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Multi-Proxy Sampling Protocol for Teeth from Archaeological Collections

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We use this protocol and it's working

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Abstract

This protocol introduces a streamlined approach for concurrent sampling for endogenous and microbial ancient DNA (aDNA) and stable isotopes (particularly, but not exclusively, enamel sampling for strontium isotope analysis) from a single archaeological tooth. By combining sampling strategies into a single workflow, the protocol eliminates the risk of inadvertently sampling different individuals. It reduces the need for multiple sampling rounds, optimises the use of each sample, and eliminates the need to collect multiple samples for different analyses. Additionally, it minimises logistical complexity by reducing shipments between institutions and the risk of sample loss during transit.

Image Attribution

Denisa Zlámálová, Sarah Defant

Guidelines

This Protocol is destructive.

Every element must undergo thorough documentation prior to sampling, ideally via CT-scans or 3D modelling, but at a minimum through high-resolution photography.

This protocol requires clean-room conditions.

Stated times refer to the standard procedures in the aDNA laboratory at Masaryk University Brno, Czechia.



Materials

General Materials

- Polyethylene clear plastic bags in several sizes
- Aluminium foil
- Paper towels
- Paper plates
- Waterproof pens
- A4 paper
- Scale/Ruler
- 10-20ml glass vials with lid
- Weighing apers (e.g. 2105-1900 Fisherbrand 100×100, 250pcs)
- Hinged 2ml Safe-Lock tubes (e.g. Eppendorf, Catalog No. 0030120094)

Electronics

- UV-Lights/UV-cabinets
- Drill handpiece
- Ultrasonicator
- Camera
- Magnifying lamp (minimum 10x magnification).
- Digital precision scale

Drills & (Dental)Equipment

- Dental pliers (e.g. Wire Bending Pliers (e.g. Krampon Zange CARAT from Scheu Dental GmbH - 2040)).
- Dental sickle probe/Dental explorer (e.g. HuFriedyGroup CI-2/3 Sickle Scaler)
- Periodontal scaler (e.g. HuFriedyGroup H6/7 Hygienist Scale)
- Diamond saw wheel (e.g. Diamond Disc Superflex, 19mm or 22mm from Kahla, SKU, 806 104 358 514 190/220)
- Round carbide bur (e.g. Allport Bone Cutter from NTI-Kahla (SKU: H141-014-HP; Tungsten Carbide, 0.14mm diameter, 2.35 diameter shank)
- Mandrel/Adapter for 1.6mm dental tools into 2.35mm handpiece (e.g. Adapter 1.6 mm into 2.35 mm from NTI-Kahla (SK: M022B or M025B) if 1.6mm dental tools are used.)
- Small diamond-coated dental tools (e.g. ISO 806 314 111 016 (zylindrical), ISO 806 314 198 016 (zylindrical), ISO 806 314 001 016 (round) from Medin))

Chemicals (producers can vary depending on availability in respective countries; Lab-grade chemicals are necessary to avoid contamination)

- High percentage Alcohol (Ethanol, Isopropyl or Methanol)
-  DNA Exitus Plus **Panreac AppliChem Catalog # A7089**
-  10% bleach (1:10 dilution of commercial 5.25-6.0% hypochlorite bleach) (Diluted with UV treated Reverse Osmosis water)
- UV-treated Reverse Osmosis water



- Deionised water

Safety warnings

! Keep alcohol and diluted bleach solutions separate at any time.

Do not pour alcohol in ultrasonicator, but use smaller vessels (glass vials) instead.

Bleach can be hazardous to eyes and skin. Ensure a source of clean water/eye wash is available.

Handle all tools with care. Dental tools can cause injuries.

When the crown breaks during sampling, the pieces can reach high velocities and can cause injuries. Protective goggles/face shields should be worn to avoid injuries.



