TEETH & HEALTH

Dental **Health** through Time

Case **S**tudy

Dental **P**athology

Dental **D**ata

Indicators of **S**tress

Indicators of **O**ral **H**ealth

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MUNI SCI

TEETH & HEALTH

1. Methods in dental pathology
2. Indicators of stress
3. Indicators of health
4. Presentation of dental data
5. Case study
6. Dental health through time

1. METHODS IN DENTAL PATHOLOGY

1. **C**ompare the 'suspicious' teeth with normal bones/teeth
2. **E**liminate the non-metric traits & post-mortem damage (taphonomy)
3. **U**se detailed descriptions
4. **R**ecorded their distribution pattern
5. **C**onsider possible (**Differential Diagnoses**)

Abnormalities: recognized

pathological lesions: noted

Diseases: defined

MACROSCOPIC

GROSS EVALUATION

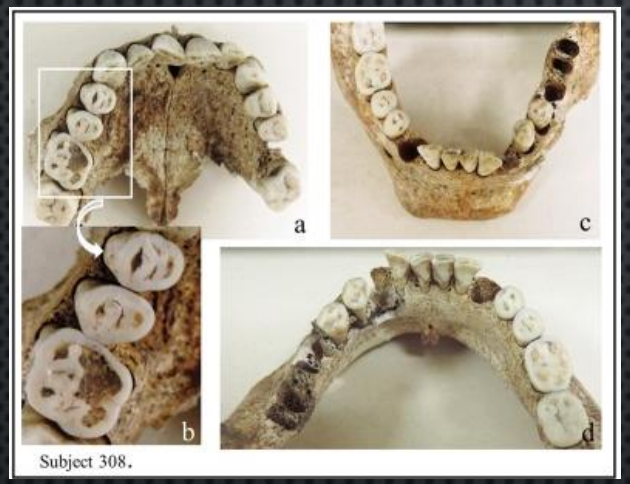
IMAGING

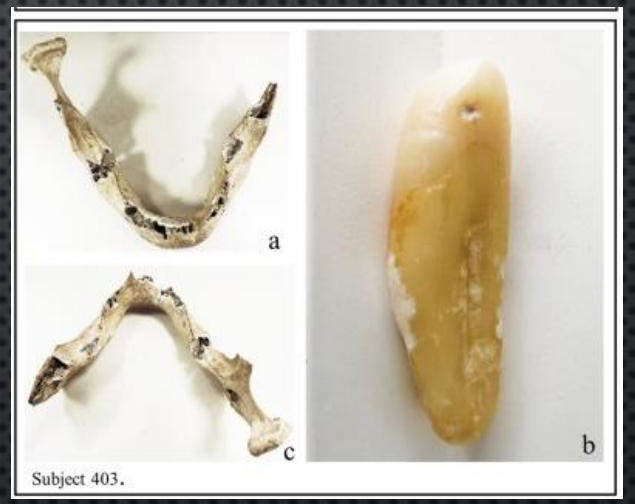
3D SCANNING, CT, X-RAYS

BIOCHEMICAL ANALYSIS

DNA, ISOTOPES

1.1. MACROSCOPIC





1.2. IMAGING

- Outstanding diagnostic tools
- Complementary to the macroscopic analysis
- Non-invasive and non-destructive
- Facilitate visualizing internal structures of bones
- Permanent digital documentation
- Indispensable for mummified remains

IMPACT: Radiological Mummy Database of Mummies www.impactdb.uwo.ca

Fayum Mummy

Impact ID: IMP00012

Institution: Redpath Museum

Designation: RM2720

Date of Acquisition: 1895

Contact: Dr. Andrew Nelson

(anelson@uwo.ca)

Image Modality: CT

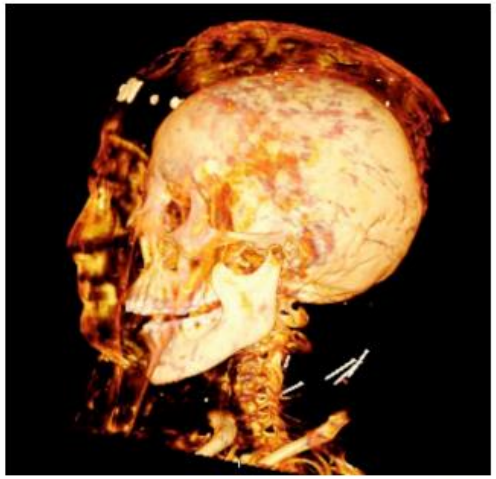


Figure 1. 3D image of head and mask of RM2720 (Wade et al., 2011)

Country: Egypt

Dig Site: Hawara el-Maktaa

Time Period: Roman

Dynasty: unknown

Sex: Female

Age: 18-24 years

Background:

In 1895, Sir Thomas Roddick donated a Fayum mummy to the well-established Redpath Museum. When writing to Sir William Dawson, geologist and university administrator of McGill University, Roddick stated the mummy was found in a tomb or solid rock pit at Hawara el-Maktaa, near the Pyramid of Amen, but the age is unknown (Lawson, 2016). Roddick is known to have travelled to Egypt himself on two occasions, serving in the Anglo-Egyptian War of 1882 and with the Camel Corps in 1884-1885 in the Nile Expedition (Lawson, 2016). In a biography about Roddick, it is noted that on the second visit to Egypt is the one in which he brought back a mummy that he donated to McGill to put in the Redpath museum (Lawson, 2016). There is still

ID: IMP00012

RM2720

Sex: Male

Estimated Age: 30-50

Institution: Redpath Museum (Montreal)

Period: Roman

Site: Hawara el-Maktaa

Modality: CT

Series #: 004

Number of Images: 961

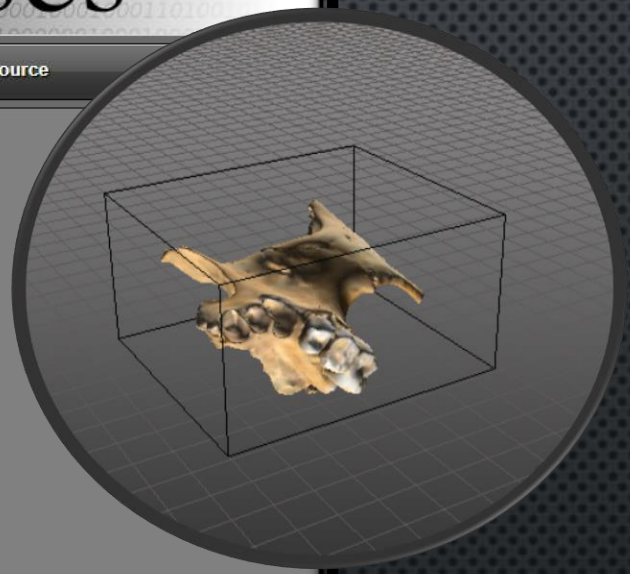
Digitised Diseases

Home | The project | The disease classification | The resource

Developmental | Hypoplastic | Missing or abnormally small teeth

View model

Download



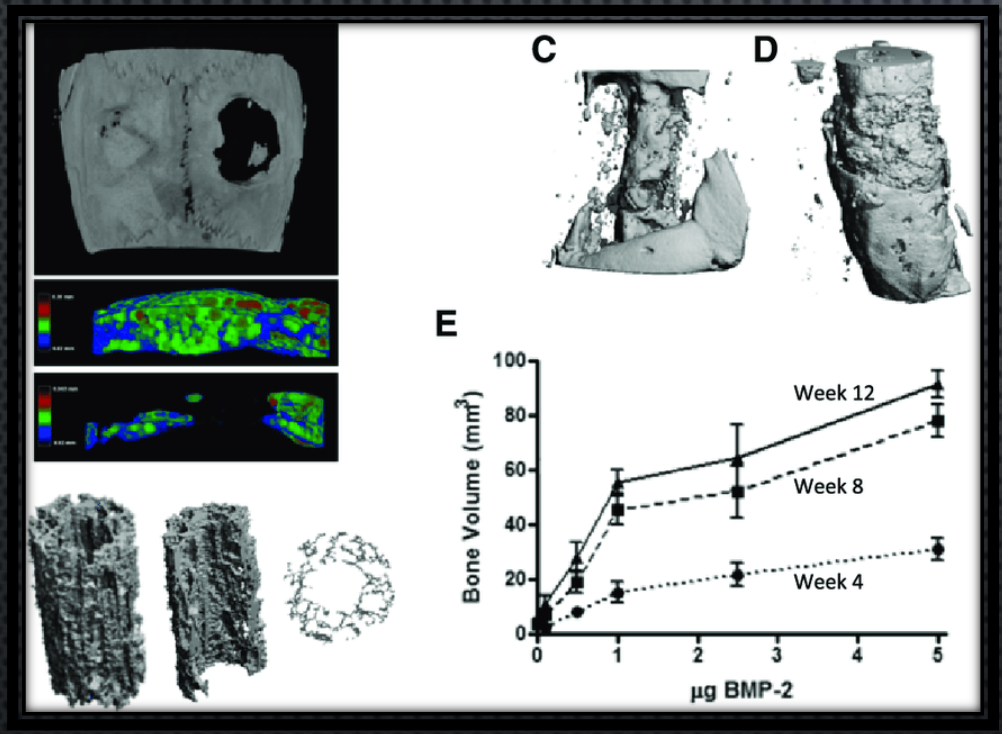
Bone: Left maxilla and zygoma
Age: Adolescent
Sex: U

Pathology description

The maxilla from this young adult reveals retention of the upper left second deciduous molar, due to failure of development of its permanent successor. There is moderate periodontal disease around the remaining teeth. The aperture into the nasal floor related to the apex of UL3 is not an oro-antral fistula as there is no evidence of pathology. The very thin layer of bone overlying the apex of this tooth has simply been lost by post-mortem fragmentation.

