

# Zamora Technique Age Estimate for Dental Environment; Mexican Population for Identification Purposes

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## Abstract

Age Estimation is defined as the forensic scientific procedure carried out on living or deceased persons (partial or total corpse remains), involved in a judicial process, in order to recognize the identity. In this way, the judge collaborates in the application of justice (Carrasco et al. 1993).

When it is necessary to determine the identity of an individual in a judicial process, the estimation of age is essential. Determination of age in bodies or unknown cadaveric remains is a frequent problem in Legal Medicine.

Nowadays people have created an enormous fascination for Forensic Sciences, possibly due to the sensationalism with which crimes and crimes are handled through the press, even television series have created interest in this topic.

But reality always surpasses fiction; since at the moment numerous corpses enter the Semefos day by day as Unidentified. Many of them buried without being recognized. Even worse; with the problems experienced in Mexico; many clandestinely buried. Forbes magazine in 2019 speaks of 40,187 Missing Persons and 37,863 Unidentified Dead in Mexico, although unofficial figures speak of higher numbers. Sadly, numerous crimes go unpunished.

Over the years, the evolution of forensic investigation has been presented slowly but gradually, with the arrival of new forms of scientific analysis and the contributions of specialized knowledge areas such as Forensic Dentistry, it is clear that an expert specialist in a certain area contributes its history, methodology, protocol and knowledge to make Forensic Sciences the true tool of justice. And to be able to say at the end that "Justice is in the hands of science" [1].

The determination of the Legal Medical age becomes a real challenge when the human remains have been subjected to processes of putrefaction, combustion and other external forces. In many of these cases, the only thing that preserved the hard structures: bone and teeth, and therefore, the latter could be the only resource to determine the legal medical age, that is, the age that was at the time of death (Carrasco et al. to the.).

Various methods have been proposed to calculate age using teeth, from correlation with growth and development processes (under 20 years of age) to regressive phenomena of tooth structures (over 20 years of age), such as attrition, enamel, pulp denticles, cement dressings, continuous eruption, periodontopathies, root dental translucency and even biochemical signals (Gustafson, 1950; Nalbandian et al., 1960; Bang & Ramm,) [2].

In the literature, the relationship between root dental trans-

lucency and increasing age has been described in individuals over 20 years of age, but, even so, no consensus has been reached in establishing a unique, reliable and precise method that delivers a satisfactory result. be it due to the existence of subjective factors, lack of specialized personnel, inadequate infrastructure, non-validated used technology, among others (Kinney et al., 2003).

Sadly we have noticed that the Identification techniques that are available in forensic sciences, referred wide ranges of up to 14 years of standard deviation and worse still these techniques were performed in France, Italy, India and the United States and arbitrarily we used in Mexican population .

Age determination tables have been created through the measurement of root dental translucency on a sample of the Chilean population, from the linear regression calculation between TDR and real age, achieving an age estimate with 70.8% of certainty with a  $\pm 6$  years, at that time very close to the real age.

In this work, with the "Zamora" modification, they did not differ significantly from the real age, compared to that of Lamendin, who did have a significant difference. Therefore the method according to which the estimated ages did not come to differ significantly from or are closest to the actual ages is the Zamora modification [3].

The average error refers to the difference between the estimated age and the actual age. Applying the average error in the estimation of age using the modification of the formula. In the case of the sample of adult individuals from Saltillo, Coahuila studied in this investigation, with the modification of the formula, an average minimum error of 3.7 years is obtained. So it can be inferred that this technique is more accurate for the Mexican population..

## Introduction

Forensic Odontology in Mexico has become one of the most important specialties of Forensic Sciences because of its wide scope to provide information regarding legal proceedings [4].

They are known two components; dental and other legal one.

Speaking of the legal component covers its field of action: Practice Mala, Lawsuits, Quantifying Damage (Injury) Estimation of Age (Detained) and Office Administration.

Speaking of the Dental component covers its field of action: Analysis and Identification puncture marks Humana]

Human Identification being a primary objective of Forensic Odontology, achieving provide parameters such as; Estimation of age, sex, Racial, place of origin and even sometimes to socioeconomic level.