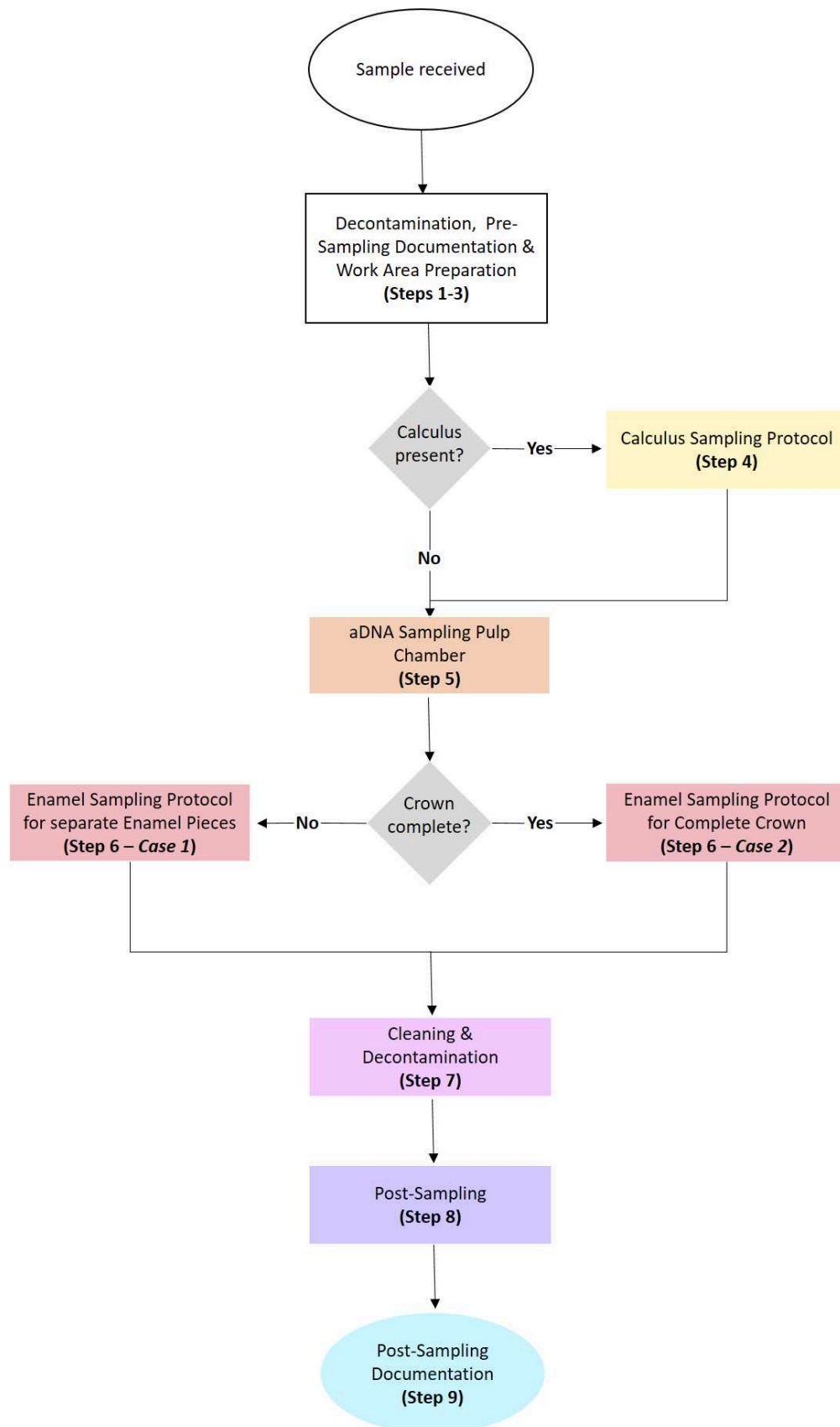
Before start

This Protocol is destructive! Every element must undergo thorough documentation prior to sampling, ideally via CT-scans or 3D modelling, but at a minimum through high-resolution photography.

This protocol requires clean-room conditions.

Make sure all equipment and work surfaces have been thoroughly cleaned before starting:

- For all tools and work surfaces used for extracting powder for aDNA analysis: Clean thoroughly with diluted commercial bleach and/or DNA Exitus Plus, followed by UV light exposure.
- For all tools used in enamel powder extraction: Clean thoroughly with alcohol, and wipe and/or brush down before use.





Decontamination & Pre-Sampling

2h

1

General Remarks

Safety information

Everything that is brought into the aDNA laboratory needs to undergo thorough decontamination to avoid contamination with modern DNA.

Everything that comes into contact with the sample itself needs to be decontaminated in order to avoid cross-contamination between samples.

Change gloves regularly.

Note

If any new equipment is introduced into the lab, it needs to be cleaned with diluted bleach and/or DNA Exitus Plus solution and UV irradiated for at least

 01:00:00 on each side before any further use.

Durations depend on individual lab procedures - the times stated in this protocol refer to the standard procedures in the aDNA laboratory of Masaryk University Brno.

1.1

Required Materials

- DNA Exitus Plus
- Diluted commercial bleach solution (1:10) (diluted with UV-irradiated Reverse Osmosis water)
- Polyethylene clear plastic bags
- A4 paper
- Waterproof pen
- Aluminium foil
- Forceps/Pliers
- Paper towels
- Scale/Ruler
- Camera

1.2

1. All new samples in their original (sample) bags must be cleaned on all sides using diluted bleach and then UV-irradiated for  00:30:00 on each side before further use. Be careful when cleaning the bags to avoid removing any sample information/markings

1h

on the sample bag. If necessary, document the sample bag (e.g., by photographing it) before decontamination to preserve important information.

2. In the meantime, prepare new, clean, correctly labelled plastic bags and A4 sheets of paper (one per sample). Each sheet should be clearly labelled with the sample ID written top centre.

Safety information

Avoid touching the tooth directly! Use forceps/pliers (*decontaminate with diluted bleach (1:10) after each use*) or pieces of aluminium foil (*dispose immediately after*) instead.

3. Once the new samples have been decontaminated, each sample must be **photographed** as follows:

- Position the tooth (removed from the decontaminated original plastic bag) on the pre-prepared A4 sheet with the sample ID written at the top. Use forceps/pliers or a piece of aluminium foil to handle the tooth.
- Place a scale/ruler directly below the tooth.
- Add the original sample label or the original sample bag beneath the scale/ruler to ensure that both the original grave ID and the newly given sample ID are visible in the photograph.
- Take one photo showing all components (new sample ID, tooth, scale/ruler, original sample label/sample bag).
- Take a second, close-up photograph that includes only the new sample ID, the tooth, and the scale/ruler (excluding the original label or bag).
- Rotate the tooth 180° along its vertical axis using forceps/pliers or a piece of aluminium foil, and repeat for this side.