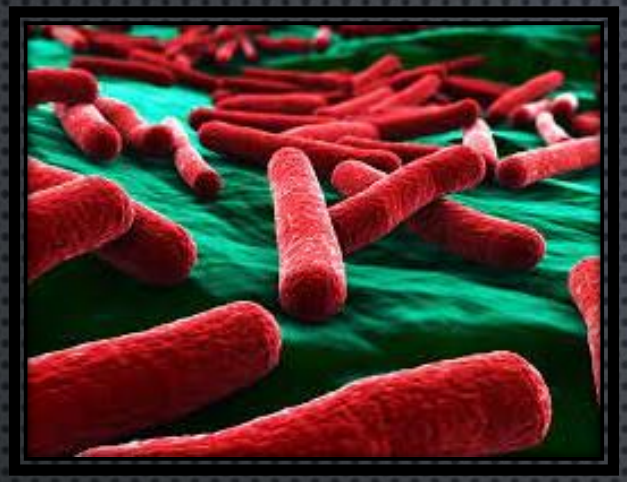
Xrays

1.2. IMAGING: OTHER EXAMPLES



microcomputed tomography

magnetic resonance imaging



1.3. BIOCHEMICAL ANALYSIS

Genomes of pathogens through aDNA is challenging, due to:

1. Preservation
2. Pathogen load & location in the body
3. Environmental microbial contamination
4. Current understanding of microbial pathogenicity

1.3. BIOCHEMICAL ANALYSIS
limits of DNA

- Bad conditions of preservation = Highly degraded aDNA sequences

→ limit the identification of the SNPs of metabolic pathways related to the pathologies

- Most genetic diseases are jointly caused by (many genes + environmental factors)

→ identifying a disease-related haplo type yields information about a possible predisposition to a disease but does not provide information on the manifestation of the disease on the analysed sample

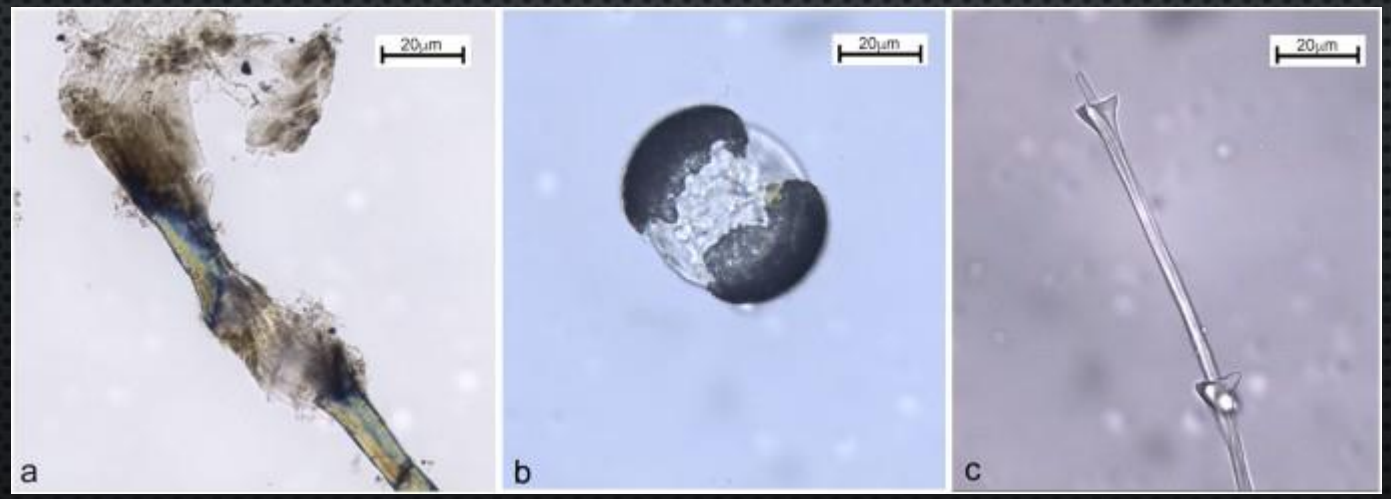
- aDNA analysis is costly and time-intensive

stable isotope method is the unique molecular method that can be efficiently used

1.3. BIOCHEMICAL ANALYSIS
advantage of using isotopic analyses

When:

- ✓ Pathology is not grossly visible
- ✓ In cases of nutritional stress, which is not always identifiable in the archaeological record



Non-dietary micro-debris identified in archaeological tartar: (a) Nettle fibre; (b) Conifer pollen; (c) Fragment of feather barbule.

Journal List > PLoS One > PMC5783410

PLOS ONE

PLoS One. 2018; 13(1): e0191757.
Published online 2018 Jan 24. doi: 10.1371/journal.pone.0191757

PMCID: PMC5783410
PMID: 29364968

Dental disease and dietary isotopes of individuals from St Gertrude Church cemetery, Riga, Latvia

Elina Petersone-Gordina, Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Visualization, Writing – original draft,[1,*] Charlotte Roberts, Conceptualization, Funding acquisition, Methodology, Supervision, Writing – review & editing,[1] Andrew R. Millard, Conceptualization, Formal analysis, Methodology, Resources, Supervision, Writing – review & editing,[1] Janet Montgomery, Methodology, Resources, Supervision, Writing – review & editing,[1] and Guntis Gerhards, Funding acquisition, Resources, Writing – review & editing[2]

Mario Novak, Editor

ELSEVIER

Journal of Archaeological Science: Reports
Volume 2, June 2015, Pages 128-140

Stable isotope and dental pathology evidence for diet in late Roman Winchester, England

Laura A. Bonsall, Catriona Pickard

TEETH & HEALTH

1. Methods in dental pathology
2. **Indicators of stress**
3. Indicators of health
4. Presentation of dental data
5. Case study
6. Dental health through time

2. INDICATORS OF STRESS

Stressors can be:

- ✓ Physical- illness or injury
- ✓ Psychological- a big exam or interview
- ✓ Social- loneliness, subordination
- ✓ Environmental- inadequate housing, noise pollution

Why is 'stress' important?

- o linked to chronic diseases in modern populations
  - ✓ Cardiovascular disease
  - ✓ Metabolic syndrome & Diabetes (type 2)
  - ✓ Immunosuppression (HIV progression to AIDS impacted by stress)
- o Storyteller about the lives people lead (past & contemporary populations)
  - ✓ Many stressors? Few stressors?
  - ✓ How do populations cope?

2. INDICATORS OF STRESS

Presence of a direct relationship between (statistically)