This process is complicated when the bodies are very destroyed or damaged by the passage of time or other circumstances of death (the effect of heat, moisture, time, etc.).

Unfortunately most skeletal methods used for estimating age, set ranges broad age and record limits minimum and maximum age, so you have the need to find techniques that are more accurate or at least reduce this age range.

It is understandable that the more wide ranges of age estimation; greater those included in that range, enabling that somehow no one is out of it, thus lowering the percentage of specificity of age estimation.

That is why the objective of this research is to contribute to the identification process Humana from the expertise of Odontology Forensic, to give greater specificity to the estimation of the age: By modifying the dental method of estimating age of Lamendin applicable in Mexican population.

## Background

For many years Forensic Dentistry has become an indispensable tool for human identification, using techniques for dental age estimation means are divided into 3 groups:

Dental Mineralization ranges from 0 to 16 years

Third Molar mineralization from 13 to 23 years

Root transparency of 25 years in front

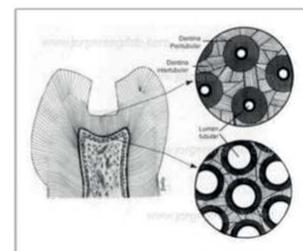
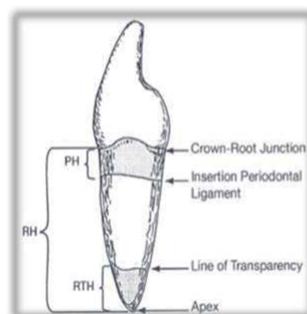
The latter age range (25 years ahead) which gives us more problematic because of the ranges has its age estimation techniques are wide; lacking specificity, although very inclusive become.

In some Latin American countries, including Mexico used as estimation technique Age through Dental; System root translucency of Lamendin et to the.

This method was developed by Lamendin (1988) [5] which is a test that was conducted French population, in which extracted teeth from a single root as incisor, premolar or canine maxilla or mandible, based only on teeth without condition caries.

**After extraction or distances the following parameters were measured:**

1. Root height (HR): which is the direct distance from the apex to the cement enamel junction (CEJ) in the buccal and / or lingual surface.
2. Periodontosis height (HPAR): which is the direct distance between the junction of the enamel cement (CEJ) and the level of placing the periodontium in the buccal and / or lingual surfaces.
3. Height of the translucency of the root (HTRAN). which it is the direct distance from the apex of the root to the point of division between the translucent and non-translucent part.



$$\text{dental age} = (0.18 \text{ XP}) + (0.42 \text{ XT}) + 25.23$$

$$P = \text{height of the periodontium / root Height} * 100 \text{ (HPAR / HR * 100)}$$

$$T = \text{height translucency / Root Height} * 100 \text{ (HTRAN / HR * 100)}$$

### Insert Formula Lamendin

The final estimate is achieved by the application of the age ranges and standard deviation according to the following table.

| Age       | 26-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70-79 | 80-89 |
|-----------|-------|-------|-------|-------|-------|-------|-------|
| Error +/- | 24.8  | 15.5  | 9.9   | 7.3   | 6.3   | 11.6  | 18.9  |

Subsequent studies have verified the effectiveness and reliability of this method. Ensuring more reliable results are achieved for men between 26 and 60 years for women between 26 and 70 years, taking into account that the method Restingue adult individuals, with a minimum age of 26 years due to the metamorphosis of translucency [6].

### Problem Statement

With the standard deviation has Lamendin Technique is re-

ally specific and selective for Mexican population?

Is it valid to use the technique of Lamendin in Saltillo, Coahuila, Mexico?

Can we adjust the technique Lamendin Population of Saltillo, Coahuila, Mexico to make it more specific?

