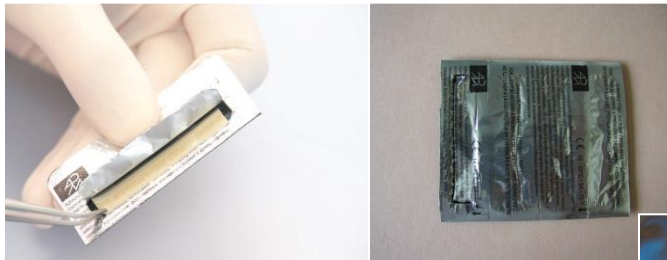
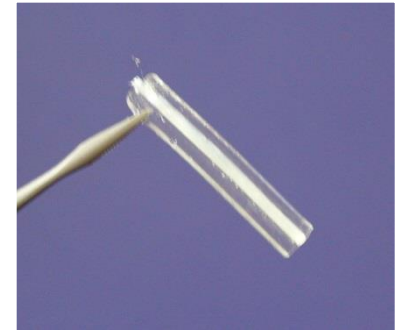


Preimpregnated framework

Fibers and organic matrix are
mixed during the fabrication



Some examples



Indications of FRCs

Splints and retainers

Frameworks of some fixed partial dentures

Root canal posts

Filling reinforcement

Repaire of removable dentures

Reinforcement of removable dentures

Splints and retainers

Good aesthetics

Combination with

RFC

Position: orally
or labially

Long or short splints

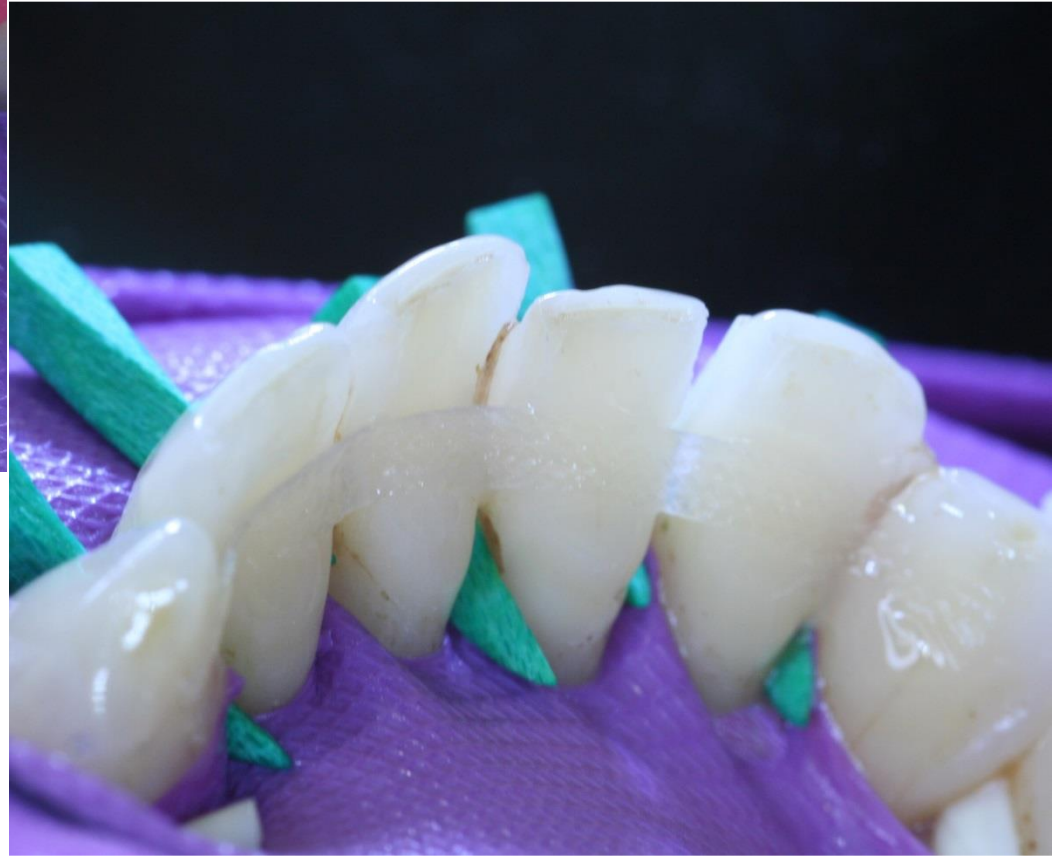
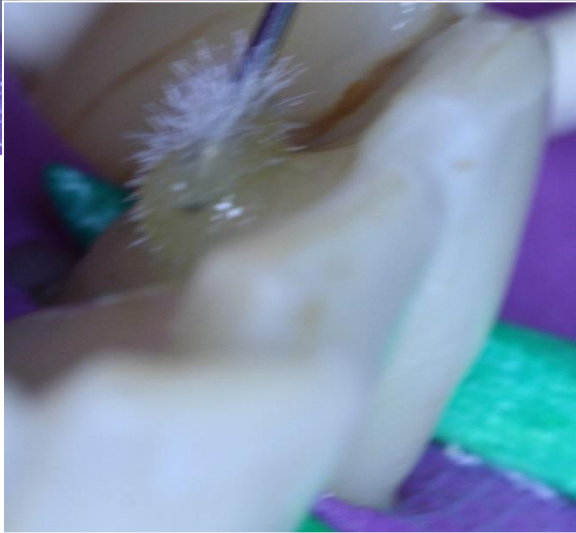
Field of application:

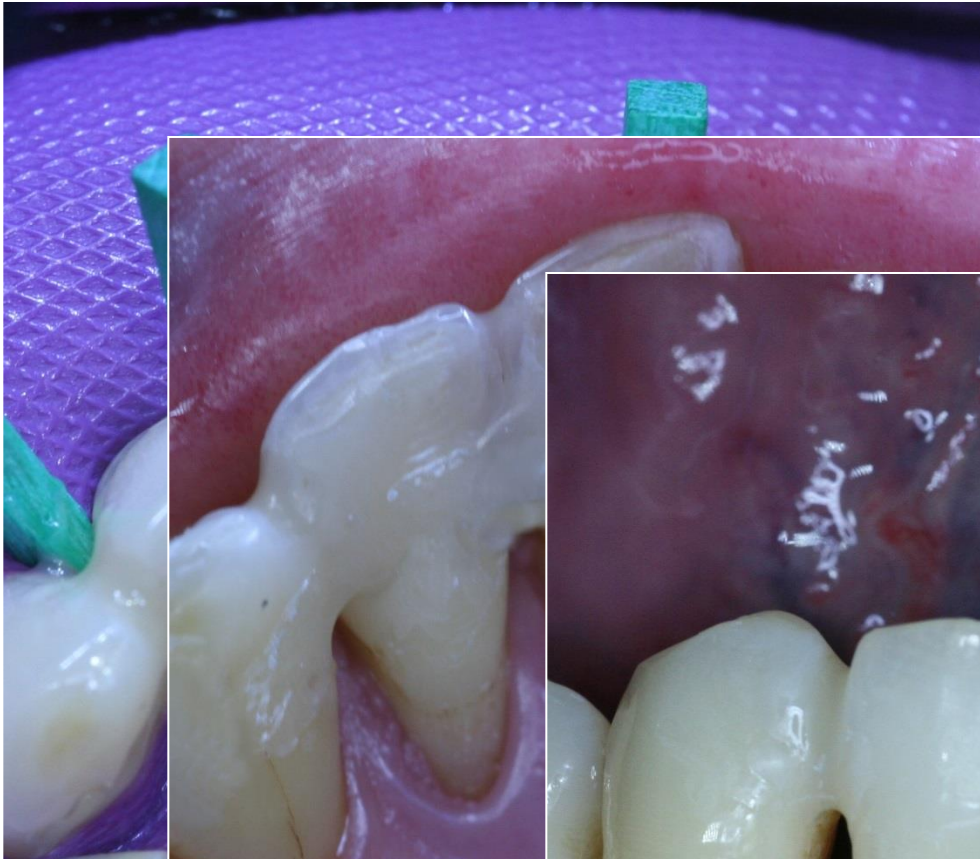
Periodontology

Traumatology





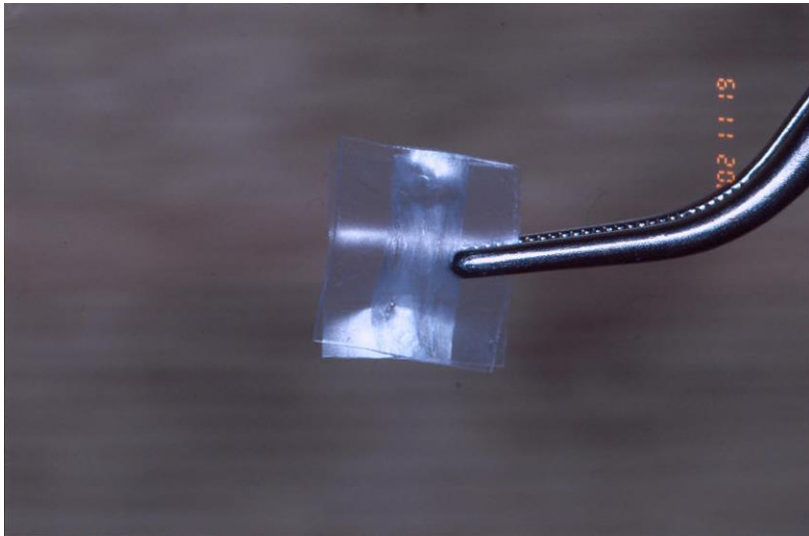


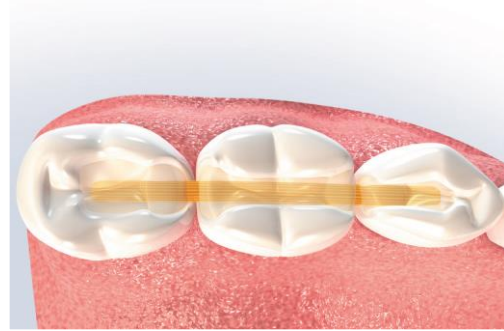
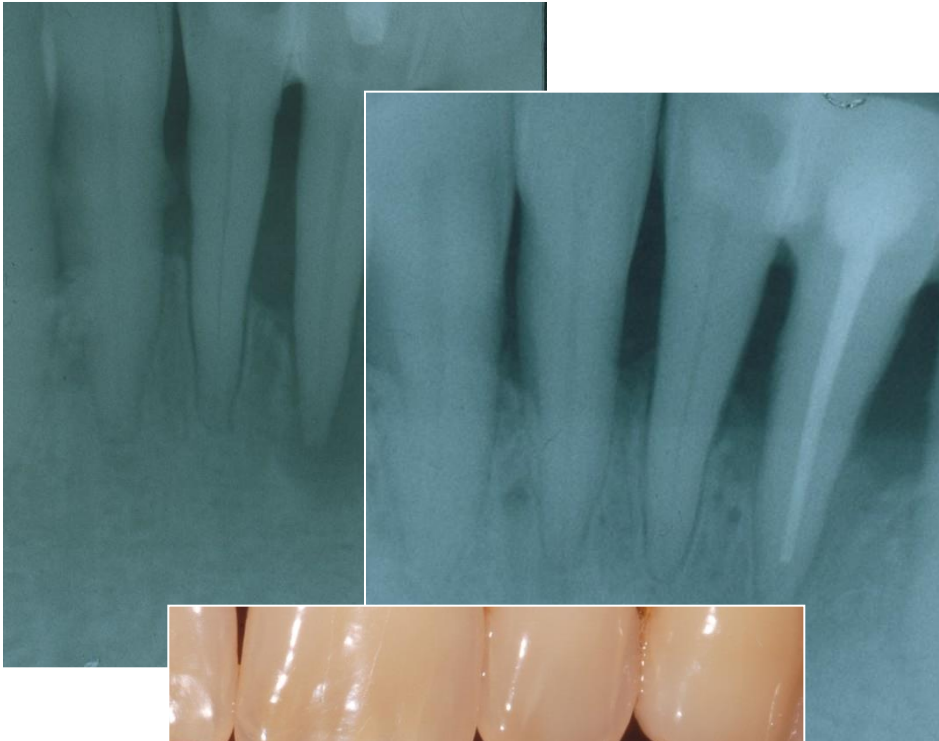