Note

The number of photographs taken may vary depending on the lab's procedure.

- Once the tooth has been photographed from both sides, place it into one of the newly prepared, labelled plastic bags using forceps/pliers or a piece of aluminium foil.
- Dispose of the A4 sheet with the sample ID, the old sample bag (including any old labels), and the aluminium foil. If forceps/pliers were used, these must be decontaminated before handling the next sample.



Example of pre-sampling photo

- 1.3 Change gloves after each sample to avoid contamination.
- 1.4 New bags with the samples inside must be cleaned again with diluted bleach on all sides and UV-irradiated for  00:30:00 on each side .
- 1.5 All individual sample bags should then be placed into a single collective bag labelled with the site code. Additionally, the collective bag should be labelled to indicate whether the bags (and later the samples - see **Section 2**) have undergone UV-irradiation (*e.g.* <Site Code>, UV bags ✓, UV samples).

If the process needs to be paused at this stage, place the bag containing the samples into a decontaminated, sealed container. You may then resume the procedure at a later time.

Preparation of Sample

30m

2

Required Materials

- Diluted commercial bleach solution (1:10) (diluted with UV-irradiated Reverse Osmosis water)
- Forceps/Pliers
- Polyethylene clear plastic bags
- Waterproof pen
- Aluminium foil



- Paper towels

2.1

30m

Safety information

Avoid touching the tooth directly! Use forceps/pliers (*decontaminate after each use*) or pieces of aluminium foil (*dispose immediately after*) instead.

If the tooth is touched, immediately change gloves to prevent cross-contamination.

1. Place a layer of paper towels in the UV chamber.
2. Prepare small sheets of aluminium foil and place them in the UV chamber.
3. Change gloves.
4. Place the tooth on the aluminium foil and place the labelled bag next to it.

Note

Multiple samples can be UV-irradiated simultaneously. Each tooth must be placed on an individual piece of aluminium foil, with the corresponding labelled sample bag next to it.

If several samples are being UV-irradiated at the same time, change gloves after placing the teeth on their respective pieces of aluminium foil. Additional glove changes are required if the teeth have been touched directly!

4. UV-irradiate each tooth for  00:15:00 on each side - change gloves before turning the tooth!
5. After the tooth has been UV-irradiated from both/all sides, change gloves and place each tooth back into its respective bag.
6. All individual bags should then be placed into a collective bag labelled with the site code. Additionally, the collective bag should be labelled to indicate whether the samples and bags have undergone UV-radiation (e.g. <Site Code>, UV samples ✓ and UV bags ✓)
7. If sampling cannot be undertaken immediately, place the bag with the samples into a decontaminated, sealed container.

The tooth is now ready for sampling.



8. Dispose of all paper towels and aluminium foil, change gloves, and decontaminate the UV chamber with diluted bleach.

Sampling - Preparation of Workstation / Set up

3

Required Materials

- Precision scale (digital weighing scale)
- Drill handpiece with adjustable speed
- Diamond saw wheel
- Round Carbide bur
- Round Nose Dental Pliers
- Mandrel/Adapter designed to hold small dental burs (1.6mm diameter) in a handpiece (2.35mm)
- Round diamond coated dental bur
- Cylindrical diamond coated dental bur
- Toothbrush
- 2 larger tubs/plastic containers
- Magnifying lamp (to clean enamel pieces)
- Diluted commercial bleach solution (1:10) (diluted with UV-irradiated Reverse Osmosis water)
- UV-treated Reverse Osmosis Water (for aDNA sampling)
- Deionised Water (for isotope sampling)
- DNA Exitus Plus
- Alcohol (Isopropyl, Ethanol or Methanol)
- 3(-4) labelled 2.0ml Safe-Lock Tubes
- 10-20ml glass vials with lid
- Labels (optional)
- Weighing paper (folded/creased in the middle)
- Paper towels
- Paper
- Waterproof pen (for labelling the tubes)
- Pen (for recording the weights)

Not all materials are needed in the working area at once, but they should remain accessible to help streamline the process.

Note

IMPORTANT: If this is the first sample, the weighing scale needs to be calibrated and decontaminated afterwards with DNA Exitus Plus.

3.1 **Preparation for decontamination after sampling**

1. Prepare one plastic tub/container with diluted commercial bleach solution (1:10) away from the working bench. This will be used to submerge all tools after sampling.
2. Place a UV-irradiated toothbrush into the bleach solution (1:10) tub, to be used later for cleaning the tools.
3. Prepare a smaller plastic tub/container with UV-treated Reverse Osmosis water, also away from the working bench. This will be used to rinse the tools after bleach submersion, helping to prevent corrosion.
4. Set up a drying area with paper towels, where tools can be left to dry after decontamination.

