Procedure to Treat Fractured Tusks in Elephants

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Exposed, partly necrotic pulp tissue. The pulp tissue looks very swollen!
Mucous membrane of the sulcus
Wall of the tusk remnant (ivory=dentin)

Preparation

- At this stage, it is not clear which treatment strategy should be followed.
- Until final treatment will take place, flush the pulp tissue 3-4 times per day with saline solution. End each session by spraying 10% Betadine solution over the pulp tissue.
- Antibiotics are not required as the wound is open and under control by flushing.
- NSAID (like ibuprofen): only if elephant shows signs of pain

Options

Depending on the fractured end of the tusk, a final treatment decision can only be made when the protruding pulp tissue has been cut off. There are 2 options:

1. The best option is to close the end of the pulp canal

2. If closure of the pulp canal is not possible, flushing should be continued until the pulp canal is closed by secondary ivory

Outline of procedure

1. Preparation
   - Check the list of requirements
   - Prepare the area where elephant will be treated
2. Standing sedation
   - Xylazine or detomidine and atipamazole (or yohimbine)
   - Oxygen cylinder + regulator in case elephant collapses during treatment
3. Tusk treatment procedure

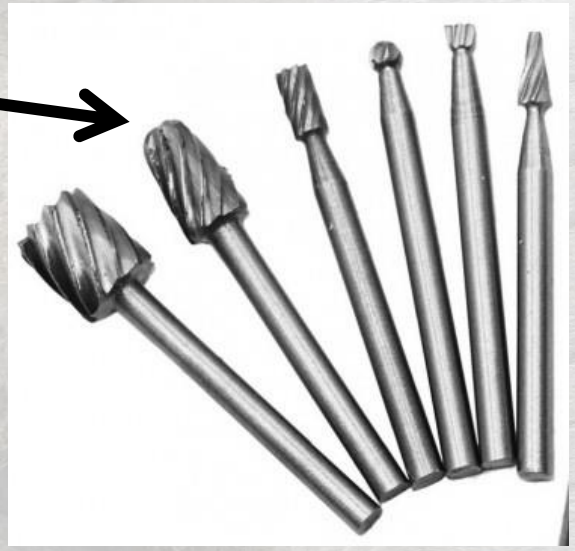
Preparation

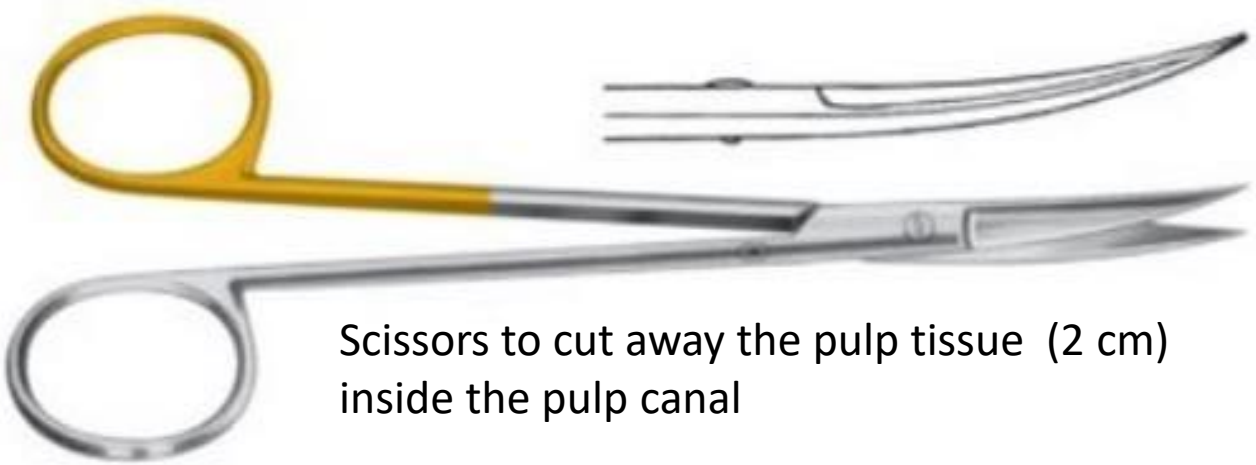
- List of requirements
  - Sedation requirements: xylazine, atipamazol, oxygen cylinder, oxygen rergulator, injection needles and syringes
  - Surgery: sterile plastic sheets, gloves, scalpel, several forceps, curved scissors with long, sharp points, sterile cotton gauze, sterile aprons, sterile clamps to fixate plastic covers, duct tape and gauze for covering the eyes, nail brush, large syringes for flushing, saw (or giggli wire, prefered), epinephrine-impregnated sponges (if available)
  - Materials for repair: saline solution, hypochlorite, Calcium hydroxy-apatite (or Mineral Trioxide Aggregate=MTA), glass-ionomer cement, two-component epoxy glue.
  - Equipment: “Dremel” with extension shaft, round-headed milling cutter.
  - Extension cable for 220V, light source