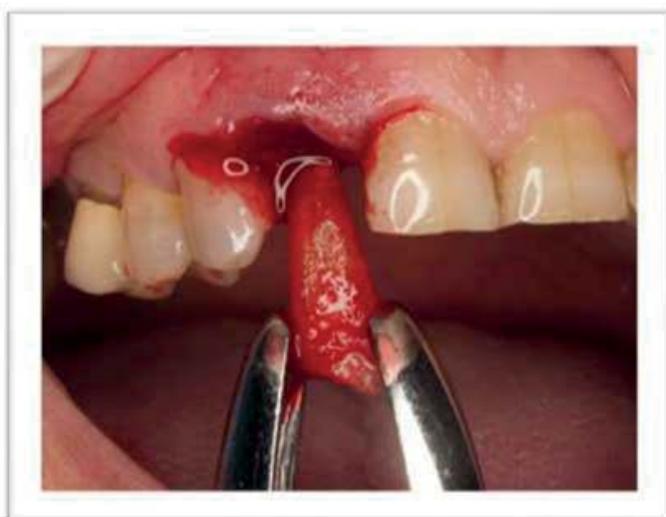
## Material and Method

The research is comparative, transversal and prospective; It was performed in 4 stages:

- Step 1: To validate the applicability of the method for estimating Lamendin age Saltillo Coahuila
- Step 2: Formulating a new age estimate equation based on the modification of the gingival regression in mm per year periodontally and obliteration of the dentinal tubules in mm per year endodontically.
- Step 3: Compare both methods and determine statistically which is more specific
- Step 4: Validate the new equation with cases of bodies admitted as NN and had a positive identification

### Step # 1 "Validation Technical Lamendin"

- They were selected at random, probabilistic and convenience 50 adult individuals aged 18 to 79 years regardless of gender, served at the Faculty of Odontology Unit of Saltillo Autonomous University of Coahuila in the city of Saltillo, Coahuila, Mexico.
- The unit of analysis was limited to: permanent teeth, uniradiculares, erupted and meet as much as possible with healthy teeth standards.
- tooth extraction was performed on an atraumatic.



- Extractions were performed without the use of elevators, seeking not alter the height of the periodontosis.
- It is important to mention that the principal investigator was present at the time of extraction and institutional clinical record that the age of patients, which were handled confidentially known.

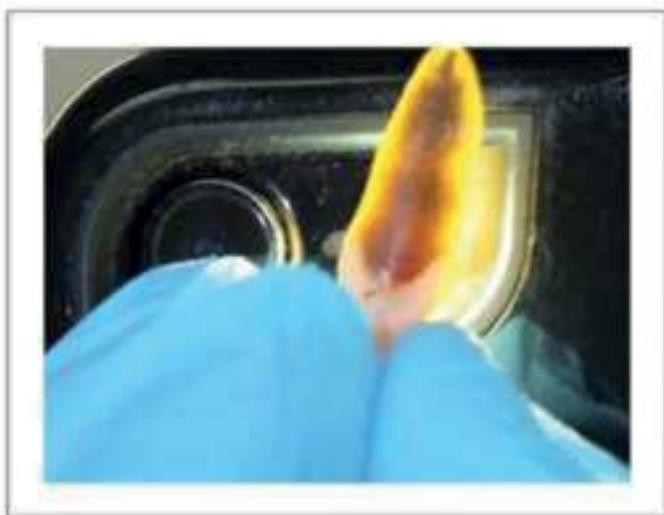
- Regression Gingival subsequently he measured through the coronal edge of the periodontal attachment to the cemento-enamel junction, measured along the buccal surface of the tooth.



- The teeth were washed and placed in sodium hypochlorite at 0.05% for 5 minutes; then they were dried, stored and identified in kraft paper bags.
- Later total root length and root length were measured transparency.
- For total root length the distance between the cemento-enamel junction to the root apex was measured. Measures taken on the labial surface of the tooth without sectioning.



- To measure the length of the transparency, the tooth was placed on the LED light source of 48-53 lumens; the height of transparency was measured from the root apex of the tooth, on the buccal and distal surface, taking the highest extension of the two because, sometimes transparency was higher distally.



- All measurements were taken with a digital caliper brand: TRUPER Measuring range 0-152,4mm / 0-6 "and Resolution: 0.01mm / 0.0005" and were expressed in tenths of millimeters.