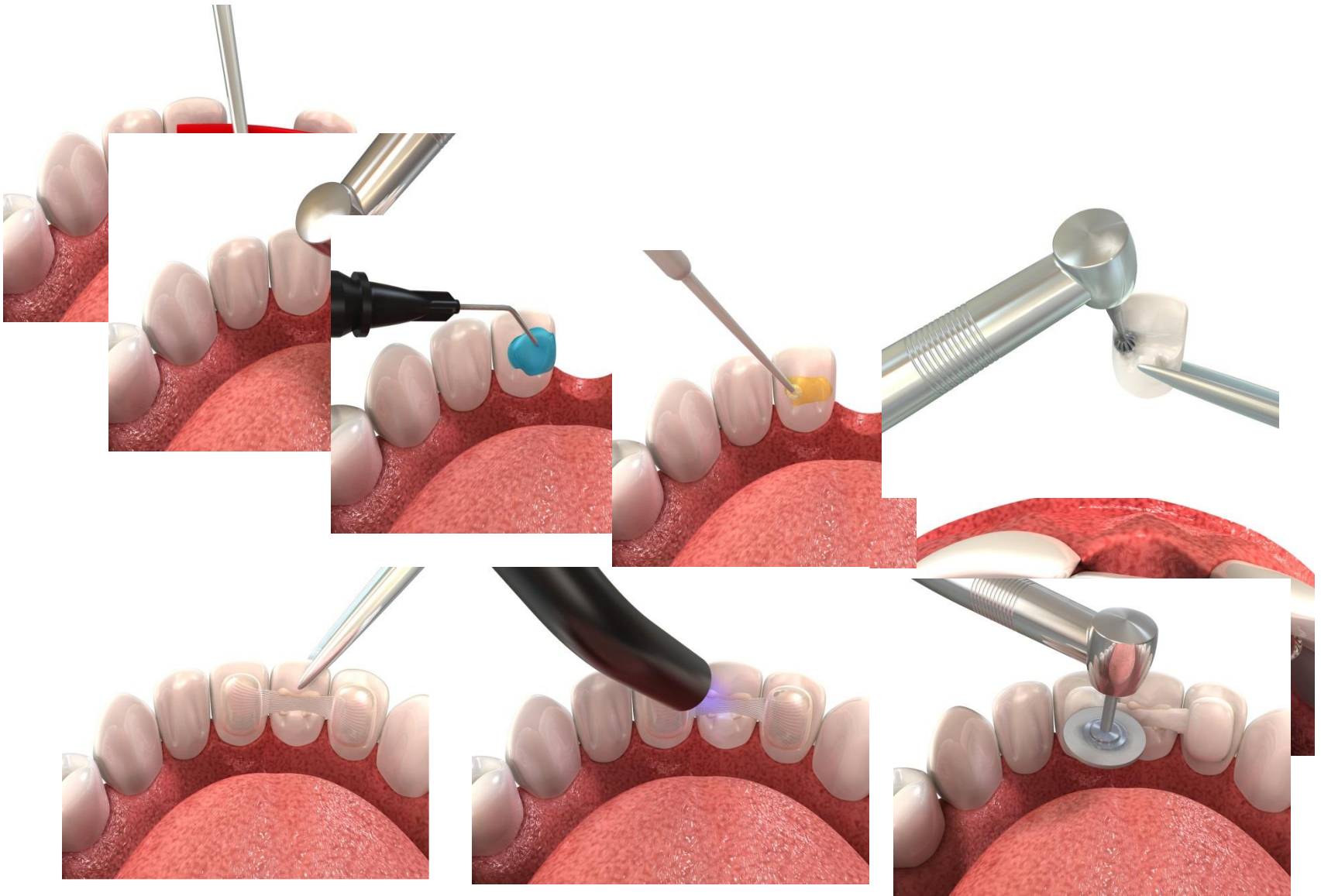


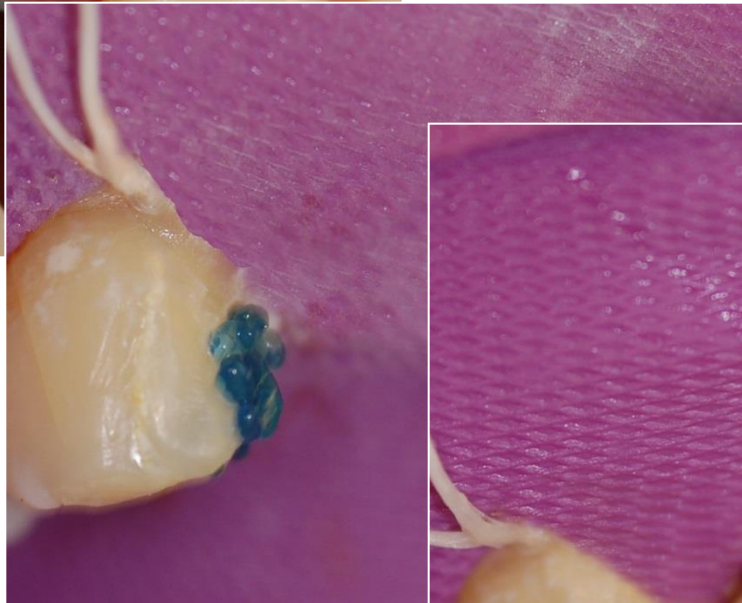
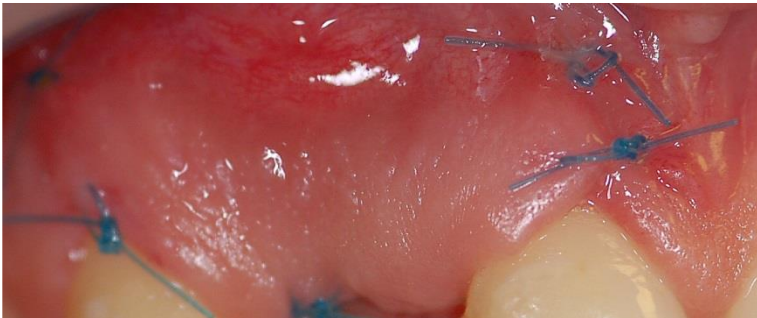
One tooth replacement – direct method

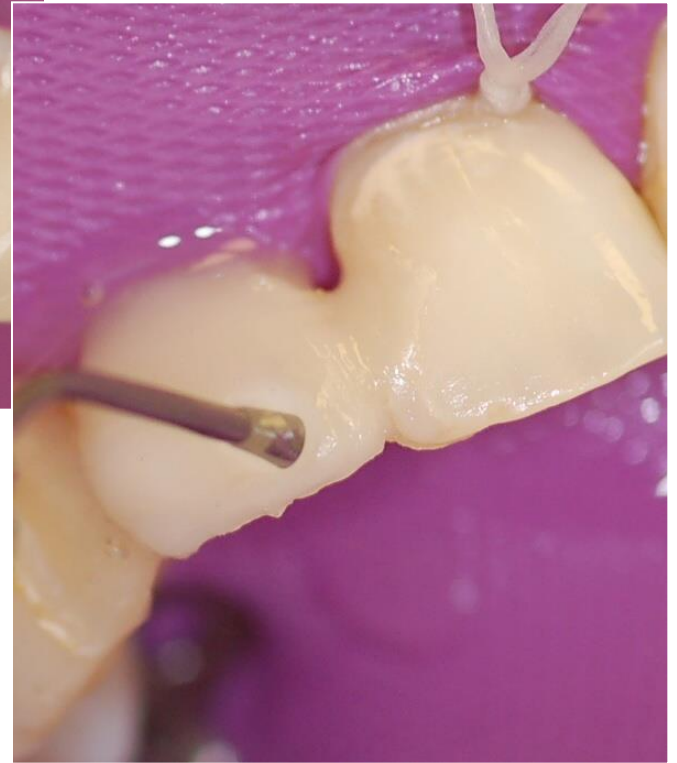
Prefabricated acrylic
tooth can be used

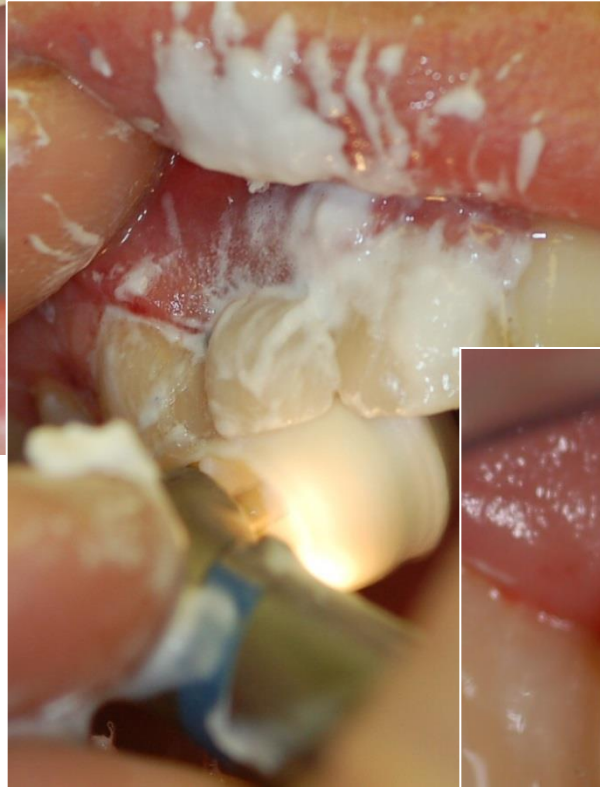
Or pontic can be made of
PFC directly in the mouth