Dremel

Dremel extension shaft

Best shape milling cutter





Scissors to cut away the pulp tissue (2 cm) inside the pulp canal

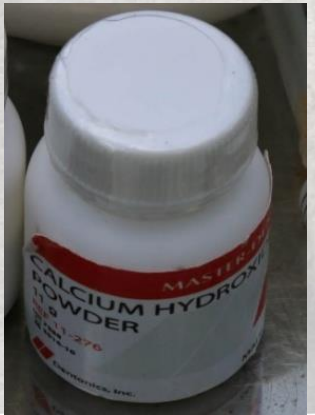
Gigli wire

Betadine solution

Sterile saline solution

Hypochlorite solution (bleach)

Calcium hydroxy-apatite (alternative: Mineral Trioxide Aggregate = MTA)



Glass-ionomer cement

Composite (or 2-component epoxy glue)

Standing sedation

- **Detomidine** 0.01-0.022 mg/kg IM (can be reversed by atipamezole at 3 times the dose of detomidine)

AND

-**Butorphanol** 0.045-0.075 mg/kg given at same time as detomidine (can be reversed with naltrexone at 2.5-5 times the dose of butorphanol)

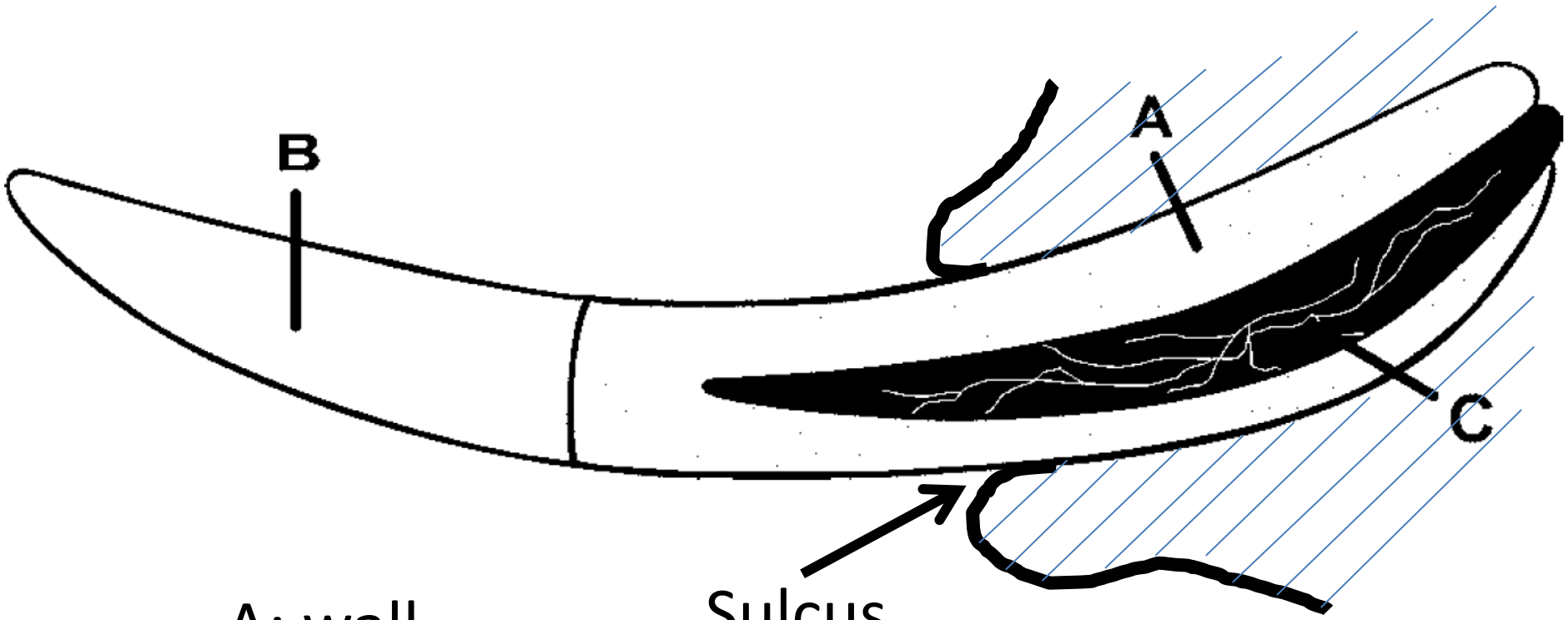
OR

-**Xylazine**: 0.08 mg/kg IM (can be reversed with atipamazole at 10% of xylazine dose)

Signs of sedation: Snooring
Salivation
Penis prolaps
Trunk relaxated

Cover eyes with gauze (duct tape)
Chain the elephant on one front leg and one hind leg

Normal tusk (bull)