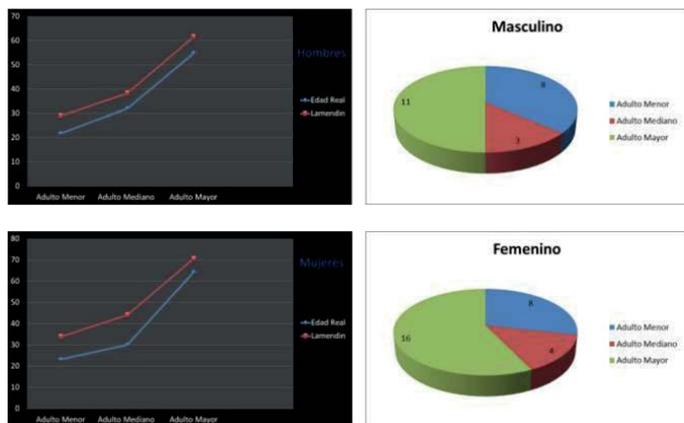
- Estimated age of the teeth of the sample using the equation et Lamendin to the (1992)
- File number, general data, location of the tooth, tooth type, height periodontosis, height of the root transparency, root length, the actual age previously reported by patients and recorded: a data matrix in Excel where he registered was developed to the onset of clinical research on your record, age estimated by methods Lamendin.
- Resulting in an age estimate, which compared with the estimated age of Lamendin, we realized that there was a shift away from the actual age of 7.2 years on average; giving a limited range of 14.4 years.

Table 1.

| Age | Gender | Tooth | Age estimation Lamendin |
|-----|--------|-------|-------------------------|
| 18  | M      | # 14  | 28                      |
| 18  | M      | # 24  | 29                      |
| 20  | M      | # 14  | 28                      |
| 20  | M      | # 24  | 28                      |
| 24  | M      | # 14  | 32                      |
| 24  | M      | # 24  | 35                      |
| 25  | M      | # 14  | 31                      |
| 25  | M      | # 24  | 36                      |
| 32  | M      | # 14  | 31                      |
| 32  | M      | # 24  | 36                      |
| 32  | M      | #11   | 42                      |
| 45  | M      | #21   | 56                      |
| 45  | M      | #11   | 54                      |
| 45  | M      | # 33  | 52                      |
| 45  | M      | # 44  | 52                      |
| 45  | M      | #34   | 51                      |
| 52  | M      | # 41  | 58                      |
| 52  | M      | # 31  | 59                      |
| 64  | M      | # 14  | 66                      |
| 64  | M      | # 14  | 69                      |
| 71  | M      | # 33  | 77                      |
| 75  | M      | #21   | 83                      |

Table 2.

| Age | Gender | Tooth | Estimation of Age Lamendin |
|-----|--------|-------|----------------------------|
| 21  | F      | # 14  | 32                         |
| 21  | F      | # 24  | 27                         |
| 23  | F      | # 14  | 3. 4                       |
| 23  | F      | # 24  | 36                         |
| 24  | F      | # 14  | 31                         |
| 24  | F      | # 24  | 32                         |
| 25  | F      | # 14  | 33                         |
| 25  | F      | # 24  | 32                         |
| 30  | F      | # 14  | 33                         |
| 30  | F      | # 24  | 42                         |
| 30  | F      | # 44  | 41                         |
| 30  | F      | #34   | 41                         |
| 42  | F      | #41   | 48                         |
| 42  | F      | #31   | 48                         |
| 48  | F      | #44   | 56                         |
| 48  | F      | #11   | 55                         |
| 48  | F      | #21   | 55                         |
| 48  | F      | # 12  | 54                         |
| 64  | F      | #21   | 66                         |
| 64  | F      | # 14  | 69                         |
| 77  | F      | # 33  | 79                         |
| 77  | F      | #55   | 85                         |
| 78  | F      | #23   | 88                         |
| 78  | F      | #13   | 88                         |
| 78  | F      | #14   | 84                         |
| 78  | F      | # 24  | 84                         |
| 79  | F      | # 41  | 84                         |
| 79  | F      | # 31  | 83                         |



**Step # 2 "Draw New Equation"**

To change the specific dental formula for estimating age a multiple regression analysis was performed with the three factors used (Translucency, Regression Gingival and length Radicular) as determinants of age, following the method of stabilization whose values ages calculated they were closest to the values of the actual ages.