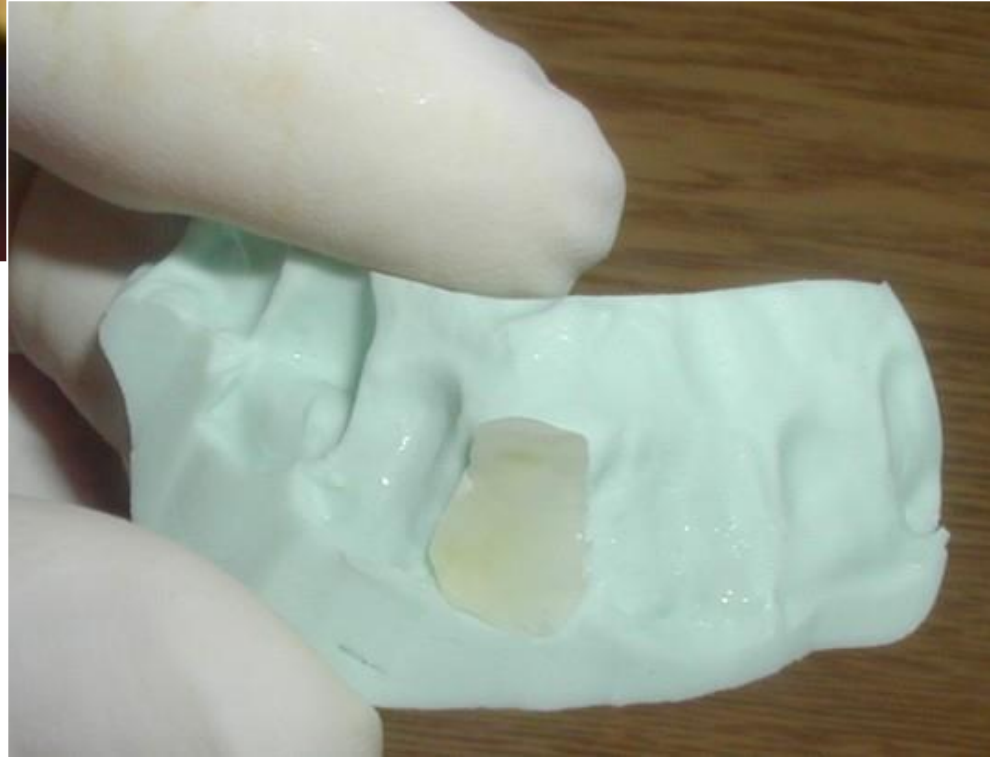








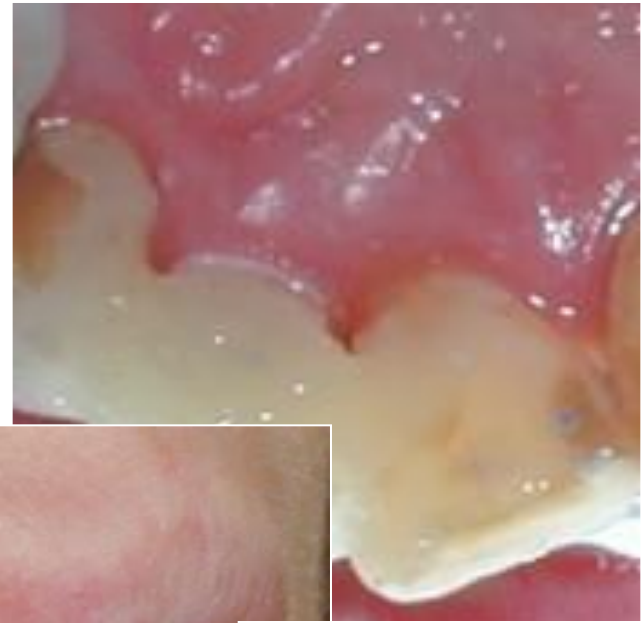




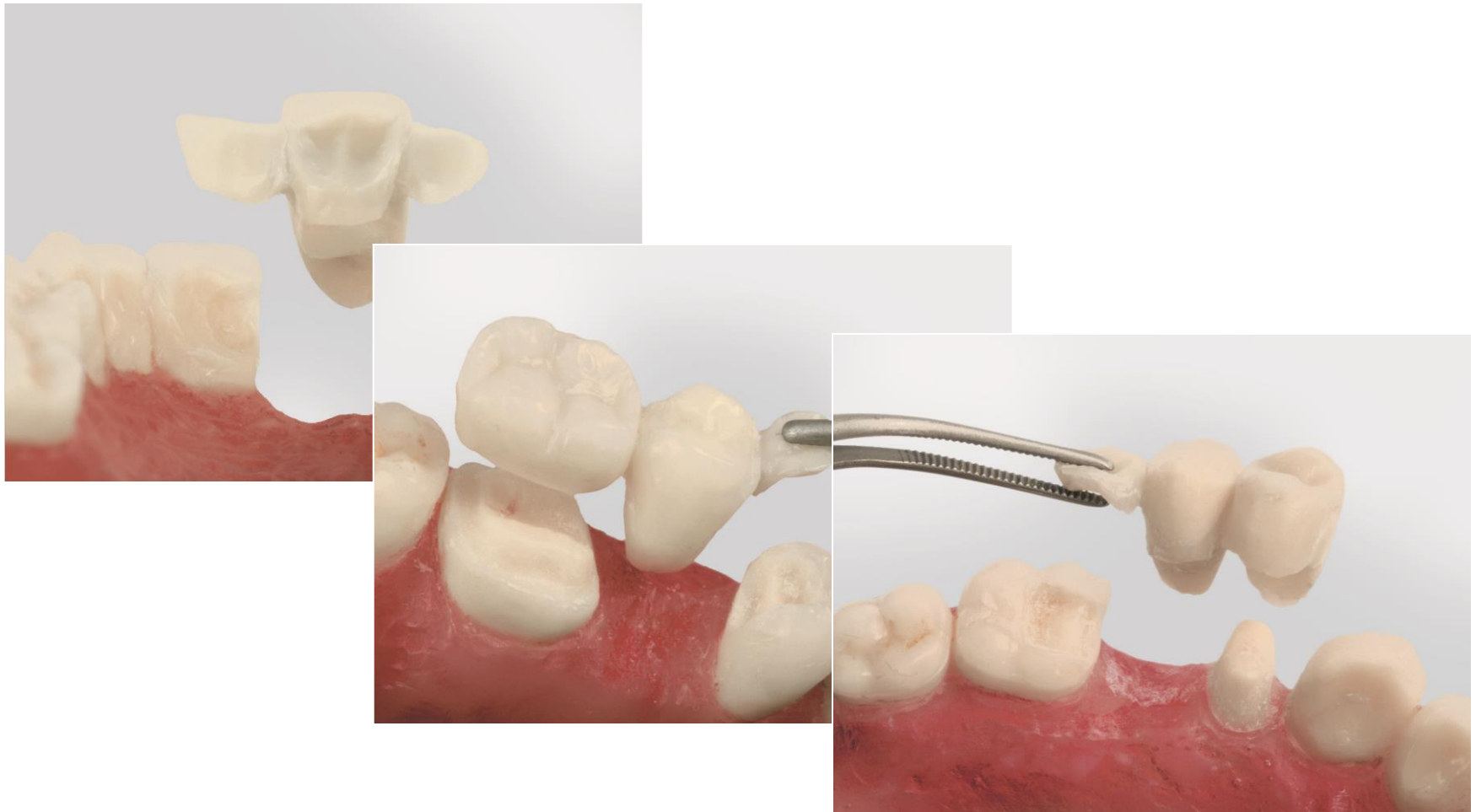




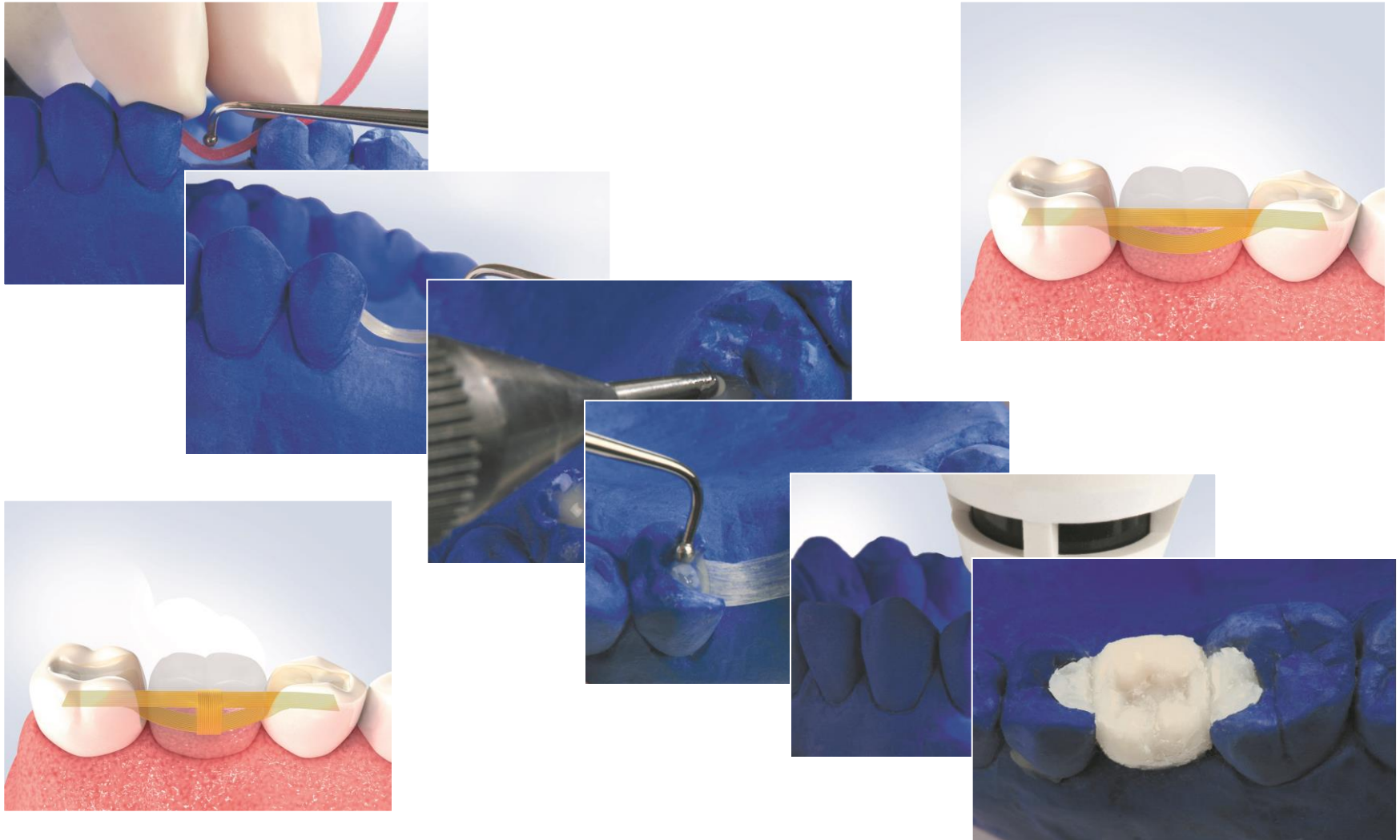


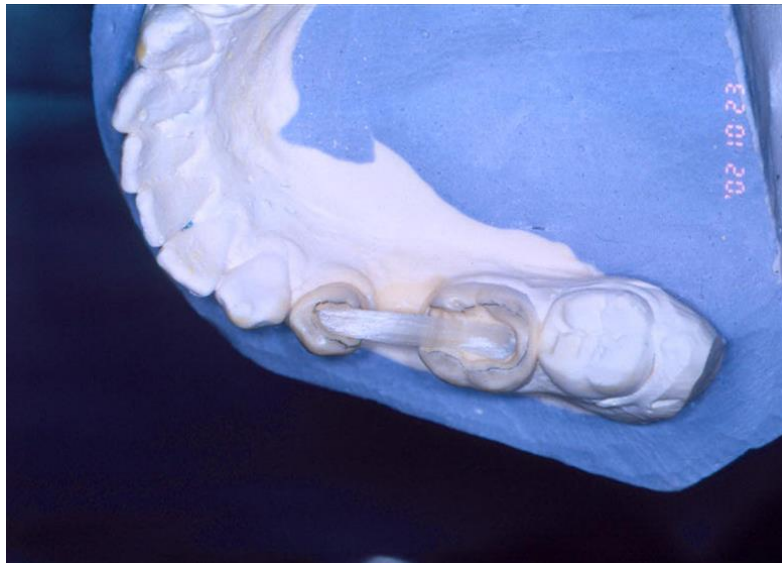
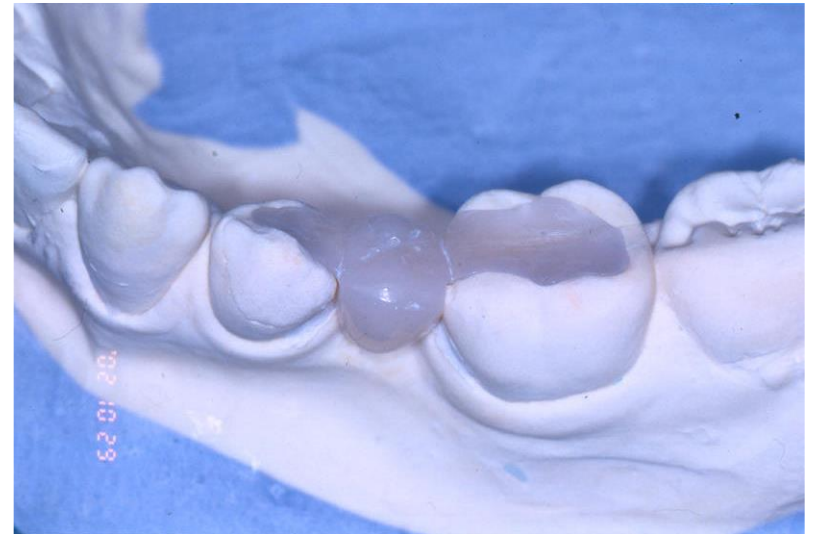


Indirect techniques – FRc reinforced fixed dentures



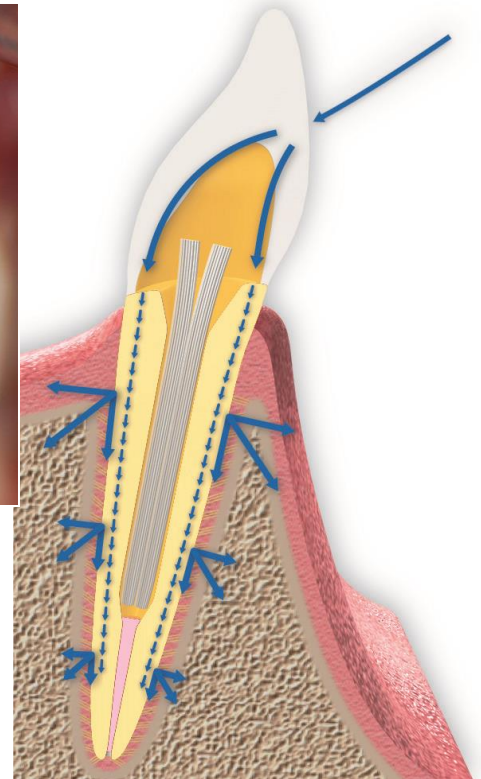
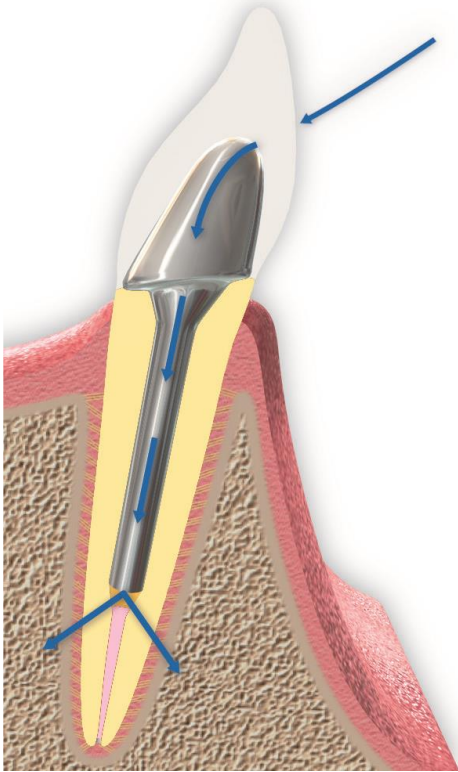
Náhrada jednoho zubu – nepřímá technika

