



# “STUDY OF MORPHOLOGY, MASS AND ELEMENTAL CHANGES IN HUMAN TEETH ON EXPOSURE TO VARIOUS EXTERNAL FACTORS WITH SPECIAL REFERENCE TO SOIL, WATER SOURCES AND ACIDS -A PROSPECTIVE TOOL AS GEOGRAPHICAL MARKERS”

## Forensic Odontology

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## ABSTRACT

The aim of the study was to establish the effect of various external factors on elemental composition of dentition and to study the correlation between morphological features in tooth and mass when exposed to various external factors using ED-XRF analysis. A total of 50 freshly extracted teeth fulfilling the inclusion criteria were selected and were divided into batches of 10 each into 5 groups of external environmental factors selected. The teeth were then measured for changes on exposure at various intervals and it was found that changes do occur in the elemental composition of teeth as well as morphology when exposed to environmental external factors with a significant p value of <0.01 in most cases.

## KEYWORDS

### Introduction :-

Forensic science is the science applicable for the purpose of aid in the justice administration. It has been well established that the application of entire range of science disciplines are useful for the purpose of establishing the fact in any mysteries.

Forensic Odontology has been off late entered into this particular subject with much application in the area of Identification of individuals.

Irrespective of race, gender, age it is possible to establish the absolute identity through the dentition. In cases of both living and dead the crisis of identity will easily be resolved by the application of odontology. The various primary and secondary characteristics may be well applied for absolute identity, it needs to be understood that the absolute identity will be possible with a combination of multi features of biometric systems. Though DNA has been found to be useful for absolute identity, there is a need for referral databases, or else there should be a probable identity established through some other means. Death may occur with a number of causes and modes either naturally or unnaturally. In most of the cases when the bodies are not available immediately after death or found in remote areas there is a scope of establishing probable identity and further to establish the absolute identity through the dental remains. In certain conditions the hard tissues that is an entire skeleton or parts of the skeleton or fragmentary remains would only be available for the purpose of identity. In such conditions scope of establishing the cause of death would be more remote. With a limited number of available resources, an attempt has been made in this study to establish the correlation between morphological changes, variations in the mass and the variations in the elemental proportions.

### AIMS AND OBJECTIVES

#### AIMS:-

- 1) To establish the effect of various external factors on elemental composition of dentition.
- 2) To establish the correlation between morphological features in tooth when exposed to various external factors.
- 3) To establish the variation of mass in tooth when exposed to various external factors.
- 4) To establish the possible exposure to external factors based on morphological status and elemental components of tooth.

#### OBJECTIVES:-

- 1) Identification and detection of teeth after being subjected to various external factors using ED-XRF.
- 2) Analysis of weight loss of human teeth induced by exposure to various external factors using semi-precision measurements.
- 3) Analysis of elemental and compositional alterations induced by various external factors in human teeth using ED-XRF.
- 4) Analysis of morphological changes in human teeth after exposure to various external factors.

### MATERIALS AND METHODS

#### 1) SAMPLE COLLECTION:-

Total 50 freshly extracted permanent teeth were collected for present study from dental practitioners where dental extraction procedure was performed.

### 2) DEBRIDEMENT AND DISINFECTION:-

Debridement was done in tap water. Tooth sample were disinfected with 5% Sodium Hypochlorite solution for 1 hour.

### 3) CRITERIA FOR EXCLUSION:-

- \* Fractured, carious and grossly decayed teeth.
- \* Erosive, hypoplastic teeth, congenitally malformed teeth.
- \* Previously restored or endodontically treated teeth.

**NOTE:-**All teeth analyzed were extracted for orthodontic and periodontal purpose.

### 4) SAMPLING METHOD:-

A total of 50 permanent extracted teeth were studied. Following extraction each tooth was rinsed with tap water to remove blood deposits and salivary coatings.

### 50 PERMANENT TEETH

|           |      |          |
|-----------|------|----------|
| SOIL      | ---- | 10 TEETH |
| SAND      | ---- | 10 TEETH |
| SEA WATER | ---- | 10 TEETH |
| TAP WATER | ---- | 10 TEETH |
| ACIDS     | ---- | 10 TEETH |