Dentin Sclerosis; Kim Trowbrige and Cohen (2002) note that dentinal sclerosis occurs by partial or complete tubule destinales of sealing can be the result of aging or produced in response to certain stimuli; as attrition of the surface of the teeth or the most common; tooth decay. Since we can not take any pathology reference must take this phenomenon as a result of aging, a feature that begins between 18 and 22 years so an average of 20.02 is taken.

The range of modification Gingival Regression (Migration of the gingiva) in mm per year (Periodontally)

The range of modification Transparency (Dentin Sclerosis) per year in mm per year (endodontic)

**Multiple Regression**

Multiple regression was used to adjust the formula Lamendin to estimate the age in the sample of individuals Saltillo Coahuila variable as dependent (response) age and independent variables (regressors): height periodontosis, root height and height radicular transparency.

It was found that the age-related variable is the height of the root transparency 0.953, then the height of the periodontosis 0.907 and root height -0391 so we can say that this is not changed over the years.

From Multiple Regression analysis, the equation is modified Lamendin; modifying it as follows to estimate the most specific and exact age.

**Zamora Formula (Modification)**

$$A = (0.15 XP) + (0.30 XT) + 20.02$$

Where:

It represents the age in years.

It represents the measurement of Regression Gingival X 100 / Length Root.

It represents the measurement of Transparency Root x 100 / Length Root.

**20.02** Media statistics time when it begins the physiological characteristic of Dentin Sclerosis

**0.15** The range of modification Gingival Regression in mm per year (Periodontally)

**0.30** The range of modification Transparency mm per year for years (Endodontic)

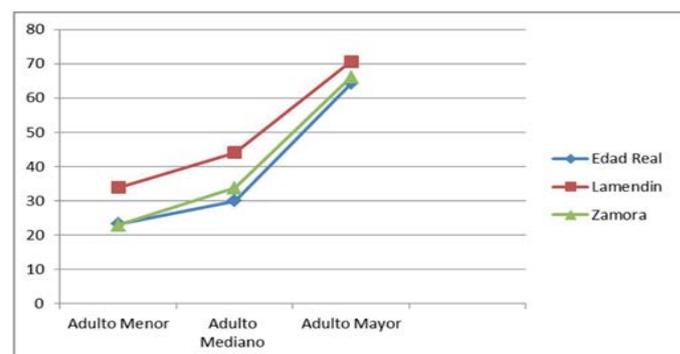
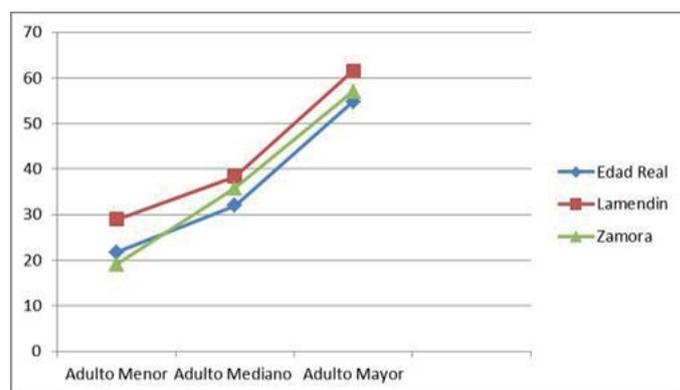
Statistical analysis SPSS was used. First, the average error of the ages estimated actual age by both methods was found with respect.

Subsequently, the Wilcoxon test which is a non-parametric test comparing two interrelated samples was used; that it was used to evaluate the applicability of the technique Lamendin vs Zamora technique in population of the Faculty of Odontology Unit of Saltillo Autonomous University of Coahuila in the city of Saltillo, Coahuila. Mexico.