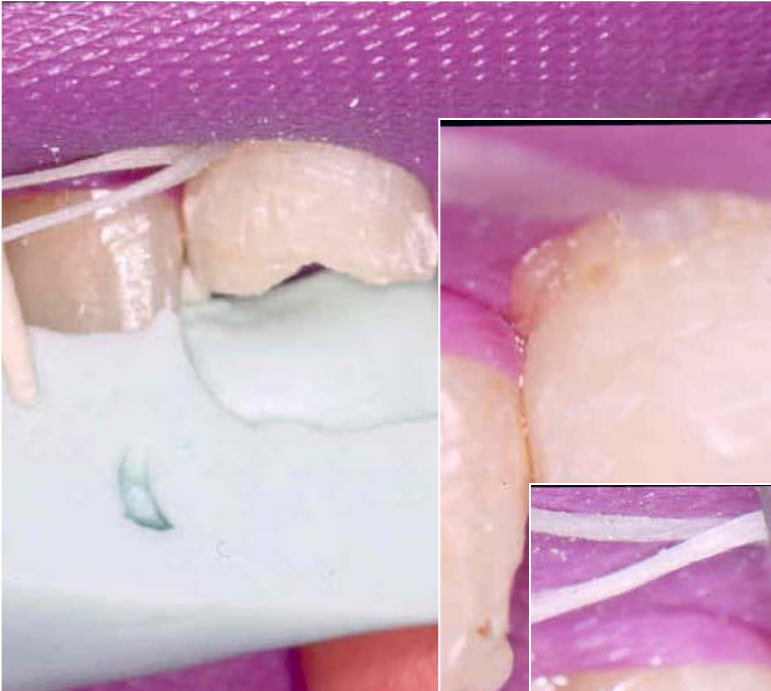
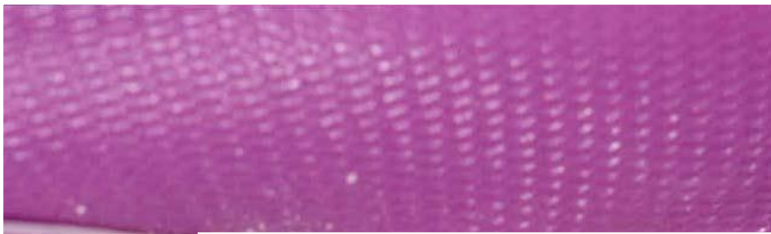


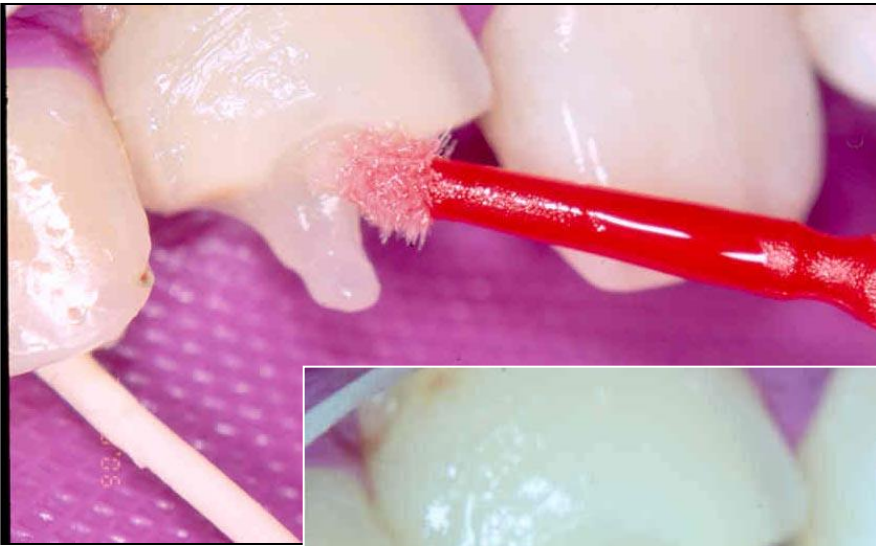


Root canal posts – postendodontics

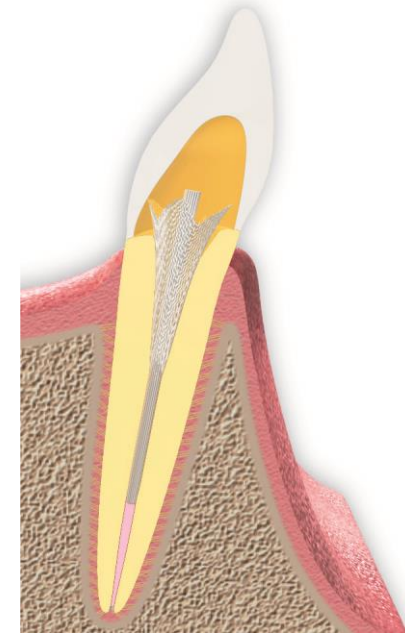
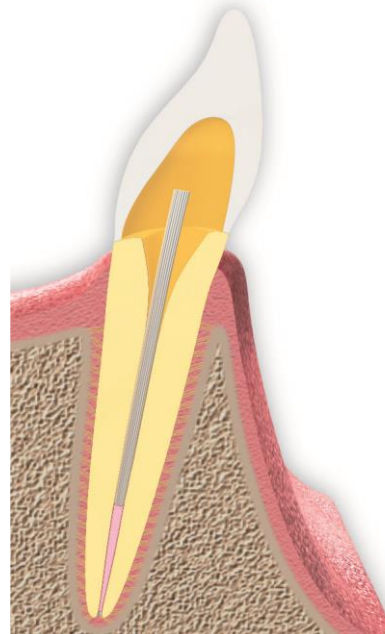
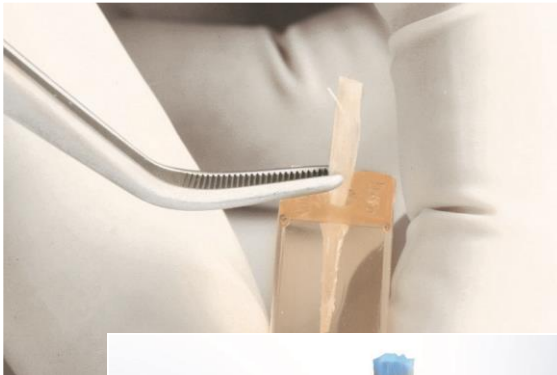
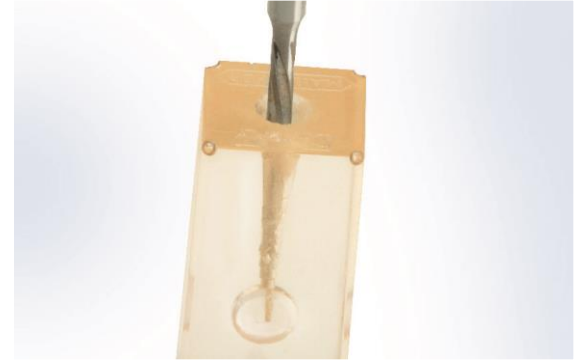
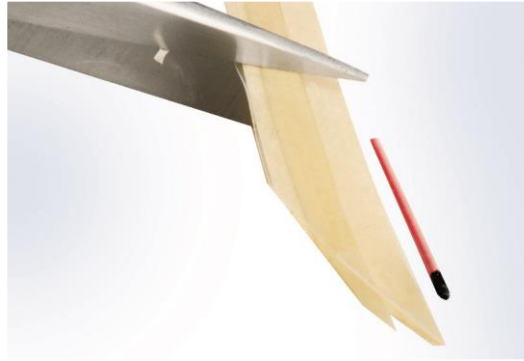
metal posts x frc posts