stress markers → health of the individuals

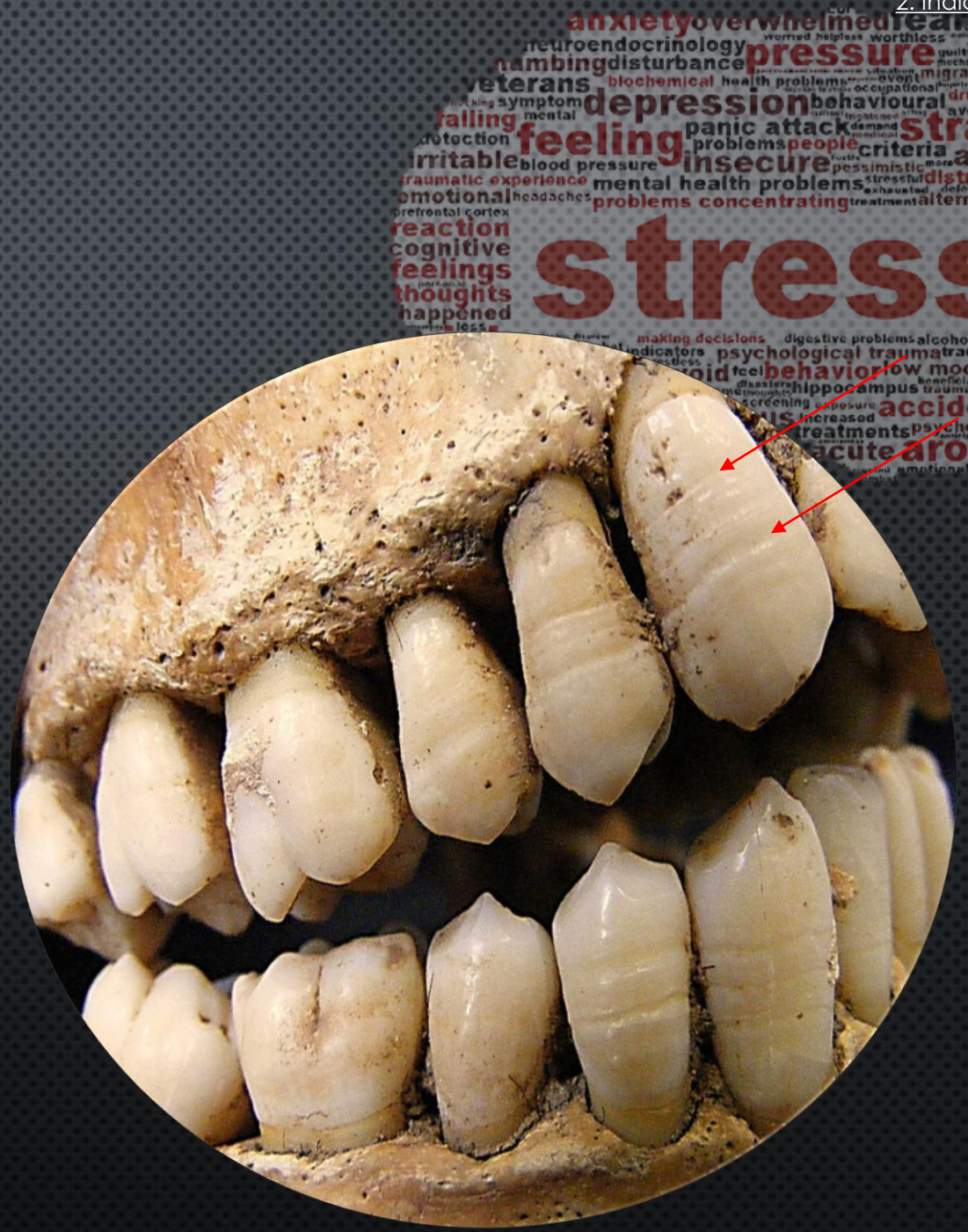
(Wood et al., 1992)

2. INDICATORS OF STRESS

2.1. Enamel Hypoplasia

known to be a useful indicator for wide range of detrimental factors in early childhood in past populations, such as:

- ✓ nutritional disturbances
- ✓ mechanical trauma
- ✓ disease
- ✓ metabolic
- ✓ genetic disorders



2. INDICATORS OF STRESS

2.1. Enamel Hypoplasia

Often seen on the buccal surface:

1. Pits
2. Grooves
3. Lines → Linear Enamel Hypoplasia (LEH)

can be obliterated by dental wear

2. INDICATORS OF STRESS

2.1. Enamel Hypoplasia

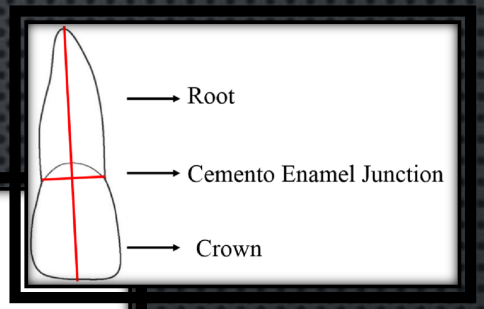
Typically recorded:

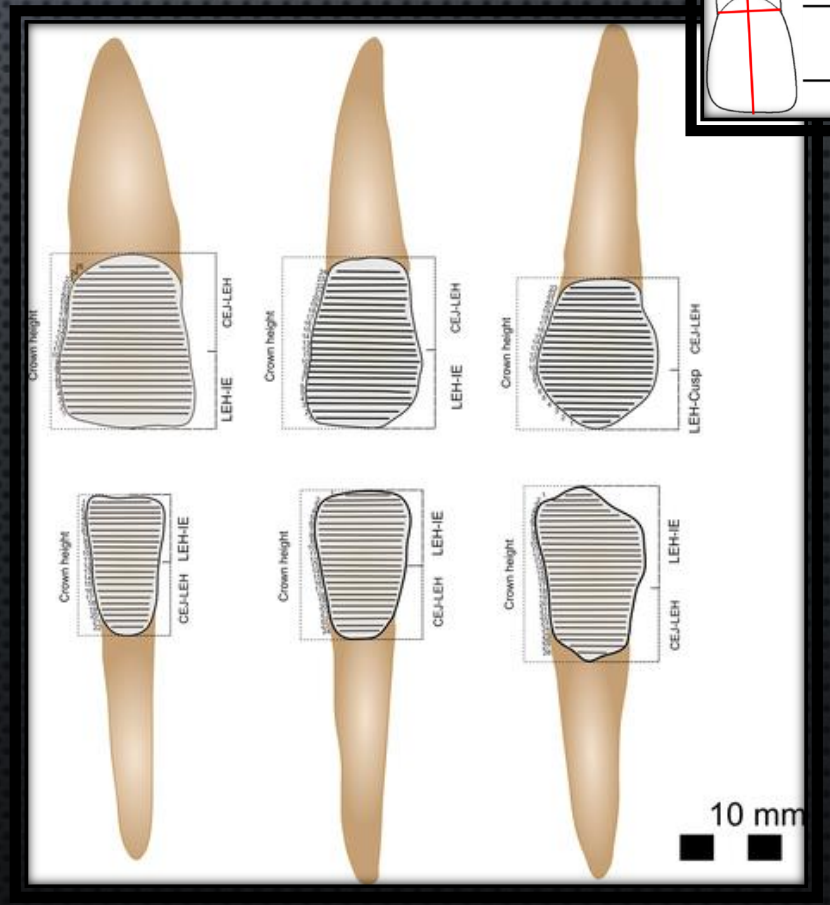
1. Presence
2. Severity
3. Location

2. INDICATORS OF STRESS

2.1. Enamel Hypoplasia

Measuring the distance between the LEH and the cementoenamel junction (CEJ) to reconstruct chronologies of stressful events





2. INDICATORS OF STRESS

2.1. Enamel Hypoplasia

Goodman & Rose 1990

Reid & Dean 2000, 2006

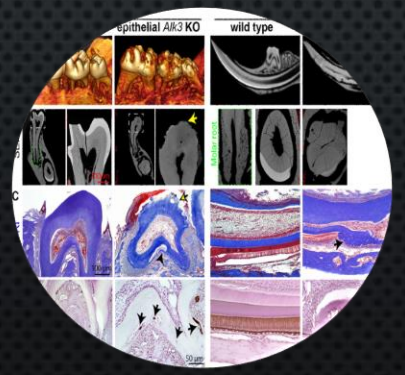
Macroscopic

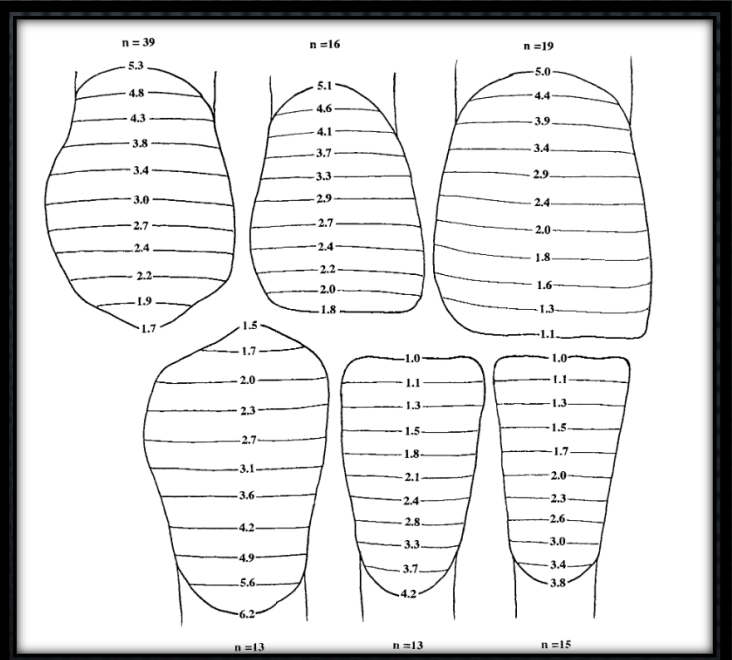
Histological

TABLE 1. Regression equations from Goodman and Rose (1990)

Tooth type	Formula[a]
Maxillary teeth	
I1	Age (in years) = −(0.454 × H) + 4.5
I2	Age (in years) = −(0.402 × H) + 4.5
C	Age (in years) = −(0.625 × H) + 6.0
P3	Age (in years) = −(0.494 × H) + 6.0
P4	Age (in years) = −(0.467 × H) + 6.0
M1	Age (in years) = −(0.448 × H) + 3.5
M2	Age (in years) = −(0.625 × H) + 7.5
Mandibular teeth	
I1	Age (in years) = −(0.460 × H) + 4.0
12	Age (in years) = −(0.417 × H) + 4.0
C	Age (in years) = −(0.588 × H) + 6.5
P3	Age (in years) = −(0.641 × H) + 6.0
P4	Age (in years) = −(0.641 × H) + 7.0
M1	Age (in years) = −(0.449 × H) + 3.5
M2	Age (in years) = −(0.580 × H) + 7.0

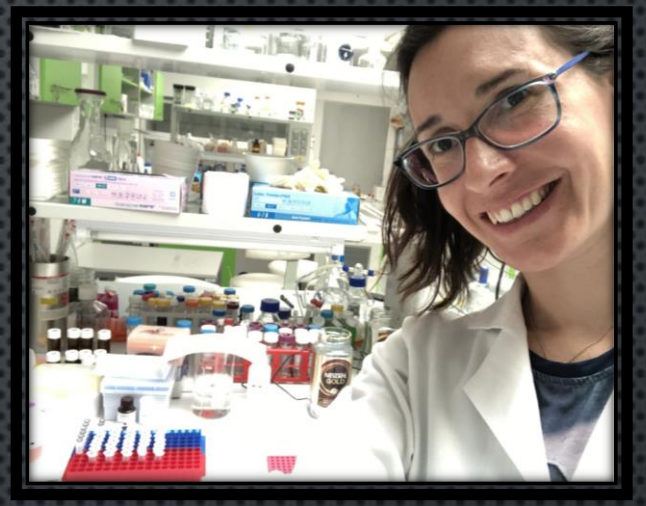
[a] Where H equals the distance between LEH and the CEJ in mm.