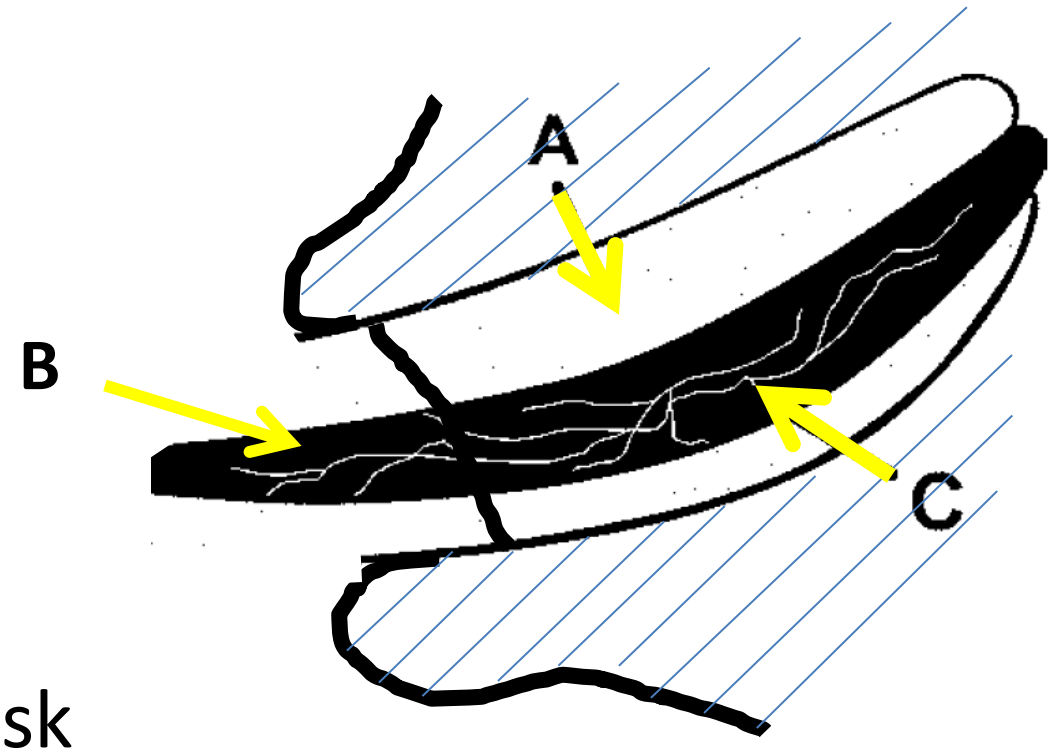
A: wall

B: tip

C: pulp canal

Modified from McCullar, 1994. Illustration by R. Green.

Fractured tusk



A: remnant of the tusk

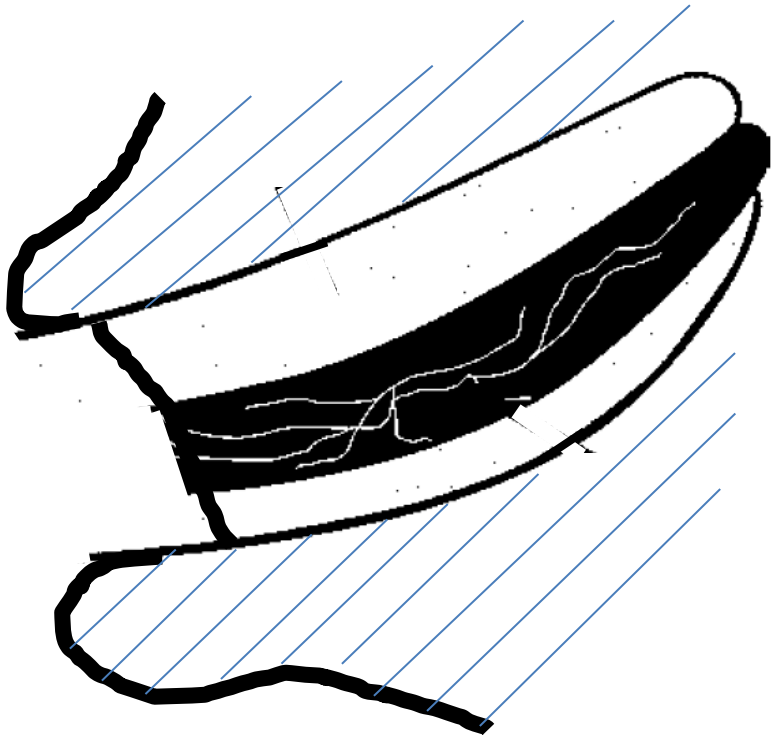
B: exposed pulp tissue from fractured part of the tusk

C: healthy pulp tussue

Fractured tusk

1. Cut off the pulp tissue

2. Remove the protruding tissue completely



At this point you must make your decision:

A Filling the pulp canal (preferred!)

B. Conservative treatment (flushing)


This tusk can be saved by filling the distal part of the tusk cavity.
First you need to cut off the tip of the tusk, making sure that the giggli wire or saw goes throught the non-affected pulp tissue.


Cutting off the tip of the fractured tusk using a giggli wire


Keep the soft tissue out
of reach of the giggli
wire or saw


Remove all abnormal
(black) ivory using the
milling cutter, especia
in the central area of
the tusk (at this stage,
partial pulpectomy ha
already been done)

• When the protruding pulp tissue has been removed from the fractured tusk, the condition of the tusk must be evaluated. If the wall of the pulp chamber is still intact (circular), filling can be done.