Individual FRC posts



Reinforcement of fillings, intracoronal splinting



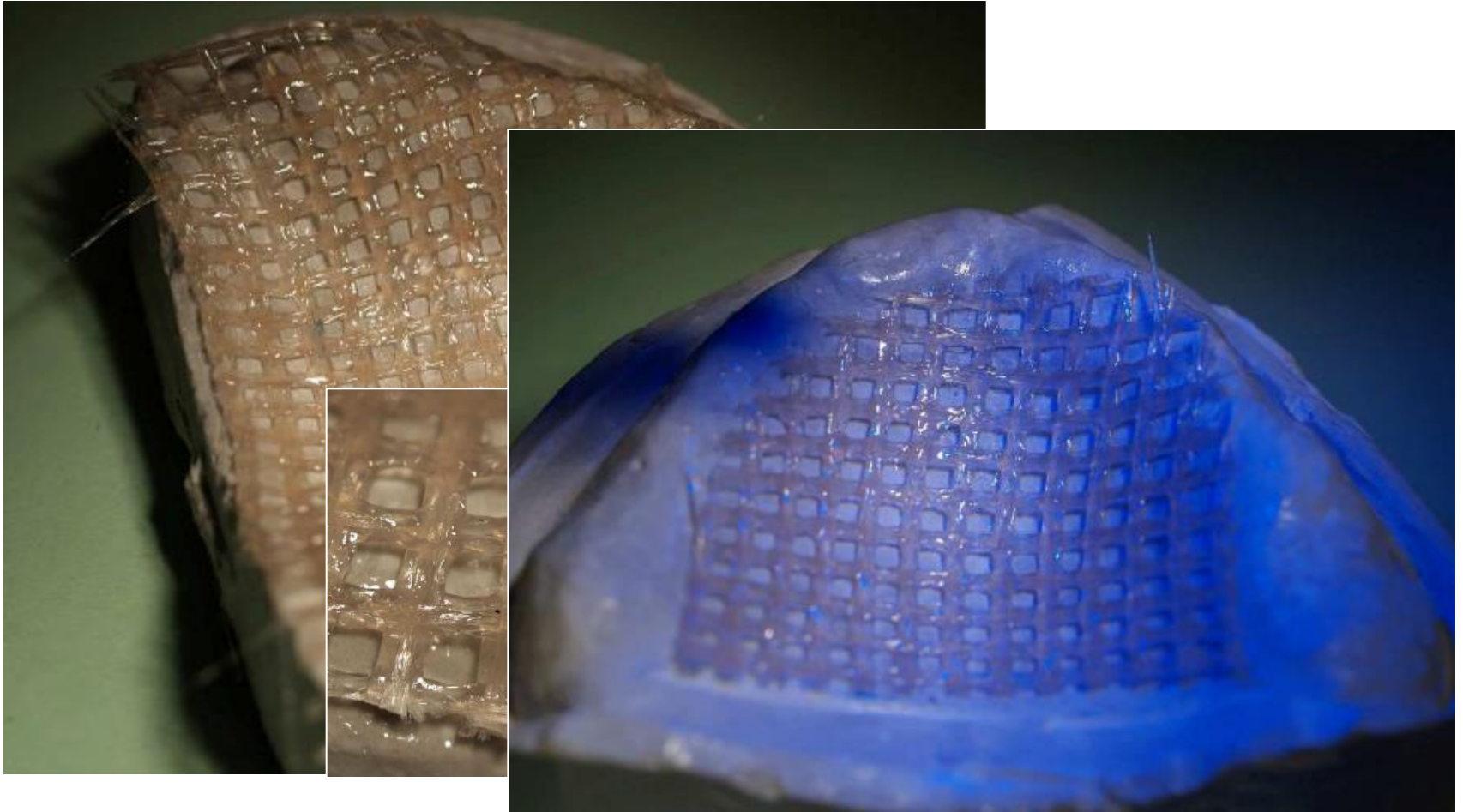
Repaire of removable dentures



Repaire of veneers



Reinforcement of removable dentures



Source of the picture: Manual Fast Splint, BCM, France

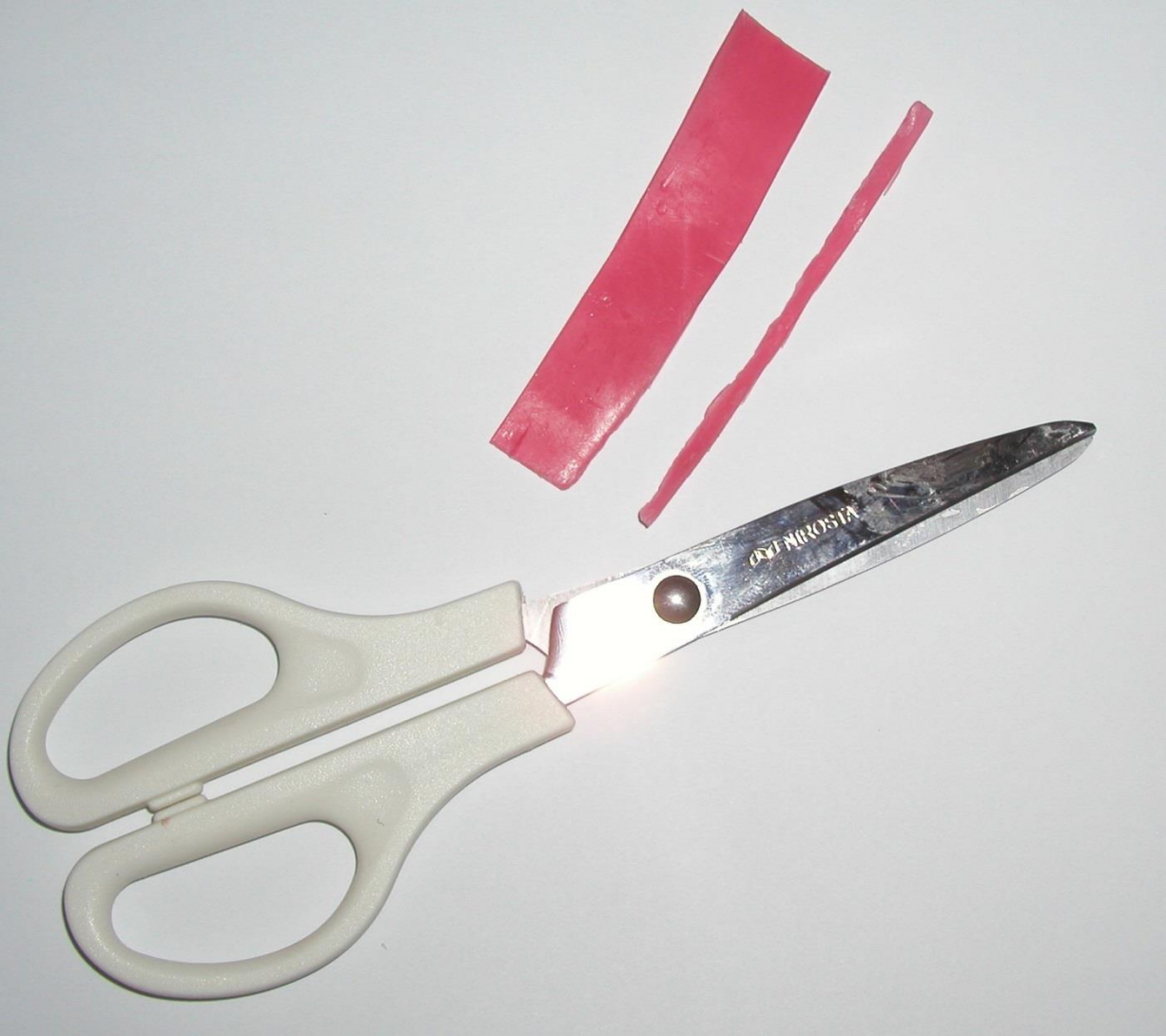
Reinforcement of temporary bridges



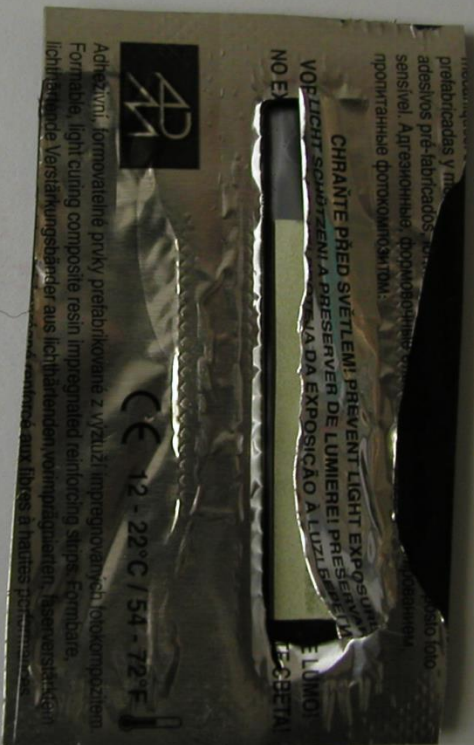
Source of the pictures: *Manual Fast Splint, BCM, France*