3.2 **Preparation for sampling the tooth**

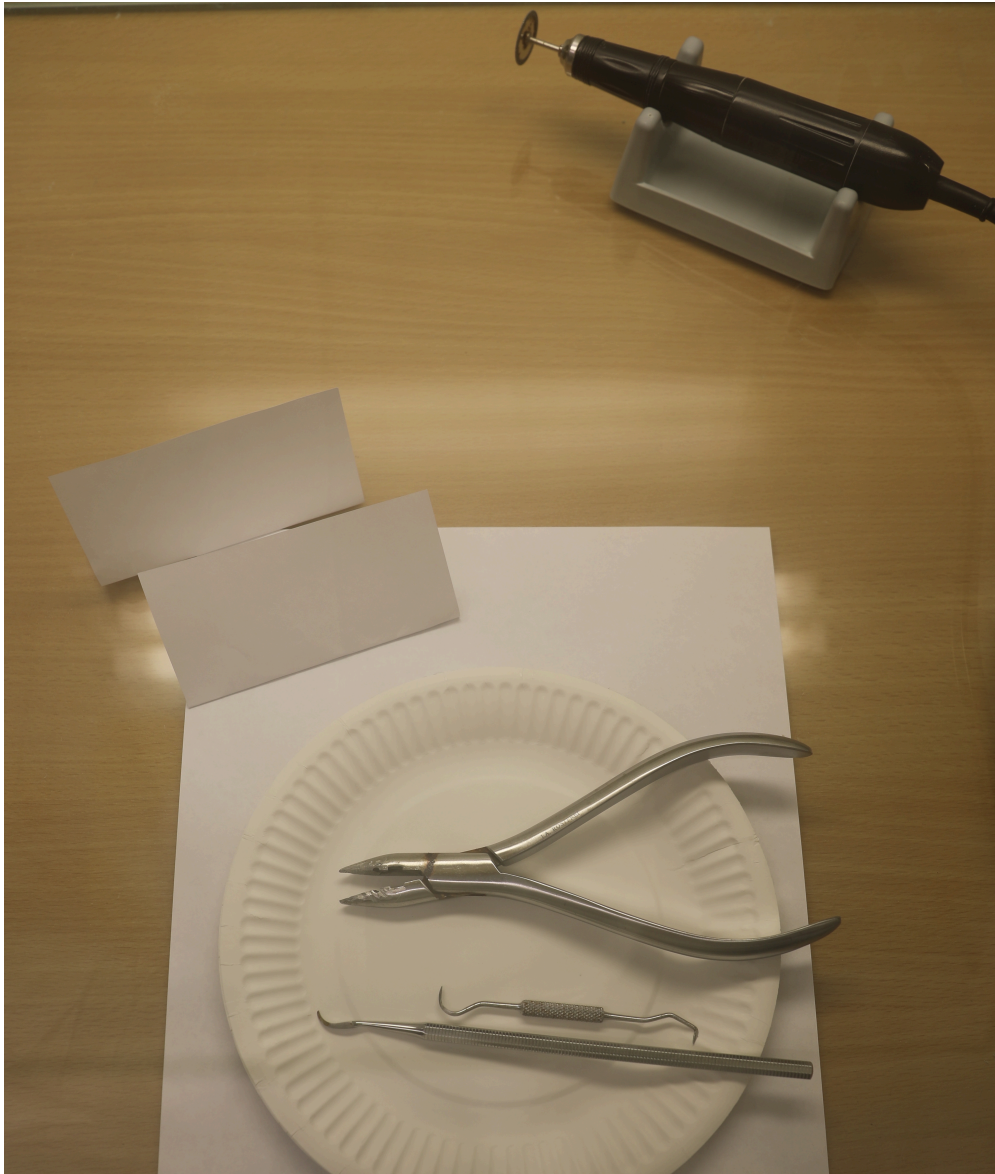
Start this part with a fresh pair of gloves!

1. Label 2.0ml Safe-Lock tubes.

The number of tubes required depends on the specific laboratory procedures. If samples are to be shipped to another lab for further processing, it is advisable to label at least two tubes and retain one as a backup. If dental calculus is present, prepare at least one additional tube.

2. Prepare paper towels outside of the working bench/sampling box.
3. Place a sheet of A4 paper or aluminium foil on the work surface.
4. Place another layer—aluminium foil, paper towel, or paper plate—on top of the first sheet, according to respective lab protocols.
5. Fold 1 or 2 weighing papers in half (*use 1 if no calculus is present, 2 if calculus is present*):
 - Place them inside the working box with the opening facing away from you.
6. Insert a diamond saw wheel into the drill handpiece.
7. Lay out the pliers and any additional tools (e.g. dental scaler, if there is calculus present) on the work surface.

8. Keep a round carbide dental bur outside the working space, within reach but at a safe distance—preferably stored in a closed container.



Example of set-up within a decontaminated working bench. Not in the picture: paper towels, carbide dental bur, Safe-Lock tubes.

9. Place the tooth on the prepared sheet of paper, aluminium foil, or paper plate—ideally without touching it directly.

Sampling - Calculus (if present)

4 This part of the protocol (Section 4) is based on the procedure outlined in:

Citation

Christina Warinner, Irina Velsko, James A Fellows Yates (2026)

. Dental Calculus Field-Sampling Protocol (Warinner Version). protocols.io.

<https://protocols.io/view/dental-calculus-field-sampling-protocol-warinner-v-7hphj5n>

LINK

If calculus is present, prepare an additional labelled Safe-Lock tube and a second piece of weighing paper, folded in half.

1. Tare the labelled Safe-Lock tube on the weighing scale (i.e. zero out its weight).
2. Carefully remove any visible calculus deposits using a dental tool such as a sickle scaler. Collect the material directly onto the weighing paper.