• If there are only minor cracks: filling can still be done after cleaning out the black ivory parts of those cracks.

• If there are big, longitudinal cracks, that go deep inside, filling is no option and further treatment consists of the same (conservative) treatment that was given from the start: flushing 3-4 times per day with saline and 10% Betadine solution (or mild antiseptic) until the pulp tissue is covered by secondary ivory.

Now continue with the filling process

- From this stage on, sterile surgery rules have to be applied:
  - Clean and brush the area with soap and Betadine
  - Cover the surrounding skin with sterile surgery sheet (secure with duct tape)
  - Put on surgery gloves
- Cut off 2 cm of the pulp tissue, creating space for the glass-ionomer cement cover
- Stop bleeding by compressing the pulp tissue with sterile gauze (for several minutes)
- Remove infected ivory (black, dirty) with Dremel and round-topped milling cutter


Further cleaning required by using a small milling cutter on a Dremel (with extended shaft)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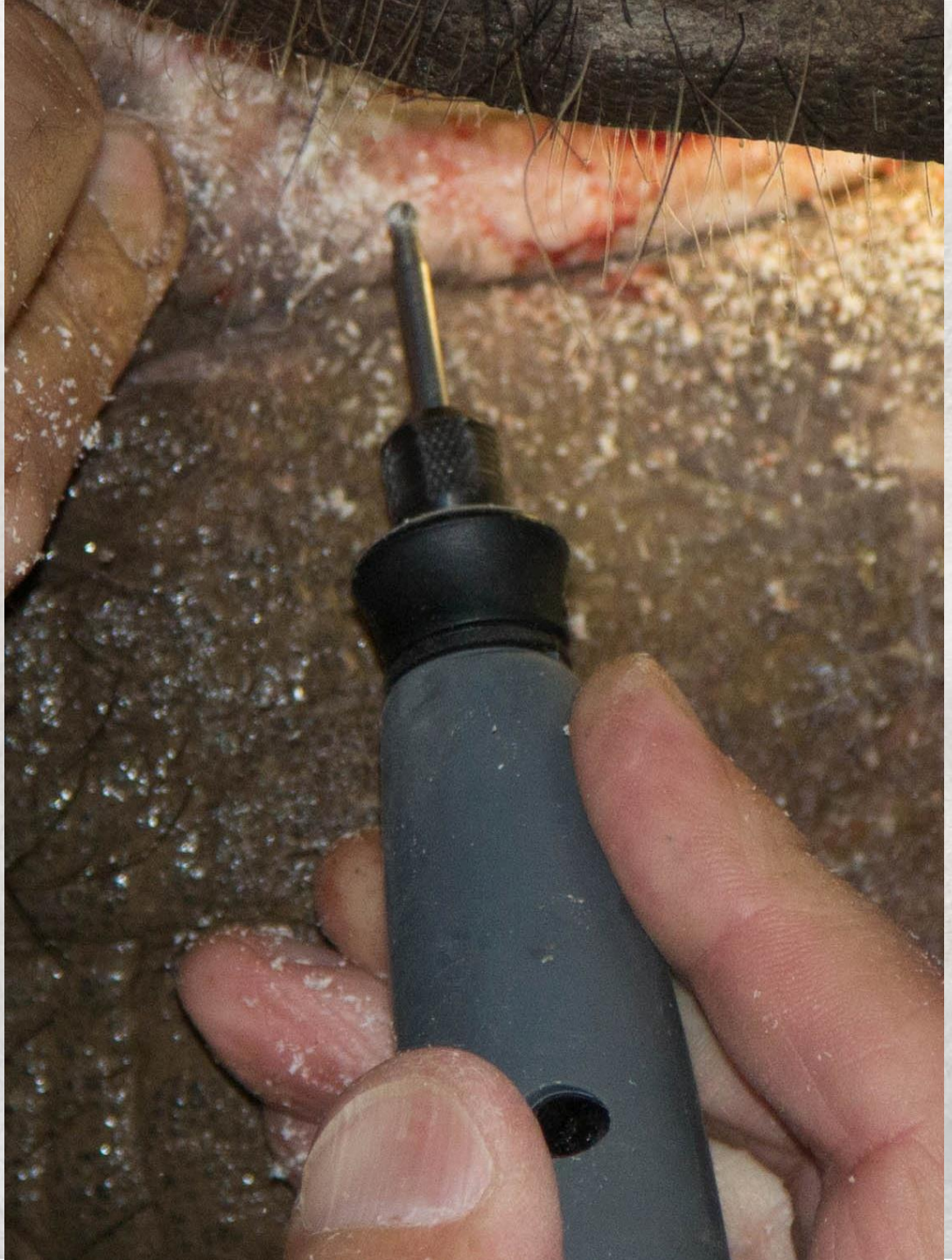
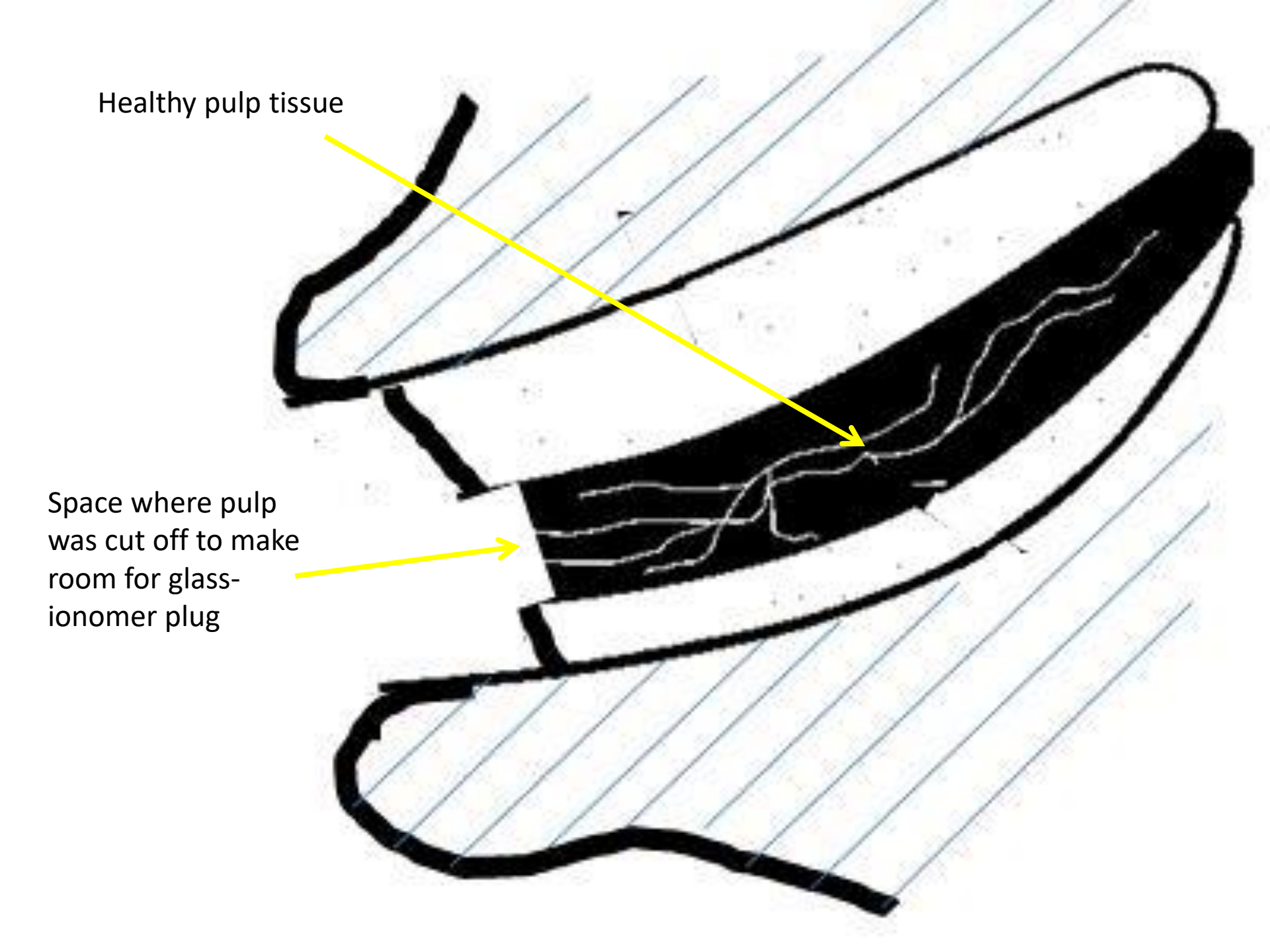
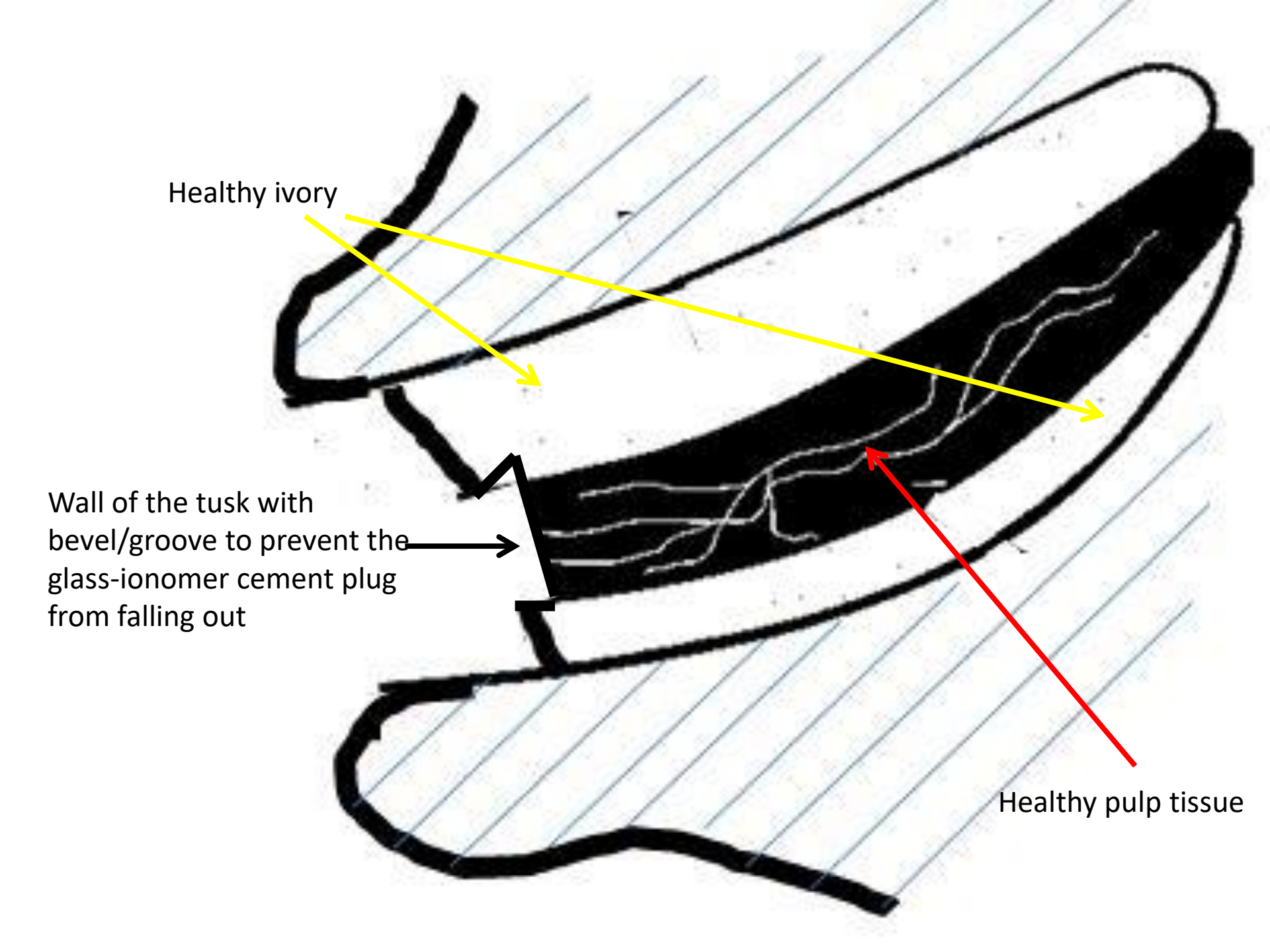