lenka.roubalikova@tiscali.cz

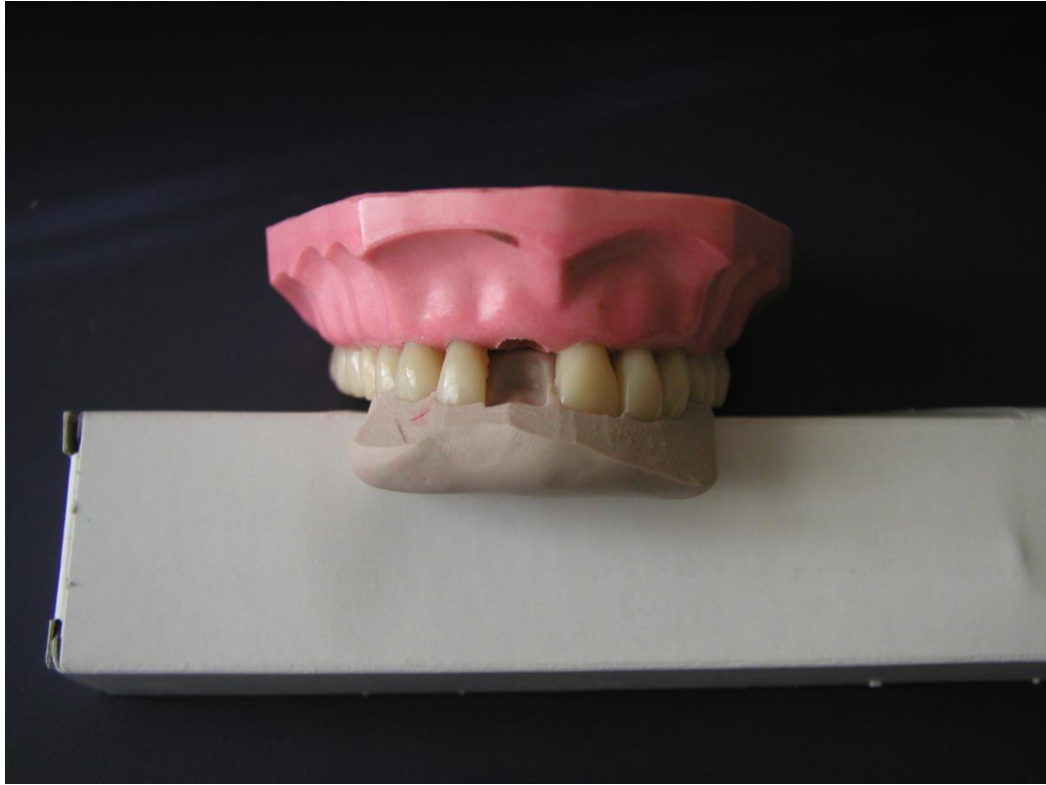
Other tips and tricks



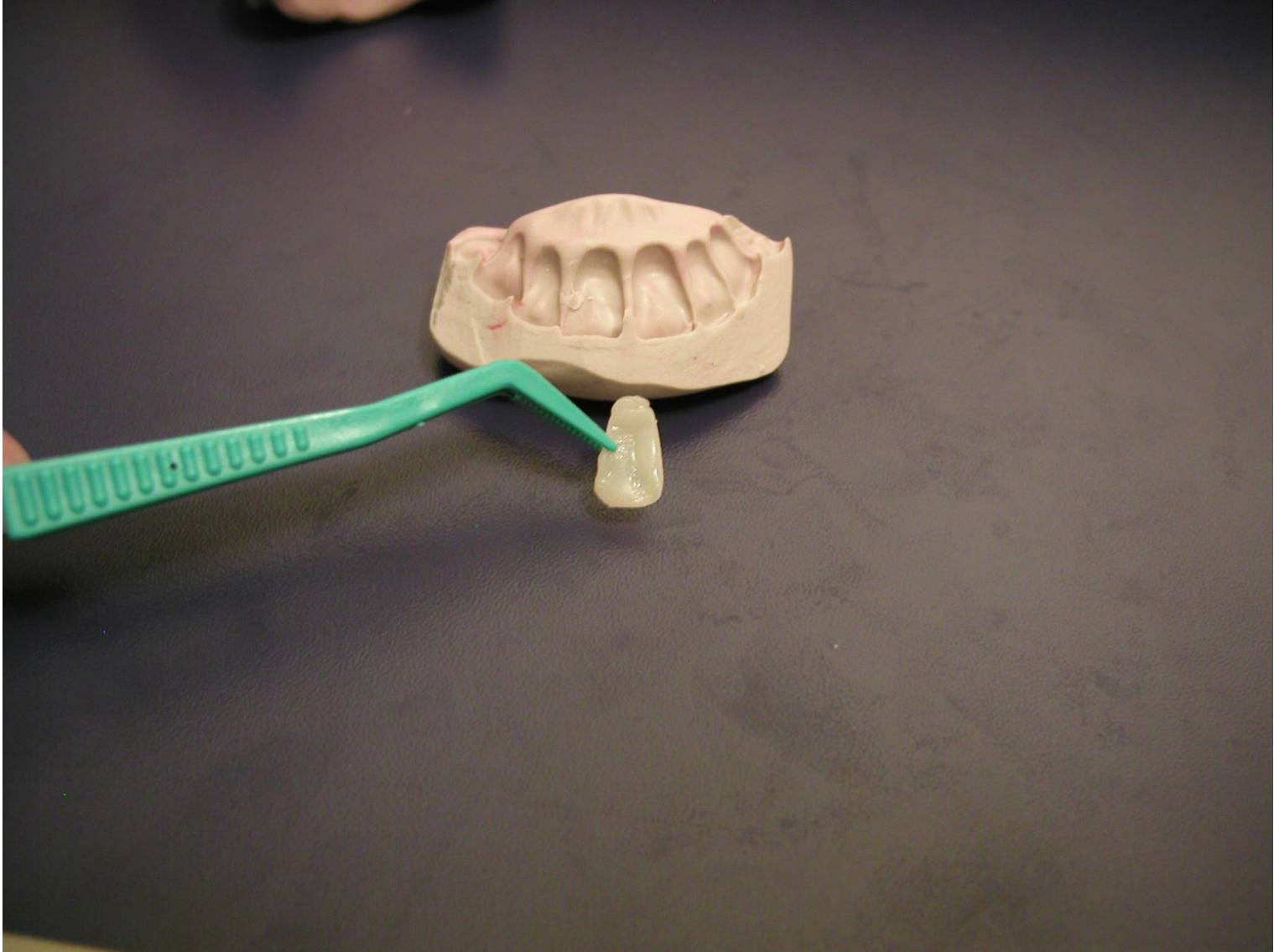










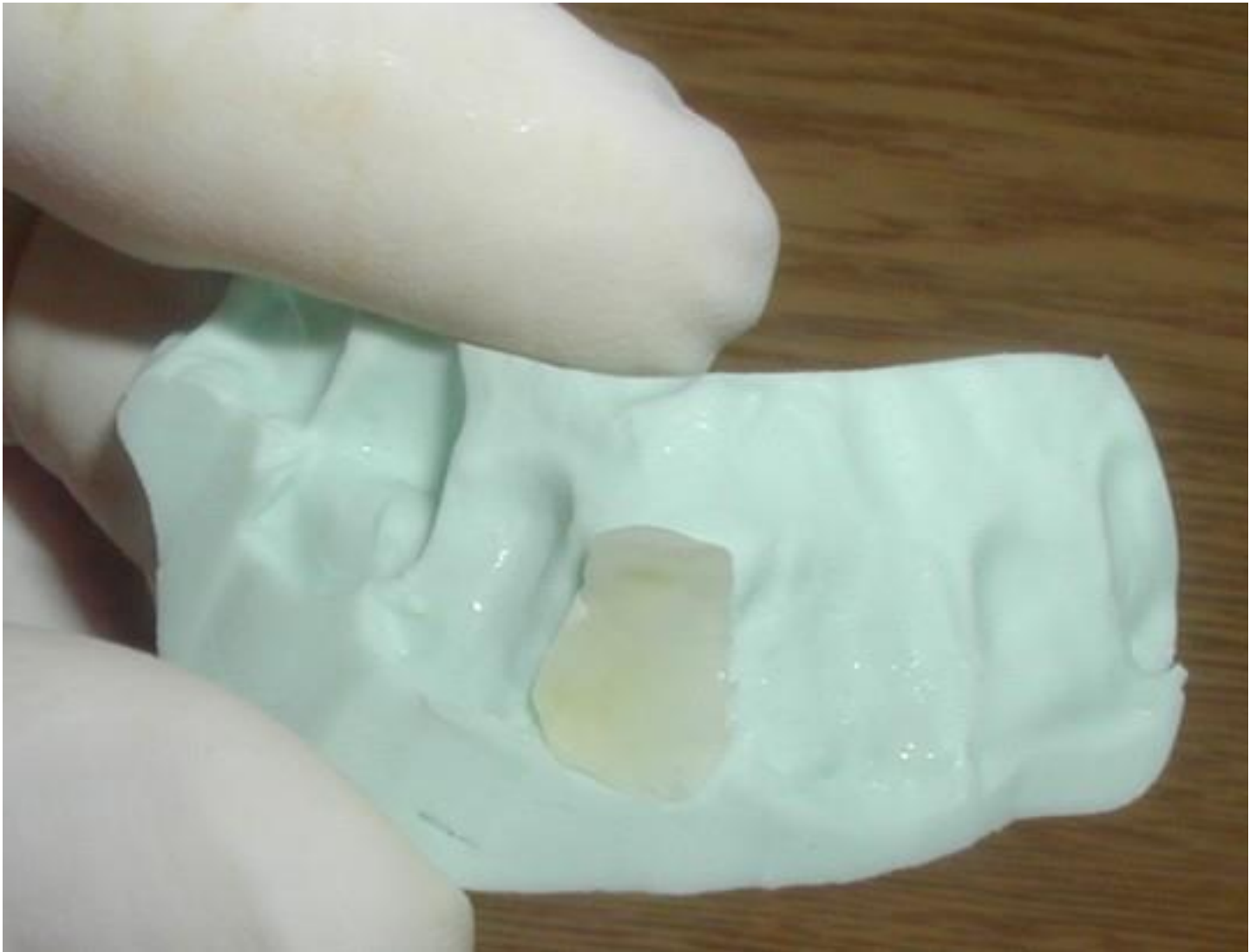




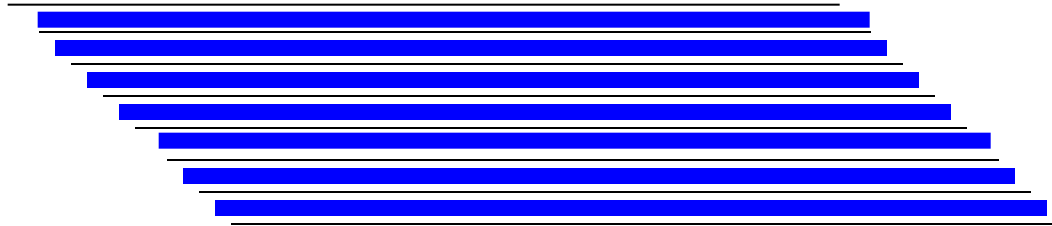
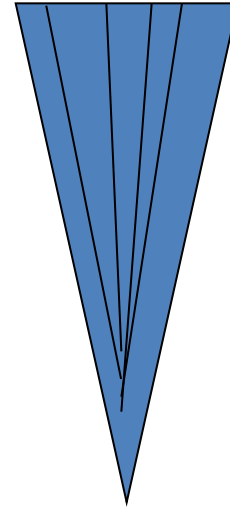


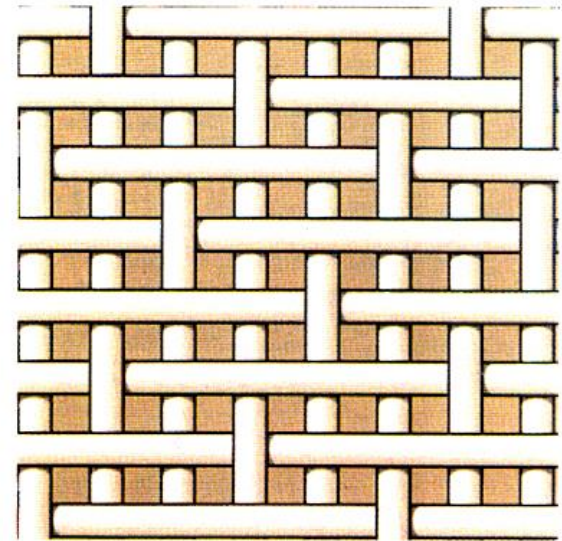
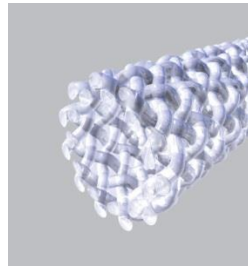
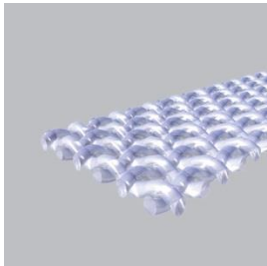
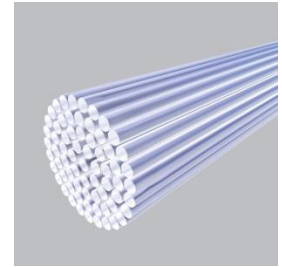
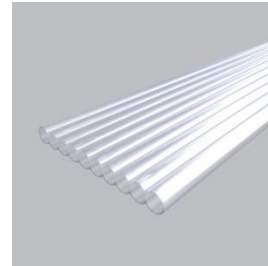
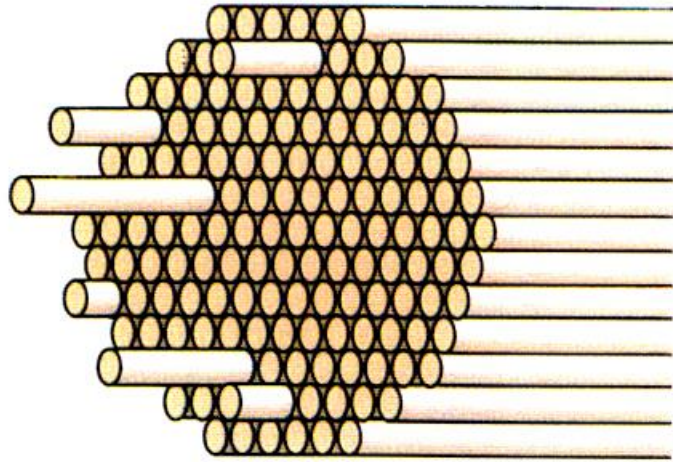






FRC in Dentistry





Modification

Tex

S - 50% volume

P- 60% volume

Form

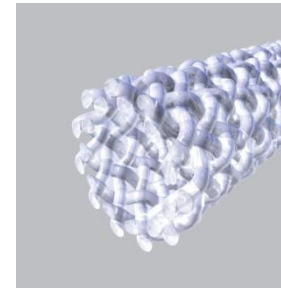
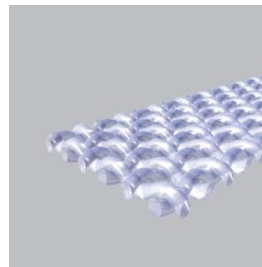
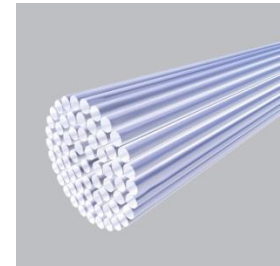
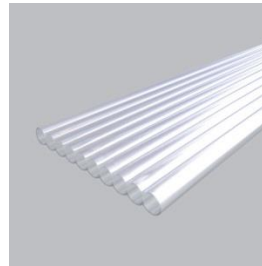
F - flat

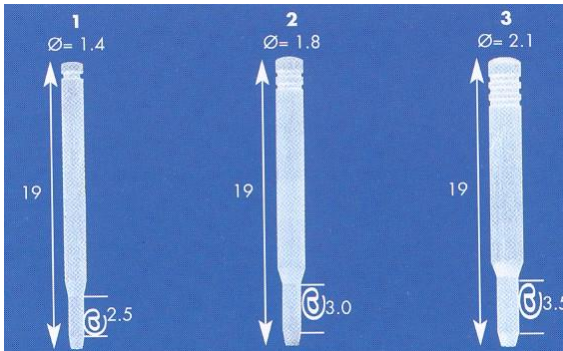
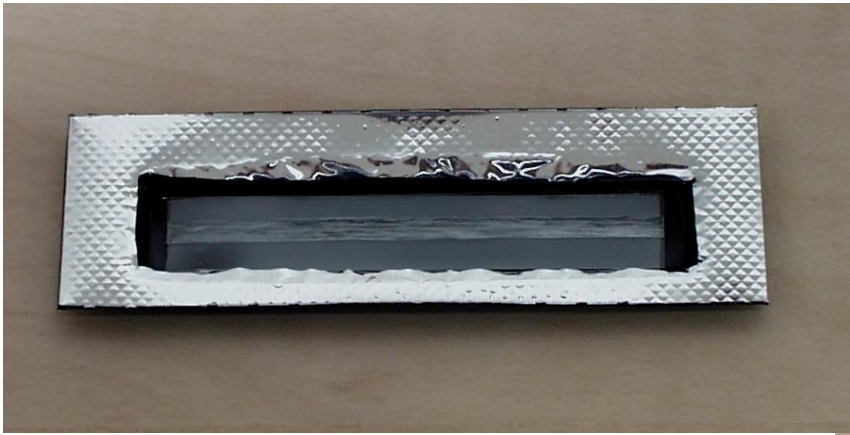
R - round