**Step # 3 "Comparative"**

Ages estimated by the modification "Zamora" does not differ significantly from the actual age compared to that of Lamendin that if he had a significant difference. Therefore the method by which the estimated ages failed to differ significantly from the actual ages or are closer to these is the modification of Zamora.

The average error refers to the difference between the estimated and actual age age. Appreciate the average error in the estimation of age using the modification formula. In the case of the sample of adult Saltillo, Coahuila studied in this research, the modification of the formula an average minimum of 3.7 years error is obtained.



**Table 3.**

| Age | Gender | Tooth | Lamendin | Zamora |
|-----|--------|-------|----------|--------|
| 18  | M      | # 14  | 28       | 21     |
| 18  | M      | # 24  | 29       | 21     |
| 20  | M      | # 14  | 28       | 23     |
| 20  | M      | # 24  | 28       | 23     |
| 24  | M      | # 14  | 32       | 27     |
| 24  | M      | # 24  | 35       | 27     |
| 25  | M      | # 14  | 31       | 29     |
| 25  | M      | # 24  | 36       | 28     |
| 32  | M      | # 14  | 31       | 26     |
| 32  | M      | # 24  | 36       | 37     |
| 32  | M      | #11   | 42       | 36     |
| 45  | M      | #21   | 56       | 49     |
| 45  | M      | #11   | 54       | 48     |
| 45  | M      | # 33  | 52       | 48     |
| 45  | M      | # 44  | 52       | 49     |
| 45  | M      | #34   | 51       | 48     |
| 52  | M      | #41   | 58       | 55     |
| 52  | M      | # 31  | 59       | 55     |
| 64  | M      | # 14  | 66       | 67     |
| 64  | M      | # 14  | 69       | 67     |
| 71  | M      | # 33  | 77       | 74     |
| 75  | M      | #21   | 83       | 78     |

**Table 4.**

| Age | Gender | Tooth | Lamendin | Zamora |
|-----|--------|-------|----------|--------|
| 21  | F      | # 14  | 32       | 22     |
| 21  | F      | # 24  | 27       | 23     |
| 23  | F      | # 14  | 3. 4     | 24     |
| 23  | F      | # 24  | 36       | 24     |
| 24  | F      | # 14  | 31       | 25     |
| 24  | F      | # 24  | 32       | 26     |
| 25  | F      | # 14  | 33       | 26     |
| 25  | F      | # 24  | 32       | 26     |
| 30  | F      | # 14  | 33       | 33     |
| 30  | F      | # 24  | 42       | 33     |
| 30  | F      | # 44  | 41       | 33     |
| 30  | F      | #34   | 41       | 32     |
| 42  | F      | # 41  | 48       | 44     |
| 42  | F      | # 31  | 48       | 44     |
| 48  | F      | # 44  | 56       | 50     |
| 48  | F      | #11   | 55       | 50     |
| 48  | F      | #21   | 55       | 50     |
| 48  | F      | # 12  | 54       | 50     |
| 64  | F      | #21   | 66       | 67     |
| 64  | F      | # 14  | 69       | 68     |
| 77  | F      | # 33  | 79       | 80     |
| 77  | F      | #55   | 85       | 80     |
| 78  | F      | #23   | 88       | 80     |
| 78  | F      | # 13  | 88       | 80     |
| 78  | F      | # 14  | 84       | 81     |
| 78  | F      | # 24  | 84       | 81     |
| 79  | F      | # 41  | 84       | 81     |
| 79  | F      | # 31  | 83       | 81     |

**Discussion**

Validation of different methods to estimate age in a population tries to verify whether there is significant difference between the values of estimated ages and values of the actual ages.