2. INDICATORS OF STRESS

2.1. Recent Advances in Cortisol Testing



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Analyzed in human hair from archaeological contexts

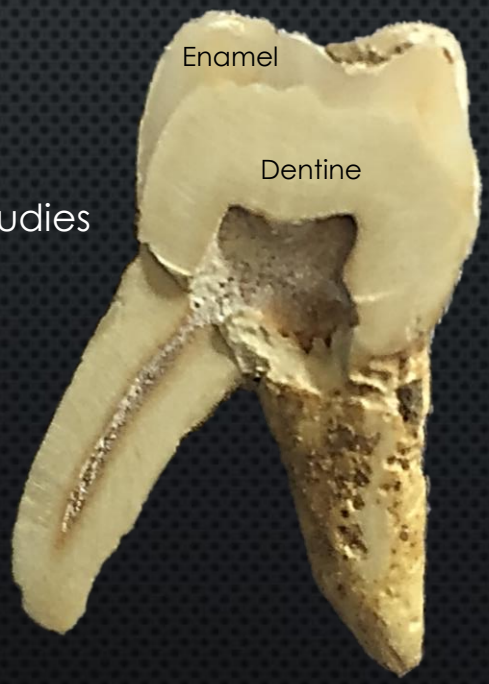
- ✓ Demonstrates preservation over hundreds of years (Webb et al. 2010, 2015a, 2015b)
- ✓ BUT very few archaeological individuals have hair

Cortisol detected in permanent teeth

- ✓ Modern tooth dentine (Nejad et al., 2016)
- ✓ Archaeological tooth dentine and enamel (Quade et al., 2021)

Tooth cortisol could provide:

- ✓ a measure of chronic 'stress' that is direct, quantifiable, and comparable with modern stress studies
- ✓ BUT we need lots more research!



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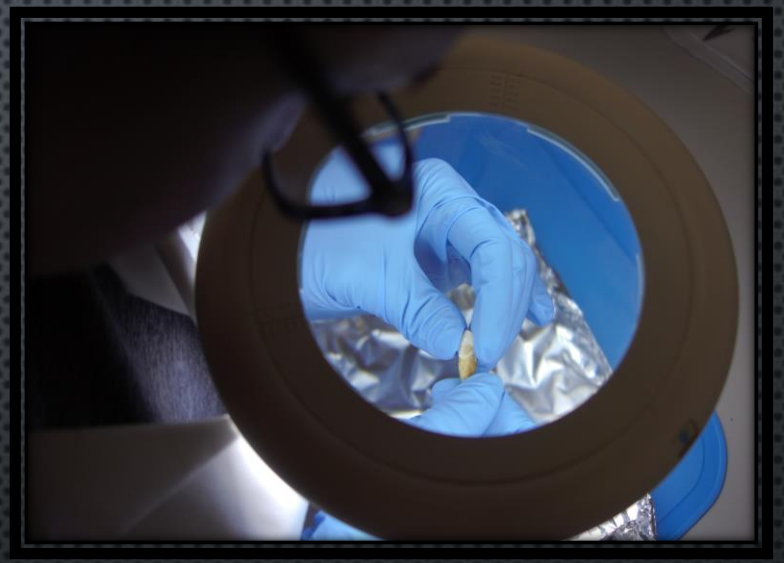
2. INDICATORS OF STRESS
2.2. Recent Advances in Cortisol Testing



Materials

- ✓ 37 dentine + 41 enamel samples from 25 teeth
- ✓ 18 teeth/17 individuals 'Brno Vídeňská Street' 11th- 12th cent
- ✓ 7 teeth /7 modern individuals 'Czech Republic'
- ✓ 2nd & 3rd molars preferentially selected

Methods

- ✓ Record, photograph and wash teeth
- ✓ Remove and grind dentine and enamel samples
- ✓ Extract cortisol and evaporate solvent
- ✓ Detect and quantify cortisol through ELISA (Salimetrics)
- ✓ Statistical Analysis

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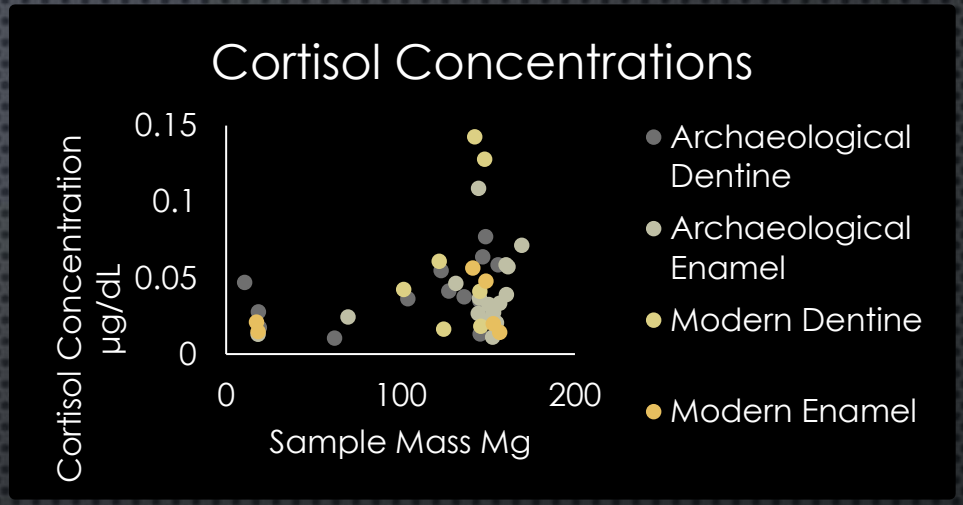
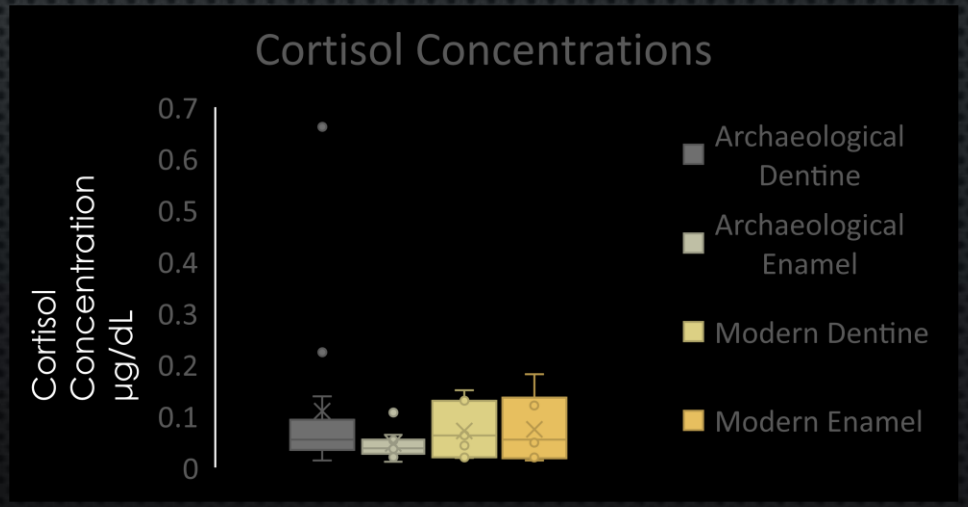
2. INDICATORS OF STRESS
2.2. Recent Advances in Cortisol Testing

Results

- ✓ Cortisol can be detected in archaeological & modern tooth structures
- ✓ Links palaeopathological data with modern data, research & interests
- ✓ Opportunities for future research:
  - ➢ Further testing of the cortisol method
  - ➢ Factors affecting cortisol preservation
  - ➢ Relationships between dental cortisol and other skeletal stress indicators?