Manual removal of calculus deposit prior to pulp chamber sampling

3. Transfer the removed calculus to the Safe-Lock tube, weigh it, remember the weight and place it aside.
4. Place the tools in a tub with commercial bleach solution (1:10).



5. Dispose of the weighing paper.

6. Change gloves and immediately continue with sampling the pulp chamber: **Section 5.**

Sampling - Pulp Chamber

5

Cleaning

1. Manually remove any dirt deposits on the tooth using, for example, a periodontal scaler or a dental sickle probe.

2. Wipe the tooth with a small amount of diluted commercial bleach solution (1:10).
(*Note: This step may vary depending on lab protocols. **Consult lab guidelines before proceeding!***)

3. Wipe the tooth with a small amount of UV-treated Reverse Osmosis water.

5.1

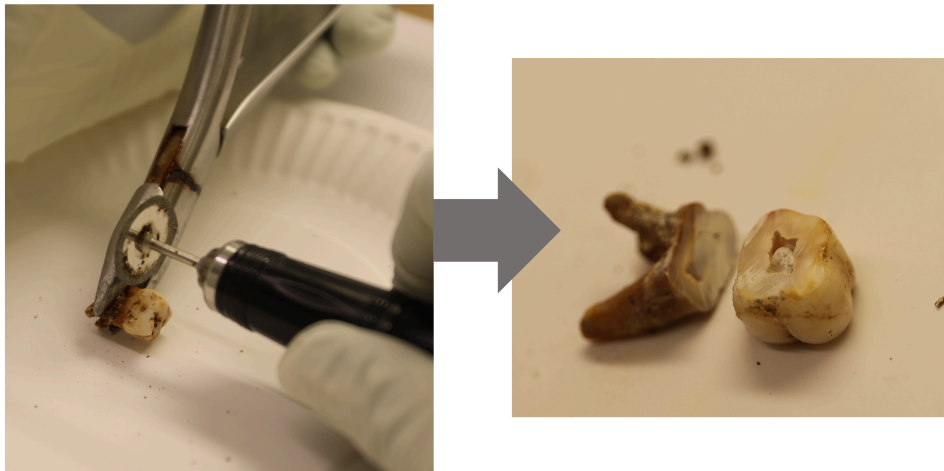
Separating the Roots from the Crown

Note

If the tooth is fragile or poorly preserved, the crown may break into several pieces, which can be ejected at high speed when separating the roots.

1. Hold the tooth securely with pliers over a piece of aluminium foil or a paper plate.

2. Carefully separate the crown from the roots just below the Cemento-Enamel Junction (CEJ) using a round diamond saw wheel at high speed.



Separating the crown from the roots using a diamond saw wheel

Safety information

The diamond wheel can become very hot! Be careful not to overheat the material, as heat can damage or destroy the DNA.

3. Gently tap the tooth on the aluminium foil or paper plate to dislodge and remove any loose powder.

4. Remove the diamond saw wheel and place it into diluted commercial bleach solution (1:10) for decontamination.

5.2 CHANGE GLOVES

5.3 Extraction of Tooth Powder

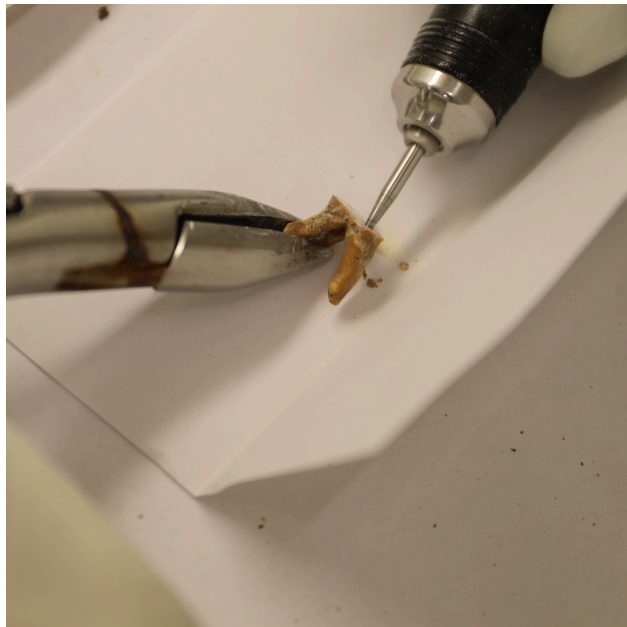
1. Attach a round carbide bur to the handpiece of the drill.

2. Reduce the drill speed to low-medium.

3. Place the Safe-Lock tube on the weighing scale and tare (zero out) the weight of the tube.

4. Place the creased weighing paper in the centre of the A4 paper or aluminium foil, ensuring the paper plate or second piece of aluminium foil is pushed to the back of the working surface.

5. Hold the roots or crown between the pliers over the centre of the weighing paper. Carefully and slowly drill into the inner pulp chamber of both the roots and crown, collecting the resulting powder on the weighing paper.