Healthy pulp tissue
Space where pulp was cut off to make room for glass-ionomer plug

- To prevent the glass-ionomer plug from falling out, it is adviable to use the milling cutter for milling a bevel in the inner wall of the tusk (see next image)


Healthy ivory
Wall of the tusk with bevel/groove to prevent the glass-ionomer cement plug from falling out
Healthy pulp tissue

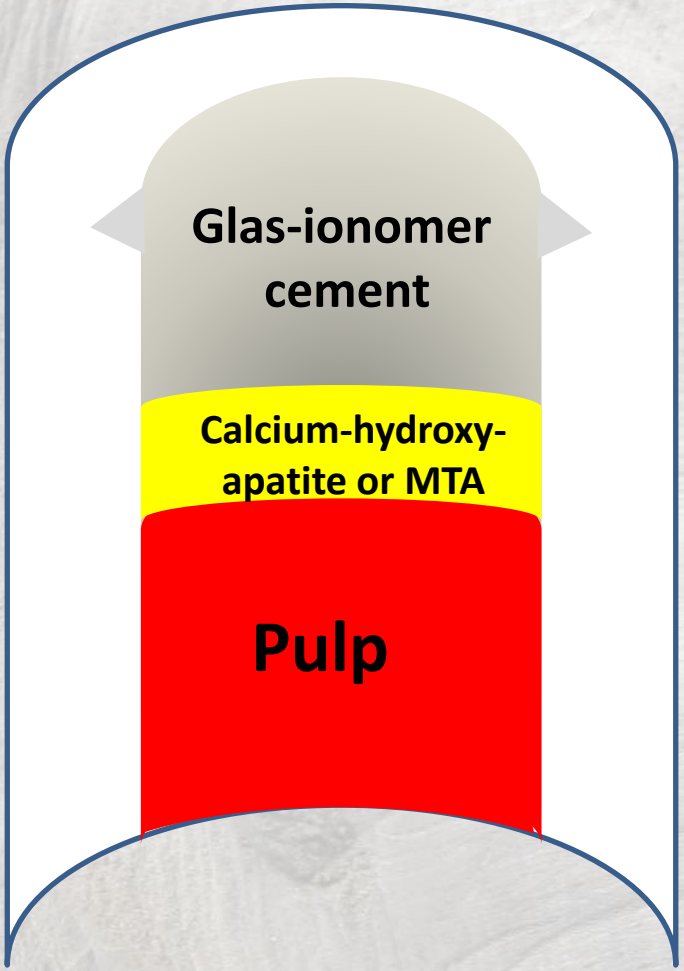
Filling process

- Flush with 10% Betadine solution or other mild antiseptic solution
- Flush again (saline solution)
- Let dry using sterile cotton gauze
- Flush the inner side of the tusk ivory with some hypochlorite; avoid spraying it on the pulp tissue! This process is called “Etching” of the dentine; it improves bonding of glass-ionomer cement to dentine.
- Flush the ivory again with saline solution.
- Let dry again
- Cover the pulp tissue with a thin layer of calcium hydroxy-apatite..
- Let dry again
- Close the opening of the pulp canal with glass-ionomer cement. Fill the entire area, including the bevel/groove
- Cover the tip of the tusk with a thick layer of 2-component epoxy glue for extra protection

Filling the tusk end with composites

This is a diagram of the entire process of root canal filling in mammals

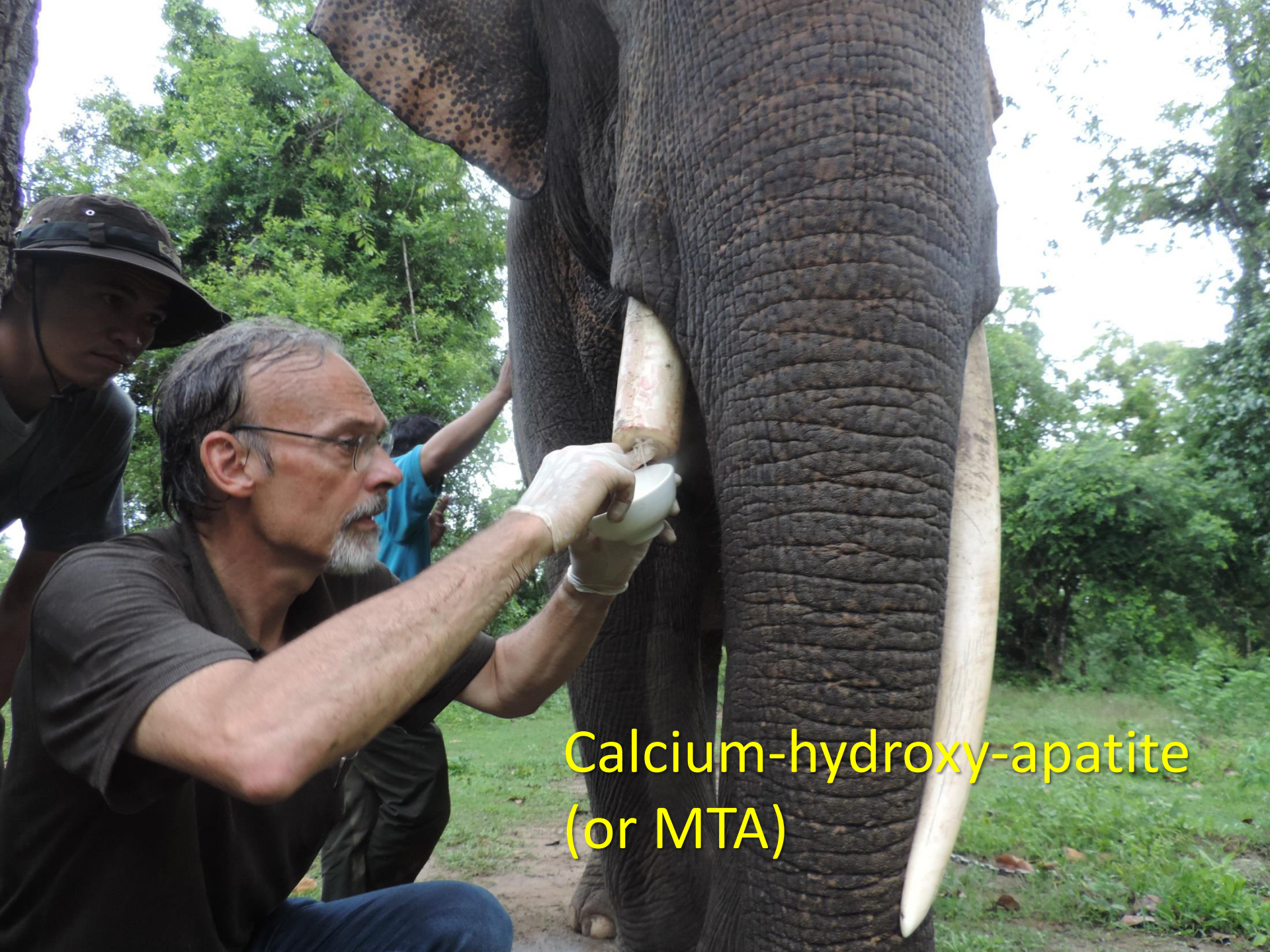
In the elephant we prefer to cover the tusk tip with an extra layer of a two-component epoxy glue