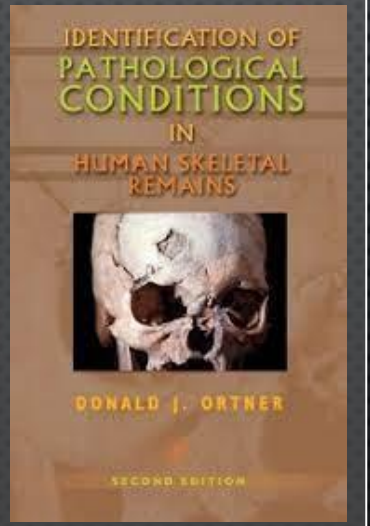
TEETH & HEALTH

1. Methods in dental pathology
2. Indicators of stress
3. **Indicators of health**
4. Presentation of dental data
5. Case study
6. Dental health through time

3. INDICATOR OF ORAL

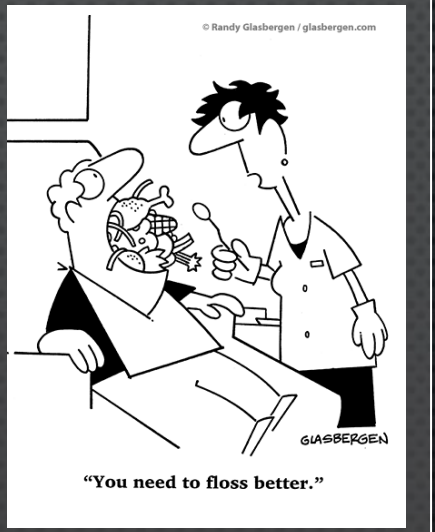
Ortner 2003

1. Dental caries
2. Periodontal diseases
3. Disturbances in Dental Development
4. Dental Trauma (AMTL)
5. Dental Attrition
6. Dental Discoloration



Most /important recorded

1. Dental caries
2. Periodontal diseases
3. AMTL
4. Abscesses
5. Calculus



REMINDER

2. INDICATORS OF HEALTH

2.1. Dental Attrition

What is it?

- ✓ A general term that can be used to describe the surface loss of dental hard tissues

Age estimation

Diet indicator

2. INDICATORS OF HEALTH

2.1. Dental Attrition

Attrition:
a physiological process
tooth-to-tooth contact during mastication
Occurs on occlusal, incisal, and proximal surfaces

Abrasion:
an abnormal process
Contact btw teeth & food/outside abrasive substances
considered pathological?

Erosion:
a chemical process
does not involve bacterial action

2. INDICATORS OF HEALTH

2.2. Calculus

Even with good care of your teeth

Bacteria in your mouth will mix with sugary or starchy food when you eat forming a sticky film on your teeth, gums, & dental restorations

Calculus, known as tartar, is a form of mineralized plaque

But not only Dietary,

- ✓ Alkaline pH in oral environment
- ✓ Activity of microorganisms
- ✓ Food preparation methods
- ✓ Individual susceptibility
- ✓ Water mineral content
- ✓ Oral hygiene

2. INDICATORS OF HEALTH
2.2. Calculus

often seen on:

1. lingual surfaces of the anterior mandibular teeth
2. buccal surfaces of the maxillary molars

Typically recorded:
- ✓ Presence
- ✓ Severity
- ✓ Location

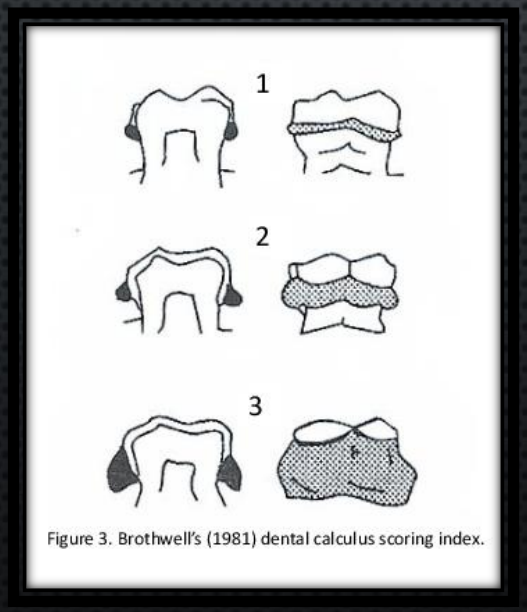


Figure 3. Brothwell's (1981) dental calculus scoring index.

Increasingly used in biochemical analyses

scientific reports

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Article | Open Access | Published: 25 May 2018

Dental calculus and isotopes provide direct evidence of fish and plant consumption in Mesolithic Mediterranean

Emanuela Cristiani, Anita Radini, Dušan Borić, Harry K. Robson, Isabella Caricola, Marialetizia Carra, Giuseppina Mutri, Gregorio Oxilia, Andrea Zupancich, Mario Šlaus & Dario Vujević

Rapid Communications in Mass Spectrometry

RESEARCH ARTICLE | Open Access

Isotope analysis of human dental calculus $\delta^{13}CO_3^{2-}$: Investigating a potential new proxy for sugar consumption

Blessing Chidimuro, Amy Mundorff, Camilla Speller, Anita Radini, Noémie Boudreault, Mary Lucas, Malin Holst, Angela Lamb, Matthew Collins, Michelle Alexander

First published: 08 March 2022 | https://doi.org/10.1002/rcm.9286

2. INDICATORS OF HEALTH
2.3. Dental Caries

Cavities are permanently damaged areas in the hard surface of your teeth that develop into tiny openings or holes

Multifactorial origins:
1. poor oral hygiene
2. dietary and alimentary practices

Location influenced by:
1. dietary cultural practices
2. tooth morphology
3. wear patterns

Infectious, transmissible, & progressive

2. INDICATORS OF HEALTH

2.3. Dental Caries

Who says Caries say Carbohydrates & Sugars

- ✓ Associated with the fermentation of carbohydrates by plaque bacteria

*sharp increases in caries frequencies in agricultural societies over hunter-gather societies

- ✓ Associated most strongly with the proportion of sugars in the diet

- ✓ Proteins and fats in the diet don't seem to contribute to caries development

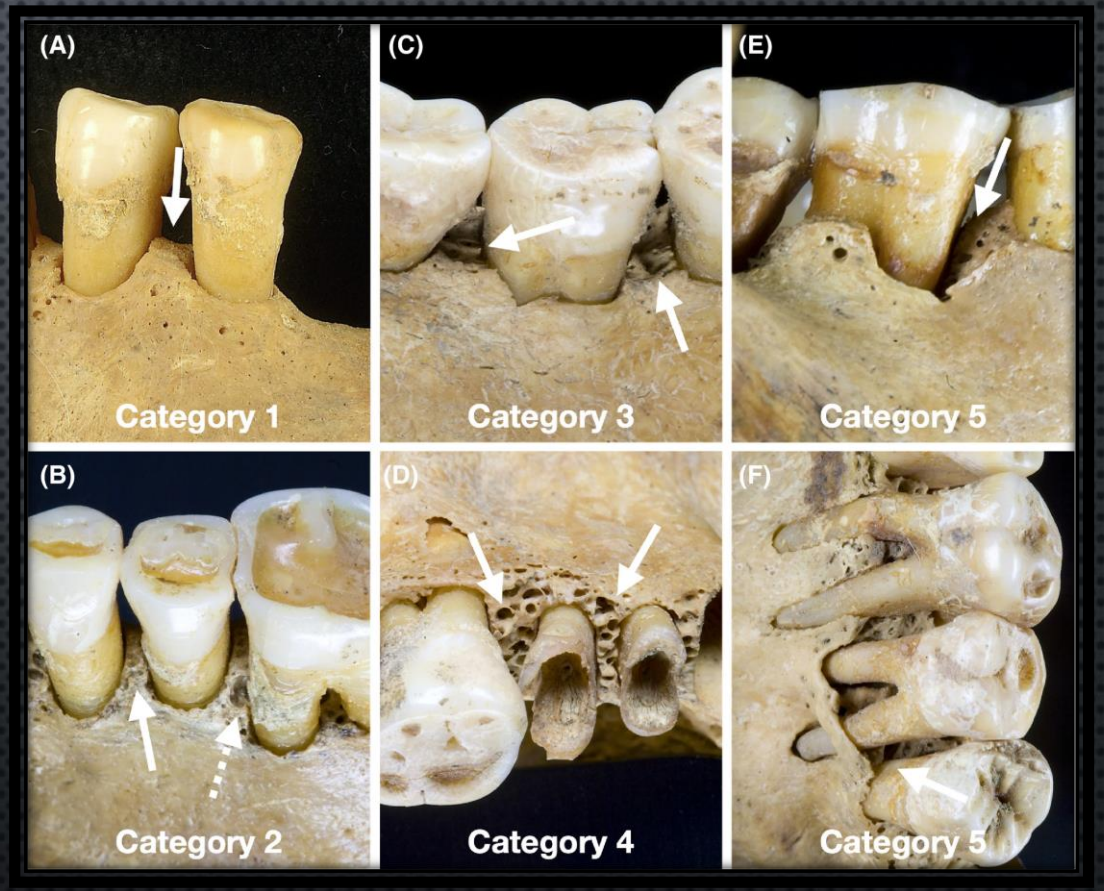
*casein, a protein present in milk products, could have a protective effect on the teeth