Roving

U - unidirectional

M - multidirectional





Clinical applications

One tooth replacement

- direct method
- indirect method

Splints

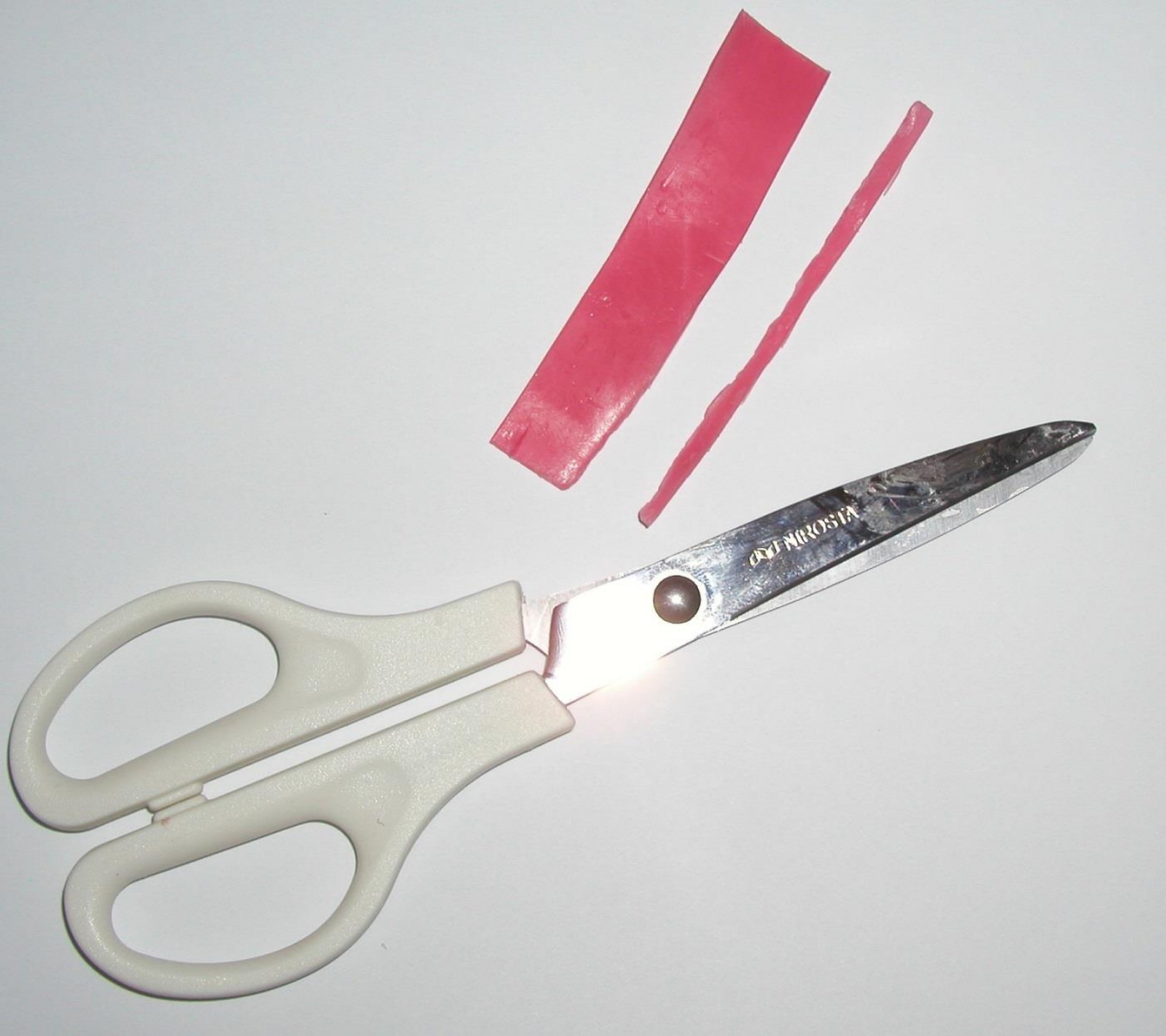
- intracoronal
- extracoronal

+ acid etch technique, bonding agent
+ particles filled composite

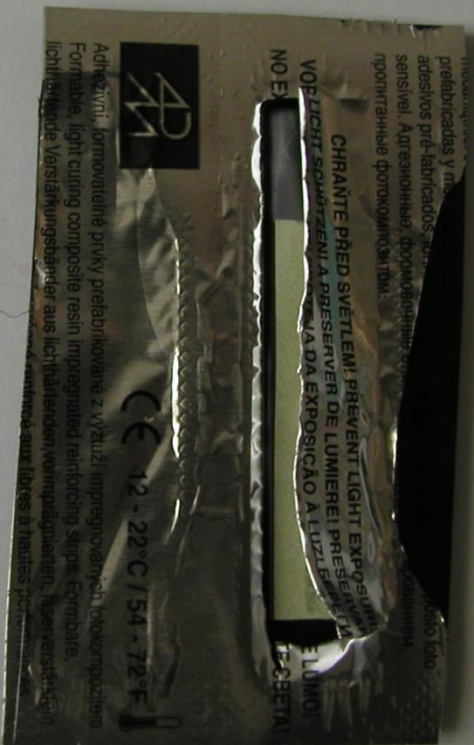
Prosthesis reinforcement

Postendodontic treatment

One tooth replacement



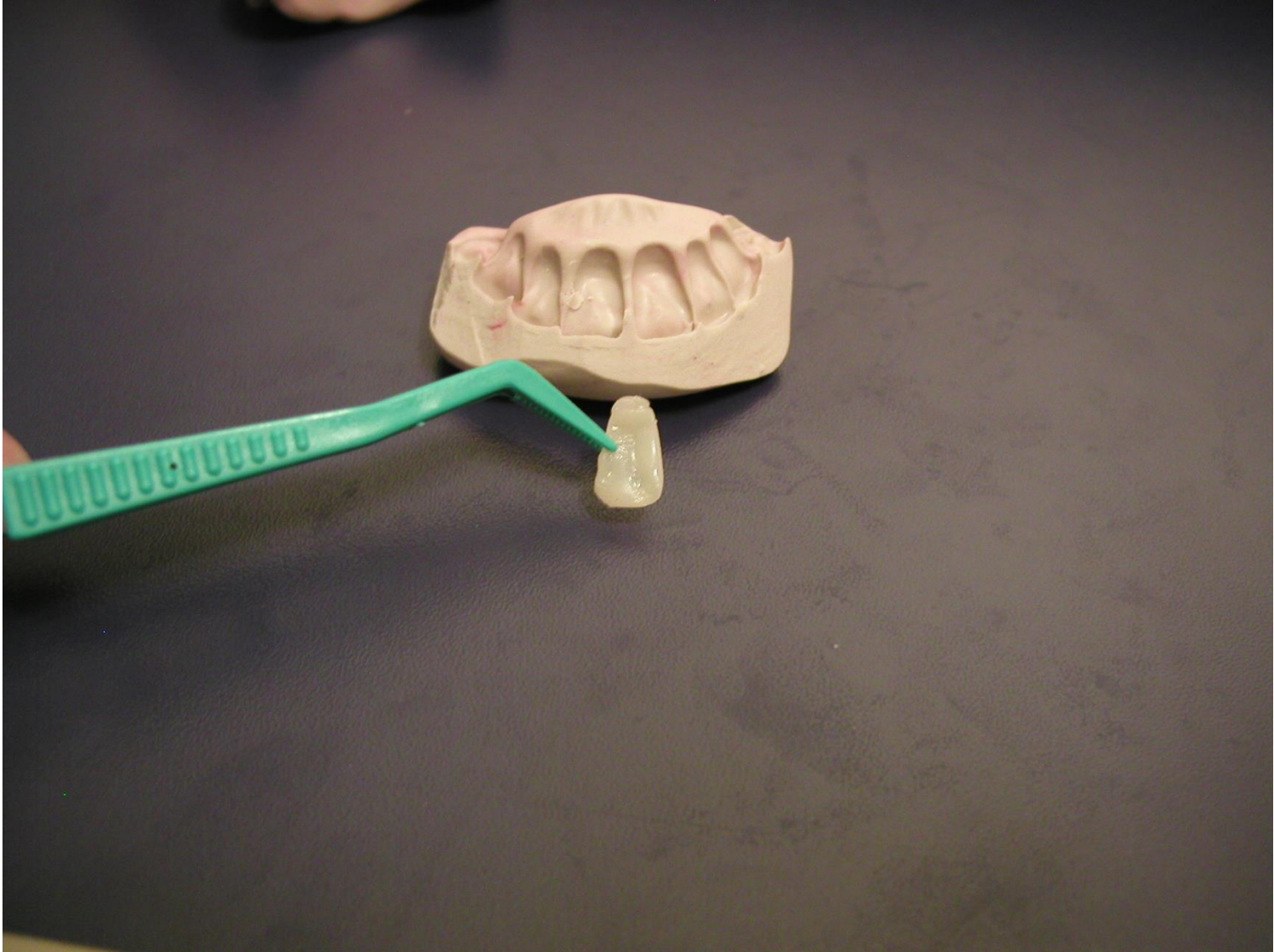