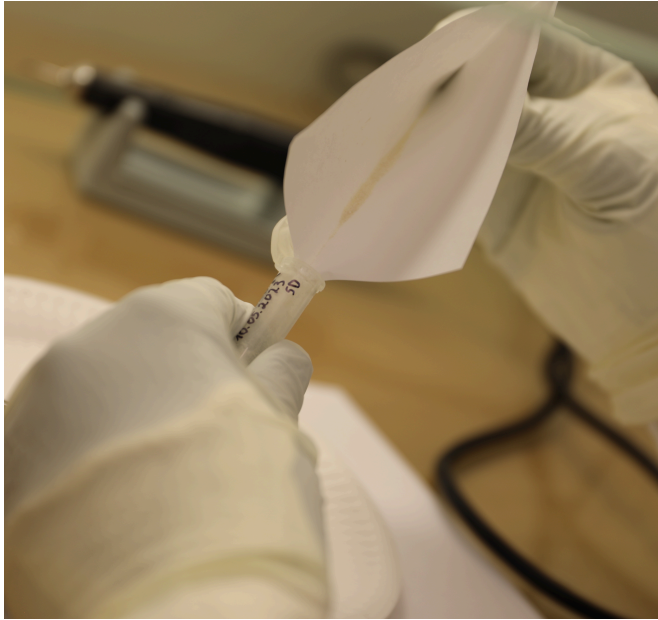


Extracting powder from the pulp chamber

Safety information

WARNING: Be careful not to overheat the drill! Heat can have detrimental effects on DNA preservation! If the drill becomes too hot, take a break, allow it to cool down, and continue once it has cooled.

6. Carefully transfer the powder into the tube. Creasing the paper will assist in transferring the powder, particularly if it is statically loaded.



Transferring the extracted powder into the labelled Safe-Lock tubes.

Note

Tip: If residual dirt particles are mixed with the bone powder, gently tap the corners or edges of the weighing paper over the paper plate or smaller piece of aluminium foil. This will help separate the dirt particles from the lighter bone powder. The dirt particles must be kept separate and discarded later.

7. Collect enough powder for a main sample ( 30–50 mg) and a back-up (minimum  7 mg , ideally at least  25 mg).

Note

The weighing step may vary between labs and largely depends on discussions with curators and the preservation of the material. It is possible to collect all of the powder in one tube and weigh it later—consult lab guidelines first.

5.4

Weighing the Sample

1. Move the weighing scale to your work surface.

2. Place the weighing paper in the centre of the weighing scale and tare (zero out) its weight.

3. Carefully pour enough powder for the main sample onto the paper (ideally  50 mg). Record the weight, then transfer the powder into the second labelled tube and place aside.

Note

Tip: If the powder is statically charged, it can be difficult to remove from the tube. Wiping the tube down with a wet paper towel can help.

4. Pour the remaining (back-up) powder onto the weighing paper, record the weight, and transfer it back into the labelled tube. This back-up sample should be no less than

 7 mg .

5.5

Post-DNA sampling & Cleaning

1. Carefully place the roots back into the plastic bag using a piece of aluminium foil or pliers, then remove from the workstation.

Note

Additional powder or the entire roots can be used for further analyses. For example, collagen can be extracted from either the powder or the roots for radiocarbon (^{14}C) or stable isotope analyses (e.g., Carbon, Nitrogen, Sulphur). Sample amounts may vary depending on the processing lab, but 300-400mg is usually required for collagen extraction.

2. *Optional if enamel is sampled:*

*Place the crown/crown pieces, or enamel pieces (depending on condition of the crown after separation) into a glass vial filled with deionised water. (**Tip:** not all pieces of the crown need to be placed in deionised water—only enough to extract the desired amount of enamel powder). If enamel is not sampled, place the crown back into the plastic bag.*

3. Place the round carbide bur, pliers, and any other tools used during the process into the prepared container with diluted commercial bleach solution (1:10) for decontamination.

**Note**

Once the tools have been in the bleach solution for an adequate amount of time, ensure that metal utensils are rinsed with UV-treated Reverse Osmosis water to remove any residual bleach and prevent corrosion.

4. Dispose of any disposable equipment (e.g., aluminium foil, paper, weighing paper, paper plates) along with your gloves, ideally wrapping the material inside your gloves before disposal.

5.6 CHANGE GLOVES

5.7 Record the sample weights on the labelled tubes using a waterproof pen, and also note them on a separate sheet of paper.

6

Note

Enamel powder can be used for several analyses, including carbon, oxygen and strontium isotope analysis.

Be sure to check with your lab of choice to confirm **how much** powder is required and **which analyses** can be performed from a single sample.

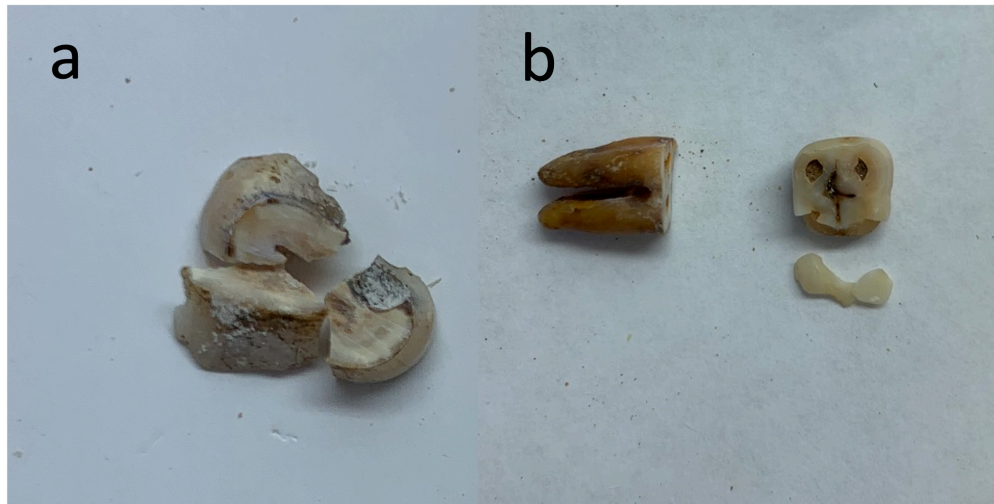
Whenever water is mentioned during the **enamel sampling process**, it refers to **deionised water**, to avoid contamination of the sample