2. INDICATORS OF HEALTH
2.4. Periodontal diseases

- ✓ Gingivitis = A gum inflammation
- ✓ Periodontitis = inflammation touches the soft tissue & bone responsible for keeping teeth firmly anchored and cause damage there

it can cause teeth to loosen

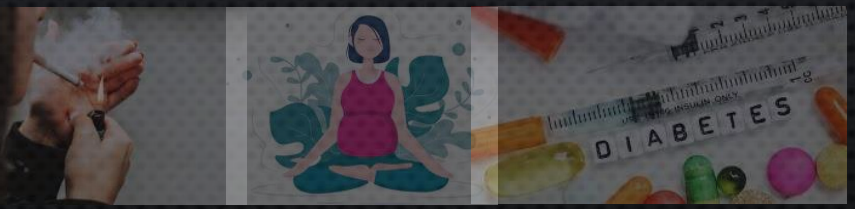
2. INDICATORS OF HEALTH
2.4. Gingivitis & Periodontitis



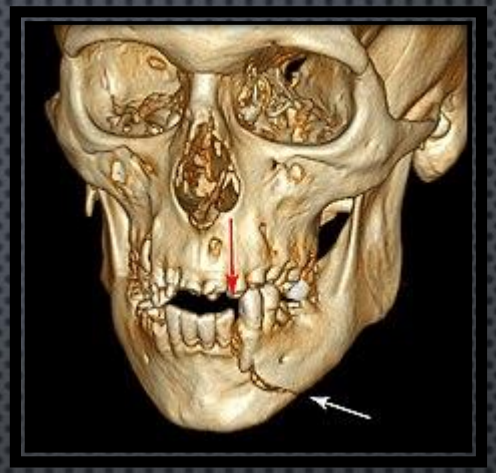
The most common cause of inflamed gums is plaque
'a thin film that is mainly made up of bacteria

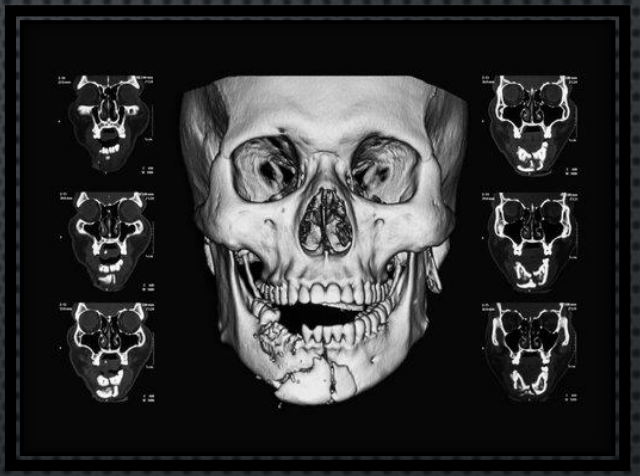
increased by various factors, including:

1. smoking
2. metabolic diseases (diabetes)
3. hormonal changes during pregnancy



2. INDICATORS OF HEALTH
2.5. Dental Trauma





Most common: Antemortem tooth loss (AMTL)

Related to:

1. nutritional deficiency diseases
2. dental ablation for aesthetic or ritual reasons
3. traumatic injury

TEETH & HEALTH

1. Methods in dental pathology
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3. Indicators of health
4. **Presentation of dental data**
5. Case study
6. Dental health through time

4. PRESENTATION OF DENTAL DATA

1. Results of each indicator are presented infrequency according to presence or absence using ither
- crude prevalence rates (cpr)
- true prevalence rate (tpr)

2. frequency is considered:
- moderate if ≤ 50%,
- high if ≥ 50%

based on the trends from the studied period in the studied region.

3. to compare frequencies of all pathological conditions between the different periods/sites/population statistic tests are applied (e.g., Fisher for small sample sizes)

TEETH & HEALTH

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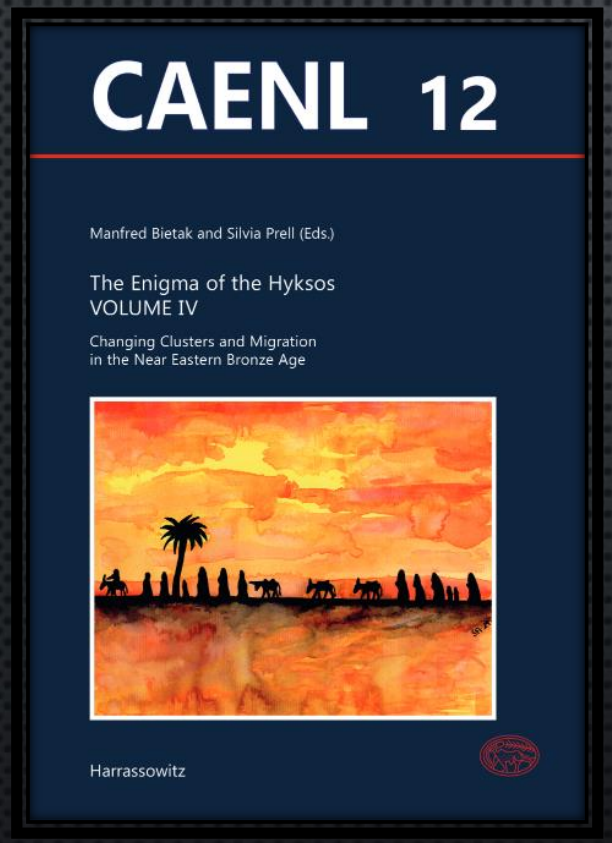
5. CASE STUDY



Contribution of Bioanthropology to Defining the Tell el-Dab'a Population in the Eastern Delta: Preliminary Findings

by Arwa Kharobi[1], Nina Maaranen[2], Chris Stantis[3], Sonia Zakrzewski[4] and Holger Schutkowski †

Abstract

The data provided in this paper was presented at the workshop 'Changing clusters and migration in the Near Eastern Bronze Age', held at the Austrian Academy of Sciences in 4th–6th December, 2019. The work has been conducted under the Hyksos Enigma project's Research Track 7 (RT7) in Bournemouth University (United Kingdom), focusing on bioarchaeology and the study of skeletal human remains from Tell el-Dab'a. This paper highlights the potential of using an integrated suite of osteological analyses in the archaeological framework, offers an overview of the field of bioarchaeology, presents some preliminary findings using this framework, and offers further possibilities and directions. The paper focuses on the different aspects of research conducted by RT7, including non-destructive macroscopic (dental nonmetric trait and palaeopathological) analysis and biochemical (aDNA, stable isotope) analysis.

the project took on the task of analysing skeletal remains from Tell el-Dab'a and beyond to offer another avenue of evidence in the discussion of the nature and impact of the Hyksos.[5] A multidisciplinary approach was employed, combining non-destructive macroscopic (dental nonmetric traits and palaeopathological) and biochemical (stable isotopes and ancient DNA) analyses. The informatio
only diverse but complem
dynamic entity governed
factors. By combining the
and considering them to
the archaeological record
both population and indiv

Skeletal remains were
institutions from several
deeply grateful to our co
these analyses are current

Research question: Who were the Hyksos?

60% nonadults
High mortality of new-born
56% of the sexed skeletons belong to males