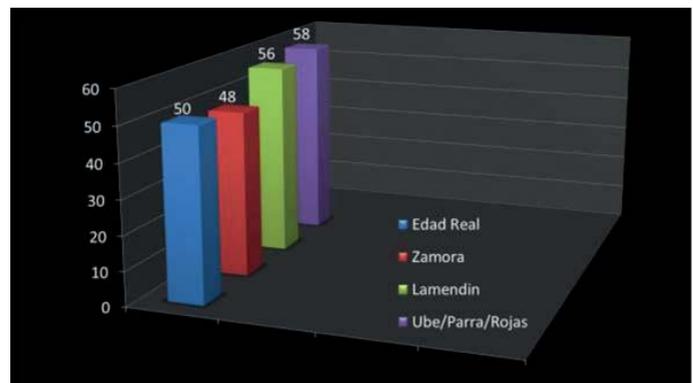
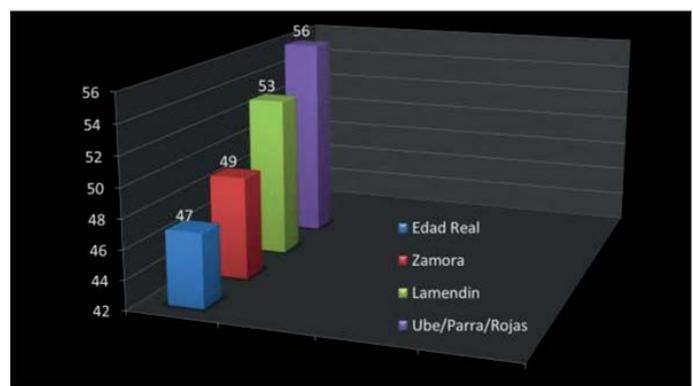
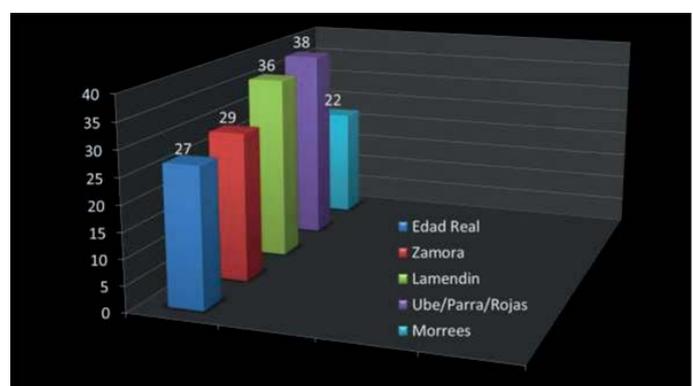
Among the results of this research it showed that there are significant differences between the values of ages estimated with the method Lamendin and values of the actual ages.

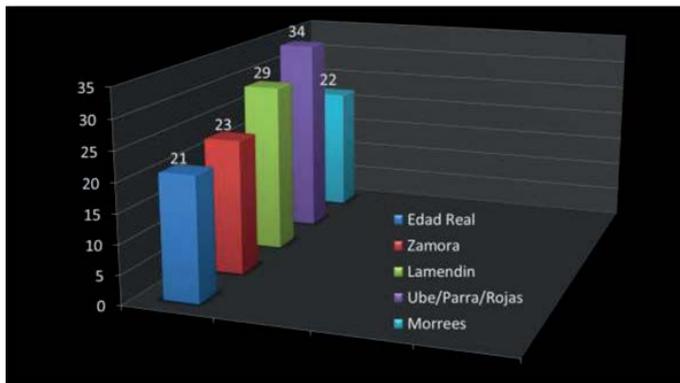
I believe that the use of several methods together to estimate the age provides more accurate results than the only use of a dental method. In the study of Zamora a modification of the specific formula for a particular population group, which managed to estimate the age more accurately developed [7].

The adjustment method Zamora using test multiple regression to estimate the age of the sample of adults of Saltillo, Mexico, was obtained from the correlation analysis that the higher correlation of age with the root transparency ( $r = 0.735$ ).

| Method   | Average Error | Standard deviation |
|----------|---------------|--------------------|
| Lamendin | 5.6           | 5.69236            |
| Zamora   | 3.7           | 3.50068            |

**Step # 4 Validation**





## Conclusions

- Standard Deviation range of Lamendin to the technique as wide being becomes little specific and very selective, but highly inclusive in Mexican population
- Technique was invalid Lamendin to estimate age in the sample of adults of Saltillo, Coahuila. Mexico.
- Zamora modification was valid to estimate the age of the sample, this being more precise.

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