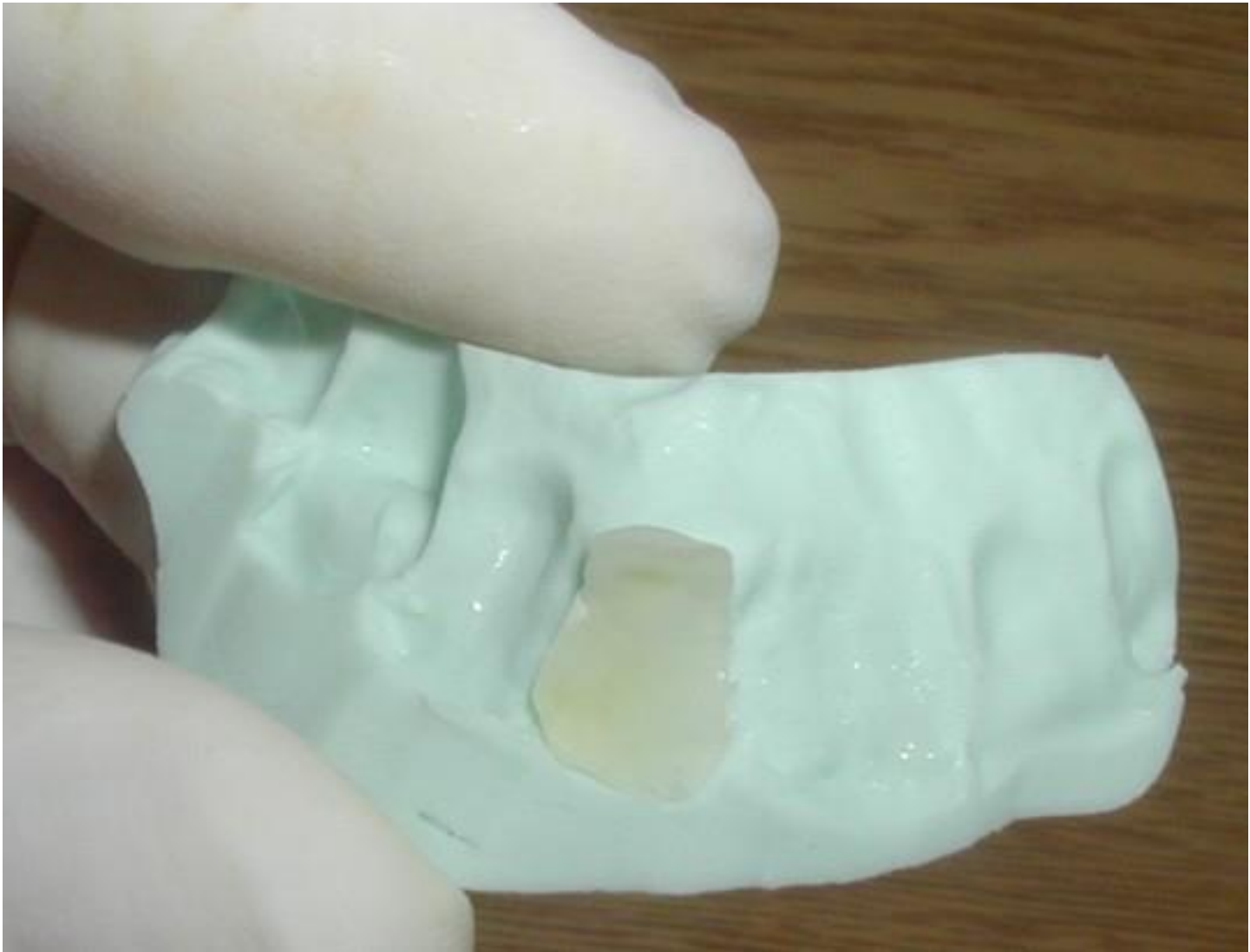


















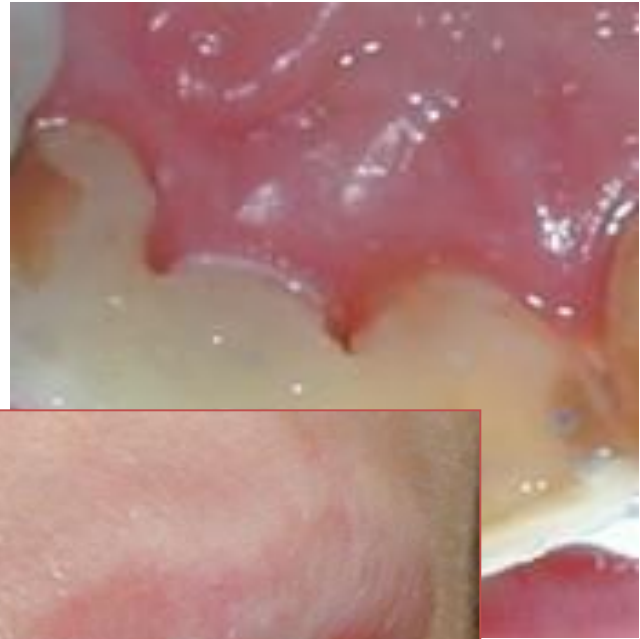


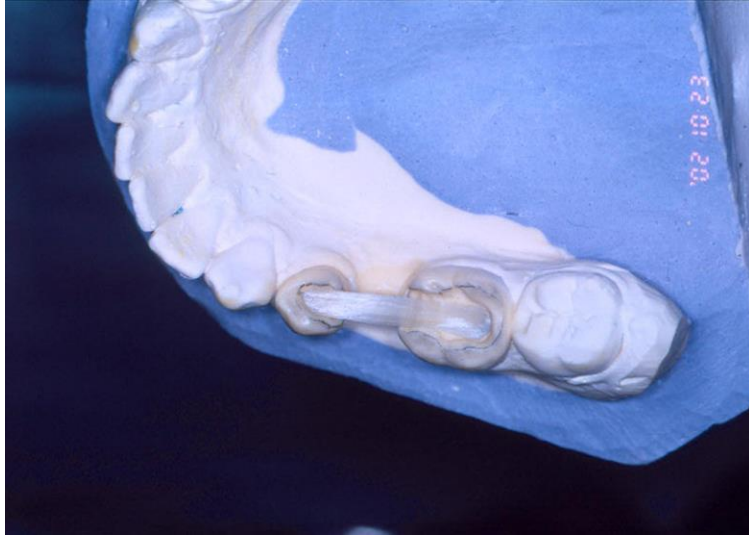




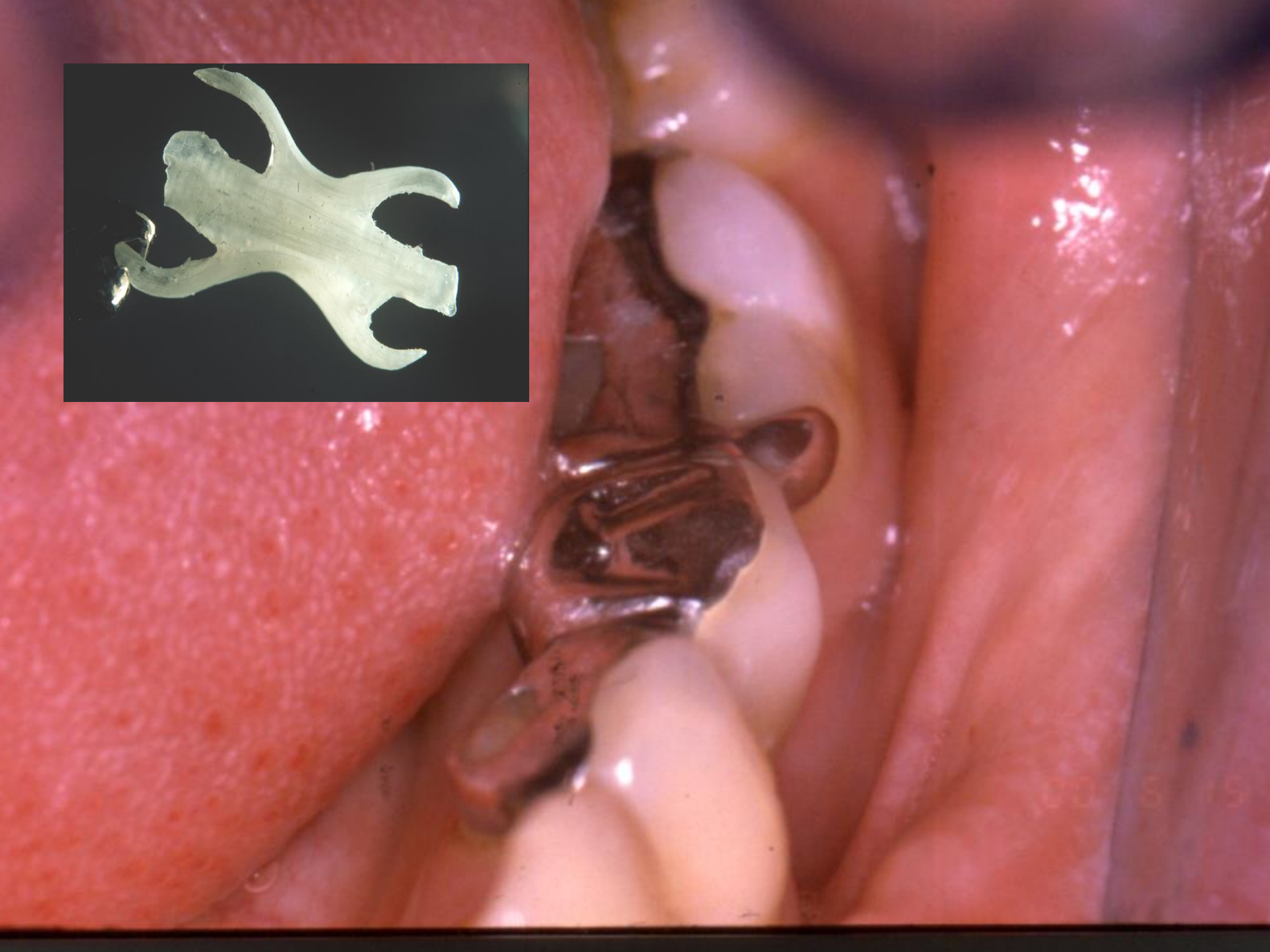




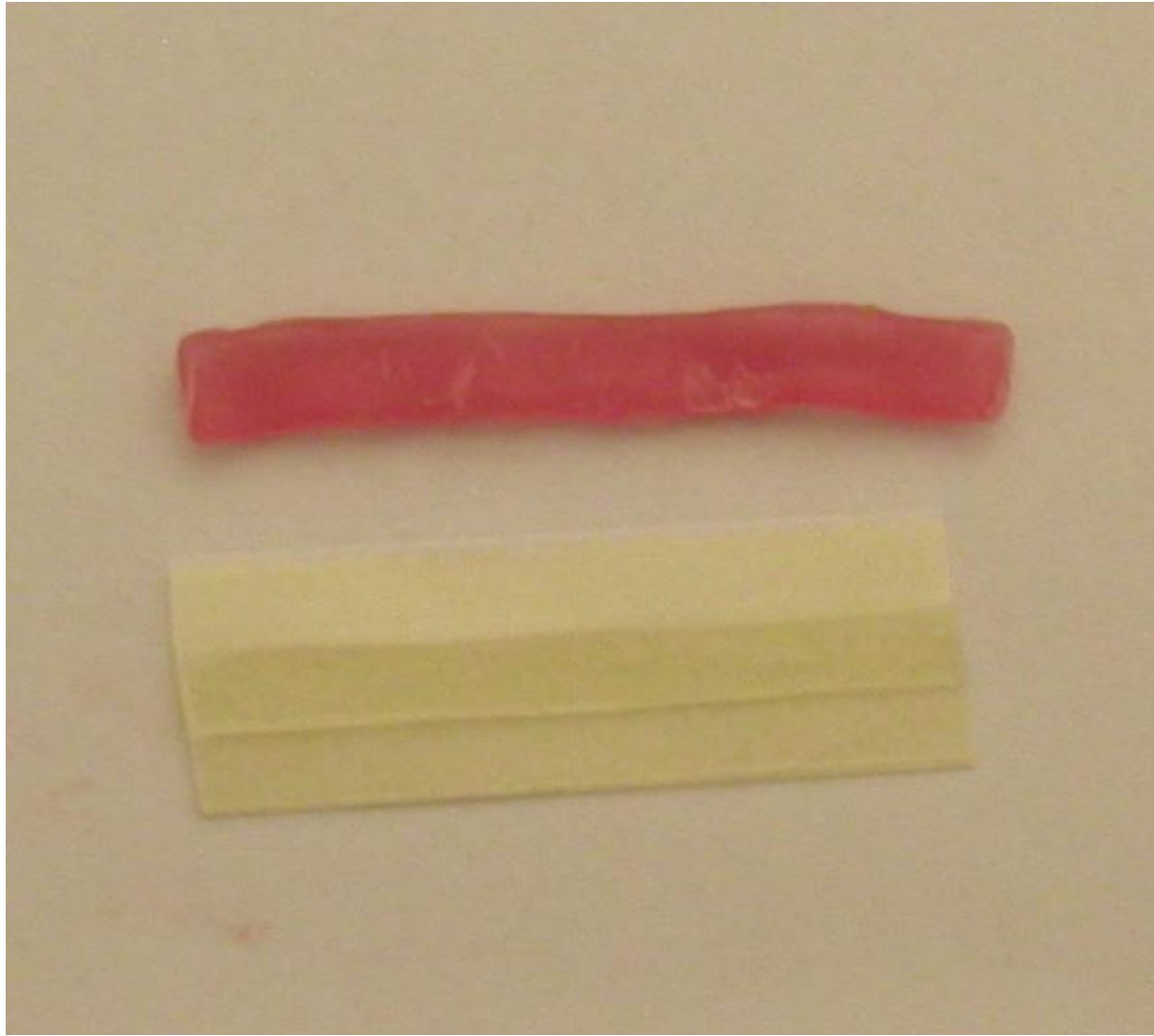




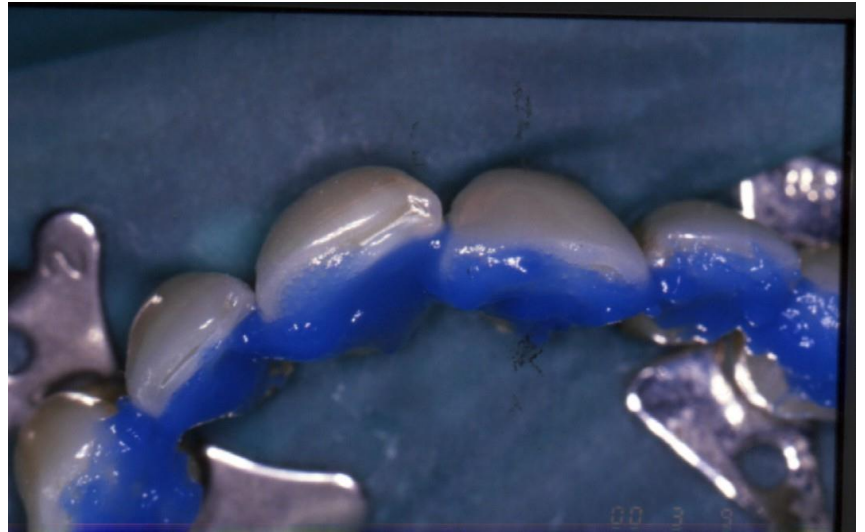




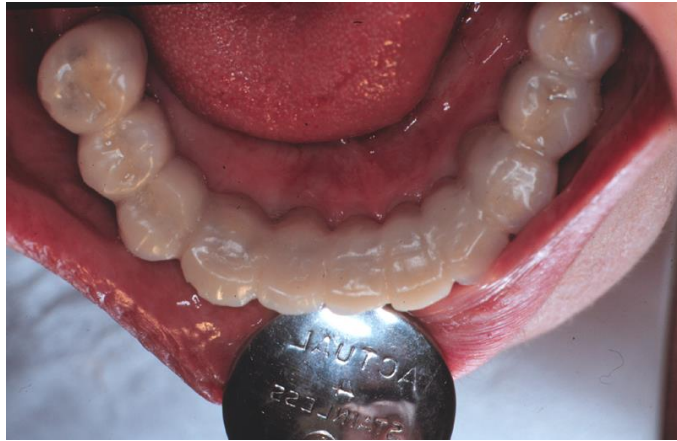
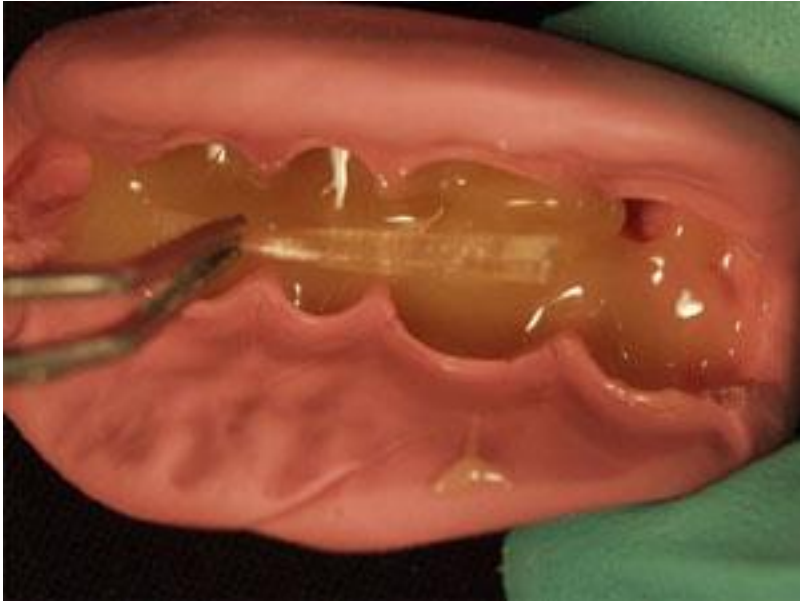
Splints







Prosthesis reinforcement



Postendodontic treatment