Nile Delta

Bronze age skeletons

Mesopotamia

Levant

Identify biological profile

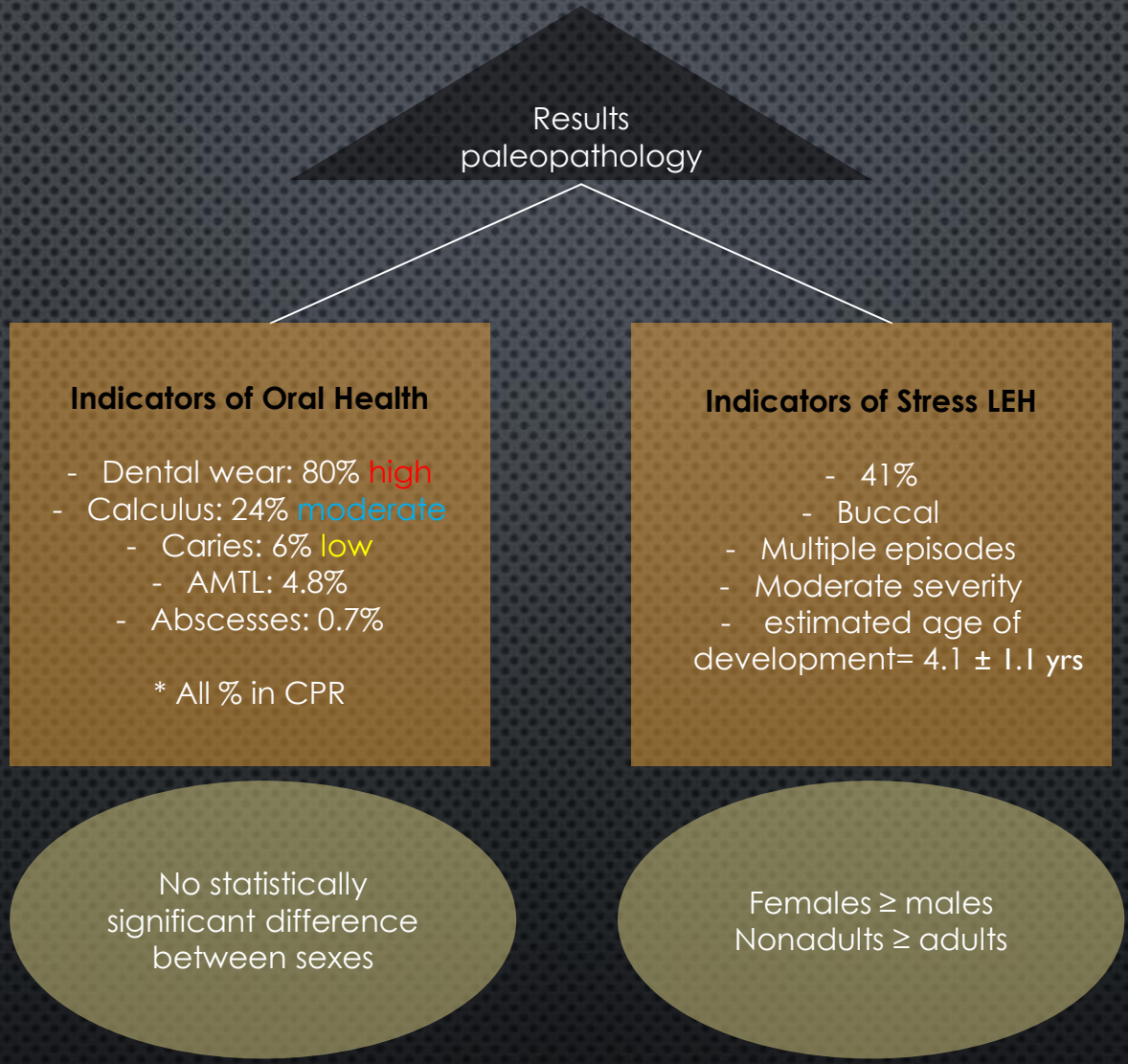
Teeth: best-preserved elements of the individuals

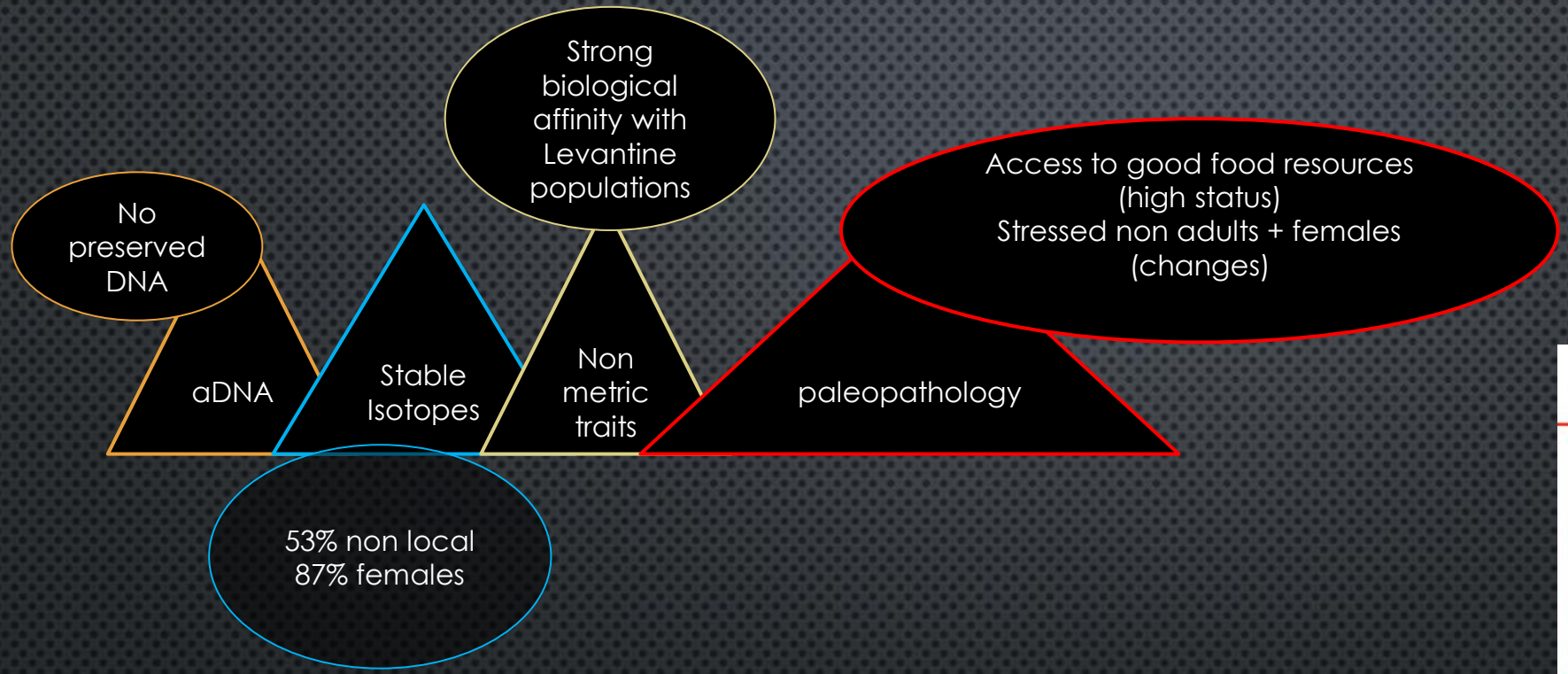
aDNA

Stable Isotopes

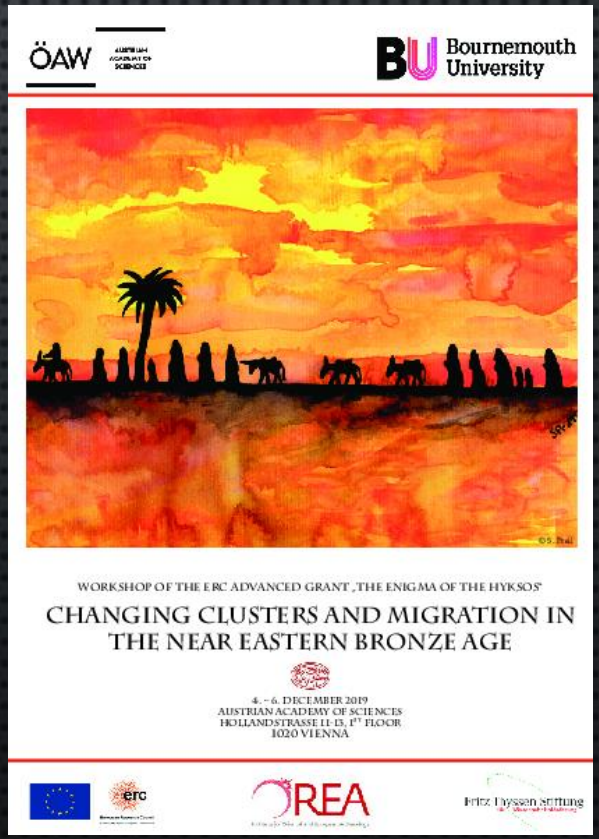
Non metric traits

paleopathology


Results
paleopathology
Indicators of Oral Health
- Dental wear: 80% high
- Calculus: 24% moderate
- Caries: 6% low
- AMTL: 4.8%
- Abscesses: 0.7%
* All % in CPR
Indicators of Stress LEH
- 41%
- Buccal
- Multiple episodes
- Moderate severity
- estimated age of development= 4.1 ± 1.1 yrs
No statistically significant difference between sexes
Females ≥ males
Nonadults ≥ adults



Hyksos is not an invasion
A smooth migration from the Levant probably
Female & children
Stress resulted from the adaption associated to cultural, socio-political changes



TEETH & HEALTH

1. Methods in dental pathology
2. Indicators of stress
3. Indicators of health
4. Presentation of dental data
5. Case study
6. **Dental health through time**

6. DENTAL HYGIENE THROUGH TIME

- Hippocrates: first to recommend cleaning teeth with what was basically a dry toothpaste ‘dentifrice powder’
- Ancient Chinese & Egyptian texts: advised cleaning teeth and removing decay to help maintain health

6. DENTAL HYGIENE THROUGH TIME

In the Arabian Peninsula, North Africa & the Indian subcontinent: 'Miswak' = Chew sticks

- Made from the Salvadora persica tree
- Tradition way of cleaning teeth

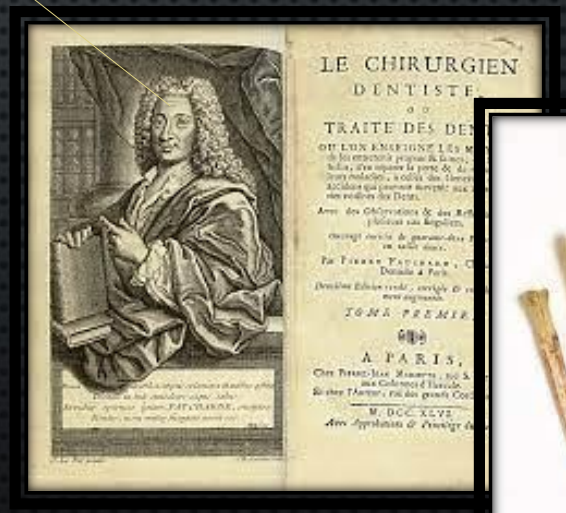
In Europe: rags rolled in salt or soot

6. DENTAL HYGIENE THROUGH TIME

Early 1700s, a French doctor, Pierre Fauchard 'the father of modern dentistry!'