Depending on the state of preservation of the crown after the extraction of powder for aDNA analysis, two different protocols can be followed:

STEP CASE**Separate (Enamel) Pieces Available after Drilling****11 steps**

This protocol should be followed if the crown breaks during separation from the root, or if separated enamel pieces are already available.

6.1



- a) The crown has broken into several pieces during separation from the root -> One fragment of the crown will be selected and cleaned for further processing.
- b) A piece of enamel has separated from the rest of the crown --> The separated enamel fragment will be cleaned for further processing.

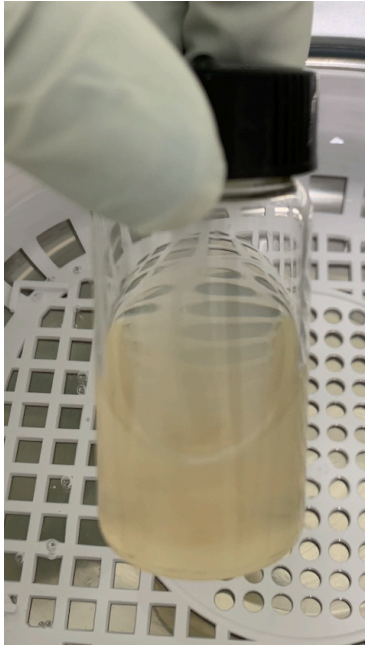
Cleaning of Sample & Preparations

1. If not yet done, place the enamel piece/crown fragment into a 10-20ml sealable glass vial filled with deionised water.

Note

Tip: If sonicating multiple samples at the same time, ensure each glass vial is clearly labelled with a waterproof pen or a removable label to avoid mix-ups.

2. Place the vial(s) in an ultrasonic bath and sonicate until any adhering soil is removed and the water runs clear. Multiple water changes will be necessary during this process (always use deionised water).



Vial containing crown pieces after the first round of sonication.

3. While the piece is sonicating, clean the dental drill, workstation and the weighing scale with alcohol (Isopropyl, Ethanol or Methanol) to remove any loose dust and dirt particles.
4. Label a Safe-Lock tube.
5. Place a piece of aluminium foil or a paper towel on the workstation.
6. Place a folded weighing paper outside the workstation, within easy reach.
7. Remove the enamel piece from glass vial, wipe it gently with a small amount of alcohol, and place it on the prepared work surface.

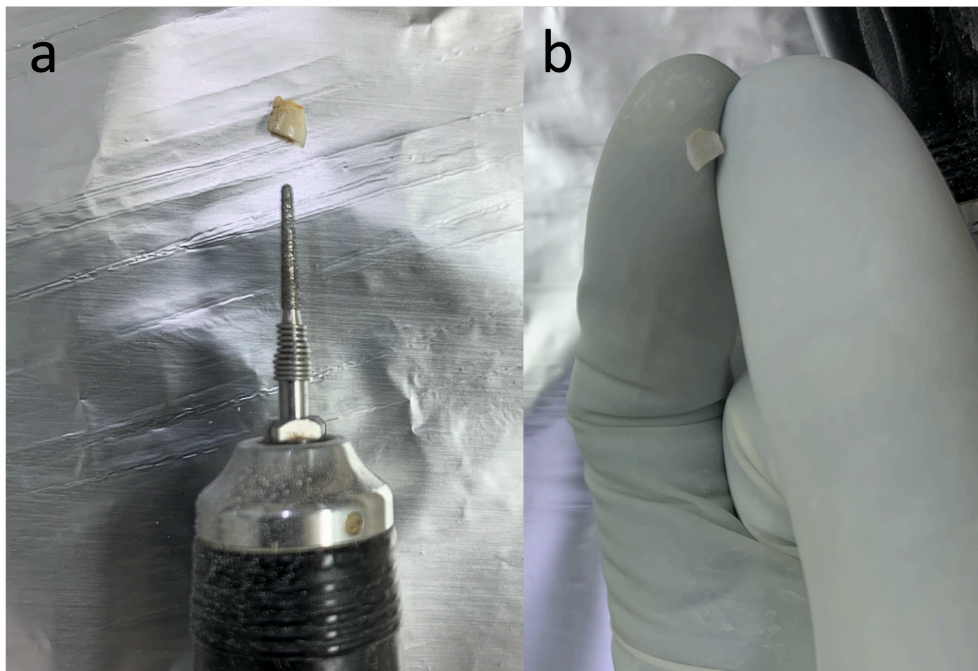
Safety information

WARNING: Ensure that all adhering soil is thoroughly removed, as even small amounts can contaminate the sample!

Note

Tip: If a larger portion of dentine is still attached to the enamel, it is more efficient to cut it off using a thin diamond wheel.