Some additional advice:

- How to stop hemorrhages:
  - Compression (cotton gauze) untill it stops
  - Epinephrine-impregnated sponge (if available)
- Disinfection can be done using cotton impregnated with Betadine
- Etching (hypochlorite): stimulates bonding between dentin and glass-ionomer cement. Use only a few milliliters and avoid contact with pulp tissue
- Try to work as clean (sterile) as possible


Method to let dry:

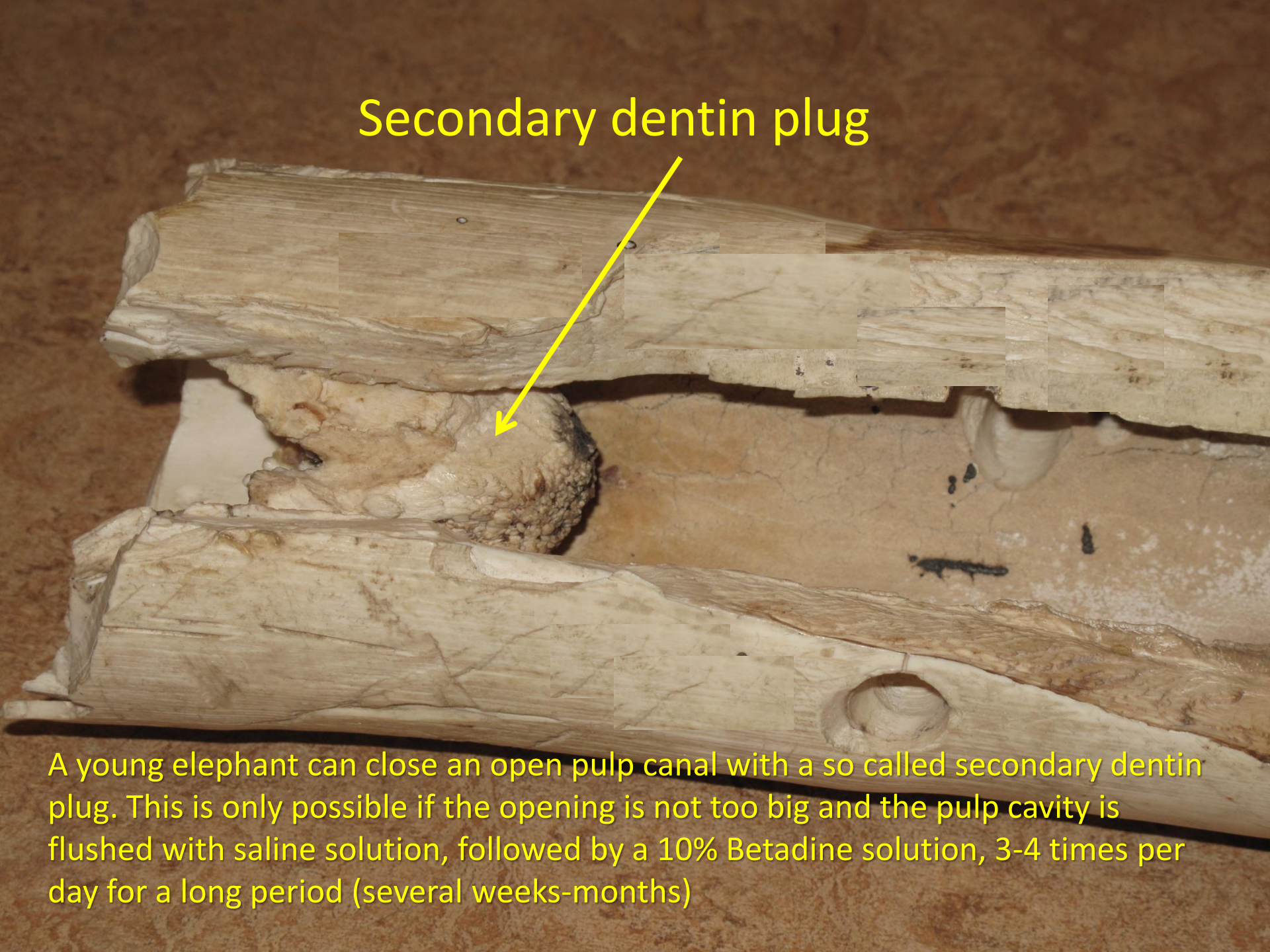

Calcium-hydroxy-apatite
(or MTA)


Glass-ionomer
Cement
preparation


Glass-ionomer
Cement application


Pulp canal and cracks filled with
glass-ionomer cement


Composite or
2-component epoxy
glue as an extra
protection for the
glass ionomer
cement



A young elephant can close an open pulp canal with a so called secondary dentin plug. This is only possible if the opening is not too big and the pulp cavity is flushed with saline solution, followed by a 10% Betadine solution, 3-4 times per day for a long period (several weeks-months)


Good luck!