**SAMPLING:-** Teeth were equally divided into 5 groups according to the type of the external factors

### Results:-

#### Soil:-

|    |         |        |
|----|---------|--------|
| Ca | Z       | -1.753 |
|    | P value | 0.080  |
| Cu | Z       | -1.761 |
|    | P value | 0.078  |
| Fe | Z       | -2.023 |
|    | P value | 0.043  |
| K  | Z       | -1.753 |
|    | P value | 0.080  |
| Mn | Z       | -1.604 |
|    | P value | 0.109  |
| Ni | Z       | 0.000  |
|    | P value | 1.000  |
| P  | Z       | -1.214 |
|    | P value | 0.225  |
| S  | Z       | -0.135 |
|    | P value | 0.893  |
| Si | Z       | -2.023 |
|    | P value | 0.043  |
| Sr | Z       | -1.483 |
|    | P value | 0.138  |
| Ti | Z       | -2.023 |
|    | P value | 0.043  |
| Zn | Z       | -2.023 |
|    | P value | 0.043  |

Difference in the weight of teeth between 1<sup>st</sup> and last day:-

Tooth 1 = 24mg  
Tooth 2 = 26mg  
Tooth 3 = 17mg  
Tooth 4 = 15mg  
Tooth 5 = 3mg

#### Sea water :-

|    |         |        |
|----|---------|--------|
| Br | Z       | -1.342 |
|    | P value | 0.180  |
| Ca | Z       | -1.483 |
|    | P value | 0.138  |
| Cu | Z       | -1.461 |
|    | P value | 0.144  |
| Fe | Z       | -0.542 |
|    | P value | 0.588  |
| K  | Z       | -2.023 |
|    | P value | 0.043  |
| Ni | Z       | -0.378 |
|    | P value | 0.705  |
| P  | Z       | -0.674 |
|    | P value | 0.500  |
| S  | Z       | -2.023 |
|    | P value | 0.043  |
| Sr | Z       | -0.405 |
|    | P value | 0.686  |
| Zn | Z       | -1.753 |
|    | P value | 0.080  |

Difference in weight of teeth between 1<sup>st</sup> and last day:-

Tooth 1 = 15mg  
Tooth 2 = 20mg  
Tooth 3 = 17mg  
Tooth 4 = 13mg

Tooth 5 = 1mg

#### Fresh water :-

|    |         |        |
|----|---------|--------|
| Ca | Z       | -1.753 |
|    | P value | 0.080  |
| Cu | Z       | -2.023 |
|    | P value | 0.043  |
| Fe | Z       | -2.032 |
|    | P value | 0.042  |
| K  | Z       | -1.753 |
|    | P value | 0.080  |
| Ni | Z       | -0.921 |
|    | P value | 0.357  |
| P  | Z       | -1.753 |
|    | P value | 0.080  |
| S  | Z       | -0.405 |
|    | P value | 0.686  |
| Sr | Z       | -0.674 |
|    | P value | 0.500  |
| Zn | Z       | -1.753 |
|    | P value | 0.080  |

Difference in weight of teeth between 1<sup>st</sup> and last day:-

Tooth 1 = 1mg  
Tooth 2 = 10mg  
Tooth 3 = 1mg  
Tooth 4 = 5mg  
Tooth 5 = 14mg

#### Sand:-

|    |         |        |
|----|---------|--------|
| Ca | Z       | -1.483 |
|    | P value | 0.138  |
| Cu | Z       | -1.214 |
|    | P value | 0.225  |
| Fe | Z       | -2.023 |
|    | P value | 0.043  |
| K  | Z       | -2.023 |
|    | P value | 0.043  |
| Ni | Z       | -0.677 |
|    | P value | 0.498  |

|    |         |        |
|----|---------|--------|
| P  | Z       | -1.483 |
|    | P value | 0.138  |
| S  | Z       | -0.944 |
|    | P value | 0.345  |
| Si | Z       | -1.342 |
|    | P value | 0.180  |
| Sr | Z       | -1.461 |
|    | P value | 0.144  |
| Zn | Z       | -0.674 |
|    | P value | 0.500  |
| Zr | Z       | -1.342 |
|    | P value | 0.180  |

Difference In Mass Of Tooth Between 1<sup>st</sup> Day And Last Day

Tooth 1=20mg  
Tooth 2=22mg  
Tooth 3=10mg  
Tooth 4=31mg  
Tooth 5= 23mg

#### Acids :-

|    |         |        |
|----|---------|--------|
| Ca | Z       | -1.342 |
|    | P value | 0.180  |
| Cl | Z       | -1.342 |
|    | P value | 0.180  |
| Cu | Z       | -1.342 |
|    | P value | 0.180  |
| P  | Z       | -1.342 |
|    | P value | 0.180  |
| S  | Z       | -1.342 |
|    | P value | 0.180  |
| Sr | Z       | -1.342 |
|    | P value | 0.180  |
| Zn | Z       | -1.342 |
|    | P value | 0.180  |

Difference in weight of teeth between 1<sup>st</sup> day and last day

#### SULPHURIC ACID

Tooth 1 = 32mg  
Tooth 2 = 32mg

#### NITRIC ACID

Tooth 1 = 595mg  
Tooth 2 = 517mg

#### HYDROCHLORIC ACID

Tooth 1 = 495mg  
Tooth 2 = 558mg

#### PERCHLORIC

Tooth 1 = 289mg  
Tooth 2 = 175mg

#### DISCUSSION

Wilcoxon Test is performed when the repeated measurements of the same sample is taken. negative Z score means the score is below group mean. In our statistical data we have P value more than 0.05 which means that a significant difference does not exists.