Late 1700s, Englishman William Addis, first to sell toothbrushes on a large scale after making it from bone & animal bristles while in prison

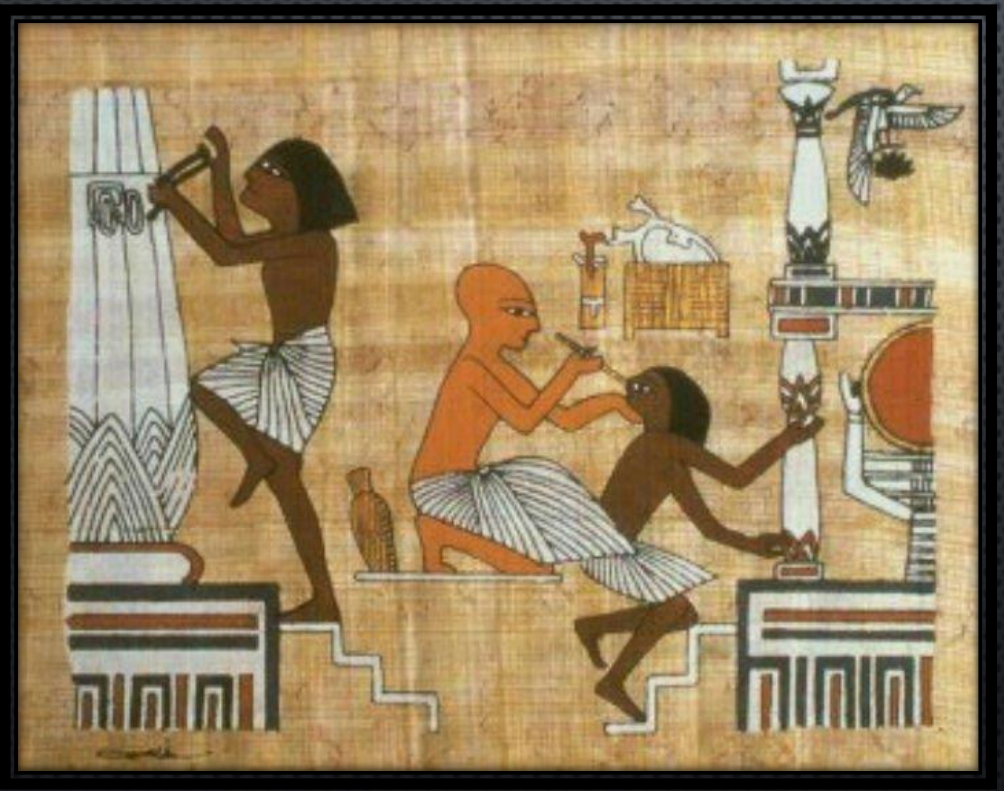
Don't brush your teeth! Instead, clean with a toothpick or sponge soaked in water in brandy!



NOWDAYS

6. DENTAL HYGIENE THROUGH TIME

6.1. Egypt



The ancients doctors were familiar with almost all modern dental diseases

- 3000 and 2500 B.C. earliest signs of dental surgery
- Usually involved drilling out cavities or pulling teeth
- No anesthesia but prescriptions for dental pain and injuries

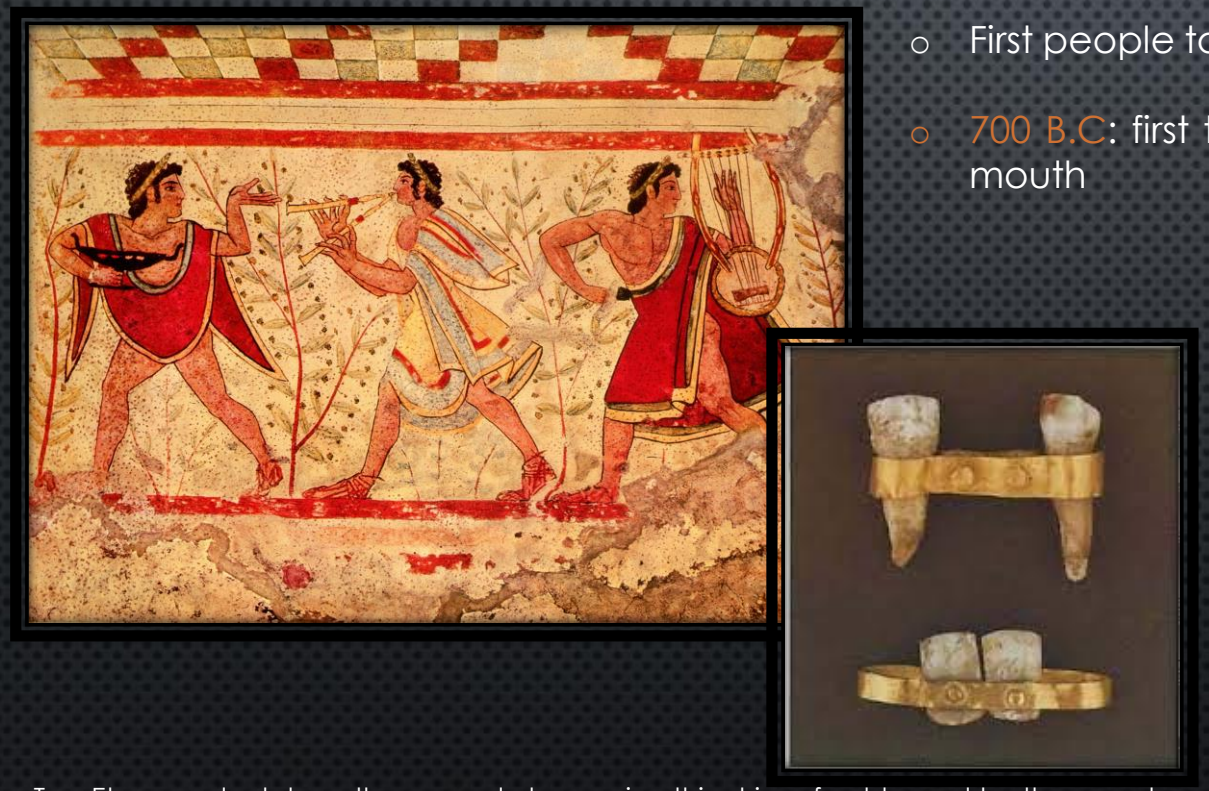
6. DENTAL HYGIENE THROUGH TIME

6.1. Egypt

The world's oldest-known recipe for toothpaste comes from ancient Egypt

6. DENTAL HYGIENE THROUGH TIME

6.2. Etruscan



- First people to take dentistry to a more artistic level
- 700 B.C: first time in history a form of prosthetics was ever used in the mouth

Two Etruscan dental prostheses made by passing thin strips of gold round teeth on each side of a space from which a tooth or teeth had been lost and rivetting the strip so as to hold the substitute teeth in place. In one case, the abutment teeth are present, but the artificial tooth is lost, and in the other case, the two substitute teeth, portions of an animal tooth, remain

6. DENTAL HYGIENE THROUGH TIME

6.3. Ancient Greek

A 3D reconstruction of the 2,100-year-old mummy's teeth. They were in horrible shape with "numerous" abscesses and cavities, problems that may have resulted in a sinus infection, possibly fatal. © International Journal of Paleopathology.

6. DENTAL HYGIENE THROUGH TIME

6.4. Ancient China

The great Sung landscapist Li T'ang depicts a country doctor cauterizing a patient's arm by burning it with the powdered leaves of an aromatic plant. The treatment is called Moxibustion that is widely used along with acupuncture for treatment such as relieving toothache.

- 6000 BC performed rudimentary dental extractions
- 2700 BC used acupuncture to treat pain associated with tooth decay
- 1000 AD treated toothaches with arsenic

6. DENTAL HYGIENE THROUGH TIME
6.5. Mesoptamia

- 3000 BC: Clay tablets written in Cuneiform mentioned toothache and treatments

In Mesopotamia gods and spirits were blamed for diseases.

LIMITS OF DENTAL PATHOLOGY

- TEETH ARE FOR EATING!
- TEETH ARE MULTIFACETED:
  - FISSURES & PITS
  - SMOOTH SURFACES OF THE CUSPS & SIDES OF THE CROWN
  - INTERPROXIMAL AREA IN BETWEEN NEIGHBORING TEETH
  - AROUND THE NECK OF THE TOOTH

SEE YOU NEXT FRIDAY