1. Attach a diamond bur to the dental drill and wipe down the drill the drill with alcohol again.
2. Abrade the surface, removing approximately the top 0.01 mm (*potentially diagenetically altered surface enamel*) and any visible surface discolouration.
3. Remove any traces of dentine from the inner surface. This should ideally be done under a magnifying lamp.



Enamel piece a) before removal of dentine and b) after removal of dentine.

Safety information

WARNING: Be sure to thoroughly remove any traces of dentine! Even small amounts can contaminate the sample!

4. Wipe down the enamel piece with alcohol



5. Place the enamel piece on weighing paper and weigh it (minimum  10 mg). Be sure to tare (zero out) the weight of the weighing paper first.

Note

The amount of enamel required may vary depending on the requirements of the processing lab.

6. Place the enamel piece in the Safe-Lock tube and record the weight both on the tube and on a separate piece of paper.

Cleaning & Decontamination

15m

7

Safety information

Everything that came into contact with the sample must be thoroughly decontaminated to avoid cross-contamination between samples.

7.1 **Ultrasonicate with alcohol** by placing the items into a glass vial filled with alcohol:

15m

- Diamond drill bits used for enamel powder extraction
- Glass vial used to clean the tooth crown/enamel piece
- Any other tools used in the process of extracting enamel powder

Safety information

WARNING: Do not pour alcohol directly into the sonicator and do not leave the sonicator with alcohol unattended! **Fire hazard!**

Soak the following items in diluted commercial bleach solution (1:10) for at least

 00:15:00 ,

brush them with an UV-irradiated toothbrush (soaked in diluted bleach solution (1:10)), and rinse with UV-irradiated Reverse Osmosis water (do this in the tubs which were prepared in Section 3).

- Diamond wheel attachment used to separate root from crown
- Carbide bur
- Pliers
- Any other tools that came in direct contact with the sample

Throw away

- Aluminium foil
- Paper towels
- Paper plates (if used)
- Weighing paper
- A4 paper
- Gloves
- Any remaining unused tooth powder

7.2 CHANGE GLOVES**7.3 Wipe down with DNA-Exitus Plus**

- Handheld drill & station
- Weighing scale
- Ultrasonicator
- Camera
- Any other electronic components used in the process
- Dried ultrasonicated strontium tools

Clean with diluted commercial bleach solution (1:10):

- Any surface or item that came into contact with the sample, especially the work surface
- Any non-electronic tools that came into contact with the sample (e.g., pens, bags, etc.)

7.4 CHANGE GLOVES

7.5 At this point, a new sample can be started: Refer back to **Step 3.2.**

7.6 At the end of the sampling day, place all portable equipment in a UV chamber and irradiate for several hours overnight.

Post-Sampling

- 8 Check that all tubes are properly labelled with the following information:
- Sample ID
 - Date
 - Initials of Person who sampled



- Weight

Note

Procedures may vary depending on the lab's protocol.

Check that all the samples are correctly documented/recorded on a sheet of paper that can be taken outside of the lab.

Separate the main bone/tooth powder sample from the backup powder.

Place all main samples in a labelled, decontaminated plastic bag with the Site/Location and the Date of Sampling written on it.

Place each back-up sample in an individual decontaminated plastic bag, and place all these plastic bags in another decontaminated plastic bag, clearly labelling it with Site/Location, Date, and "Back-Up".

Store samples in a light-protected box in a cool, dry place until further processing (e.g., inside a fridge).

Post-Sampling Documentation

- 9 Once all teeth from one site have been sampled, make sure to take photos from all sides on a neutral background with a scale/ruler (refer back to Section 1: Pre-Sampling Documentation).



Protocol references

Marie Balasse, Stanley H. Ambrose, Andrew B. Smith, and T. Douglas Price 2002. The Seasonal Mobility Model for Prehistoric Herders in the South-western Cape of South Africa Assessed by Isotopic Analysis of Sheep Tooth Enamel. *Journal of Archaeological Science* 29(9): 917–932.

Stanley H. Ambrose, John M. Marston, E. Baxter, J. Bethard, D. Honn, K. Wade 2018. Sample Preparation for Tooth Enamel Sr Analysis. Environmental Archaeology Laboratory Boston University.

<https://sites.bu.edu/ealab/files/2018/04/Sample-Prep-for-Tooth-Enamel-Sr-Analysis-Protocol.pdf>

Gunnar U Neumann, Aida Andrades Valtuena, James A Fellows Yates, Raphaela Stahl, Guido Brandt 2020. Tooth Sampling from the inner pulp chamber for ancient DNA Extraction. **protocols.io**

<https://dx.doi.org/10.17504/protocols.io.bqebmtan> Version created by **Gunnar U Neumann**

(The aDNA part of this protocol closely follows the protocol used at the Department of Archaeogenetics at the MPI-EVA (published by Gunnar U Neumann, Aida Andrades Valtuena, James A Fellows Yates, Raphaela Stahl, Guido Brandt on protocols.io under: <https://dx.doi.org/10.17504/protocols.io.bqebmtan>)

Citations

Step 4

Christina Warinner, Irina Velsko, James A Fellows Yates. Dental Calculus Field-Sampling Protocol (Warinner Version)

<https://protocols.io/view/dental-calculus-field-sampling-protocol-warinner-v-7hphj5n>

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