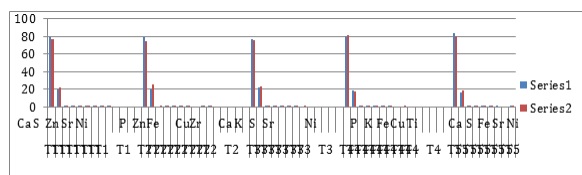
The Z value is negative and the P value is more than 0.05 for all elements in teeth exposed to Sand , Soil, sea water, Fresh water. Without considering statistics if the values we got during the elemental analysis is noted that shows that there is a consistent reduction in the calcium level and increase in the phosphorous level of most of the teeth when exposed to Sand, Soil, Sea Water and Fresh Water. The mass of the teeth is reduced due to the erosion in the soil. The addition or enhanced weight is due to the addition of elements through the adsorption and absorption of such elements those do have better compatibility and absorption characteristics or traits with specific elements. In 52 days of study there is a gradual decrease in the mass of all the teeth kept in all four medium named Sand, Soil, Sea Water, Fresh Water. There is no significant change in the morphology of the teeth subjected to Sand, Soil, Sea water and Fresh water as the decrease is beyond the recognizable levels visually. But the microscopic reduction could be possible to be noted. There would be an addition of the mineral content due to the adherence, adsorption and absorption of the same with the dental hard tissues.

For the teeth immersed in acids the Z value is negative and P value is more than 0.05 as per the statistical Data. But based on the values that we got during elemental analysis we could note that for the teeth kept in Sulphuric Acid there is significant decrease in calcium and

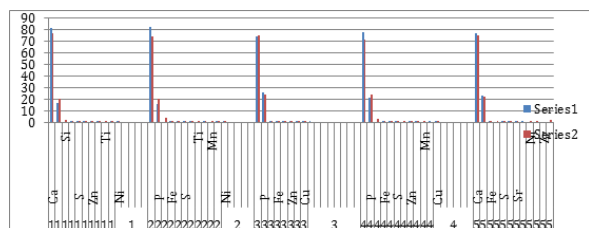
phosphorous levels and sulphur is added around 40percent. For nitric acid there is an increase in calcium level and decrease in phosphorous level and sulphur is added upto 35%. For hydrochloric acid there is decrease in calcium and phosphorous level and chlorine is added upto 48%. In case of perchloric acid there is decrease in calcium and phosphorous levels and chlorine is added upto 41%.. This may be attributed to the erosion of the morphological structure of teeth due to the exposure to acids.

There is a significant decrease in mass of the teeth immersed in all four acids. This may be attributed to the erosion of the morphological structure of teeth due to the exposure of acids. Variations of the mass may be attributed to the acids. There is a significant change in the morphology of teeth immersed in Acids.

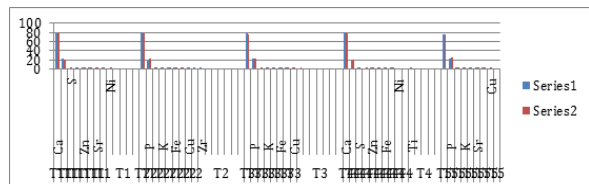
#### Sand :-



#### Soil:-



#### Sea water:-



#### Conclusions:-

- There is fluctuation in the weight and elemental concentration of the teeth which is attributed to the exposure of teeth to soil with specific characteristic of teeth and concentration of soil.
- There is fluctuation in the weight and elemental concentration of the teeth which is attributed to the exposure of teeth to sand with specific characteristic of teeth and concentration of sand.
- There is variation in mass when subjected to sea water and fresh water, could be attributed to the absorption of the minerals due to variation in concentration of mineral respectively.
- The imbibing characteristics are very well attributed to the fluctuations of the mineral concentration in cases of sea water and fresh water.
- There is remarkable reduction in the mass and the elemental concentration of the teeth due to the exposure of acids. When teeth was subjected to acid exposure, erosion of teeth occurs due to the depleted minerals in the teeth attributing to the acidic reactions a characteristic feature of acids.
- Though significant results are available with the study, still there is a scope of establishing better and precise results with the inclusion of more data.

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