Human Sacrifice and Mortuary Treatments in the Great Temple of Tenochtitlán

Research Year: 2005
Culture: Mexica
Chronology: Postclassic
Location: México City, México
Site: Tenochtitlán

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Introduction

The present report describes the study undertaken with the osteologic collection obtained from the Great Temple excavations in Tenochtitlán; this collection was assembled in the interval from 1978 to 2005. The financial support granted to us by FAMSI enabled the creation of four lines of research: 1) packing and preventive conservation; 2) osteobiography; 3) mortuary treatments; and 4) population genetics. Immediately, a detailed exposition of the work and its results up to the present moment will be given.

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Figure 1. General view of the archaeological zone of the Great Temple in México City.

The bone collection in study

For the present study the human remains found in 19 offerings in the Great Temple of Tenochtitlán were analyzed. This place symbolizes the axis mundi for the Mexicas. The deposits were temporarily situated in the period comprehended between 1440 and 1502 A.D., which corresponds mostly to stage IVb (1469-1481 A.D.). The total number of bodies studied was 107[1]. From these, seventy-four were recovered in the context of offerings and correspond to skull masks, decapitated skulls, tzompantli skulls, isolated remains and a primary context.

Figure 2. Platform from stage IVb, where 90% of the bone collection was recovered.

[1] The corresponding sample was completed with the human remains found in the construction fillings. Besides, an analysis was carried out in 14 more individuals, coming from other contexts and sites, for they were considered important for comparison reasons.

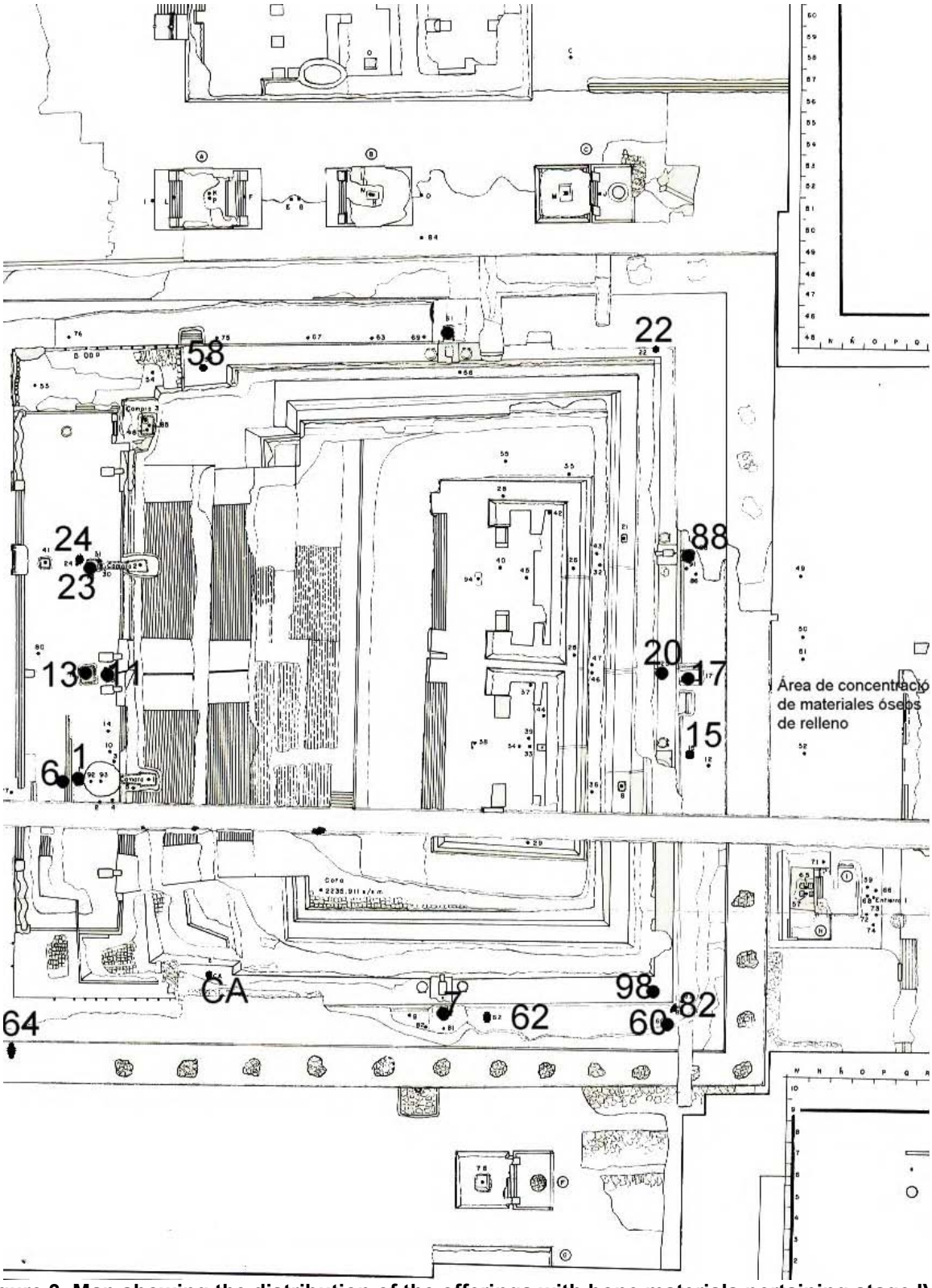


Figure 3. Map showing the distribution of the offerings with bone materials pertaining stage IVb.

Human sacrifice and mortuary treatments

By considering the characteristics of the ritual deposits and the information provided by the osteologic analysis, we were able to corroborate that the remains found in the analyzed offerings correspond to sacrificed individuals[2]. The various forms of ritual deprivation of life will be described in detail in the final publication of the present investigation.

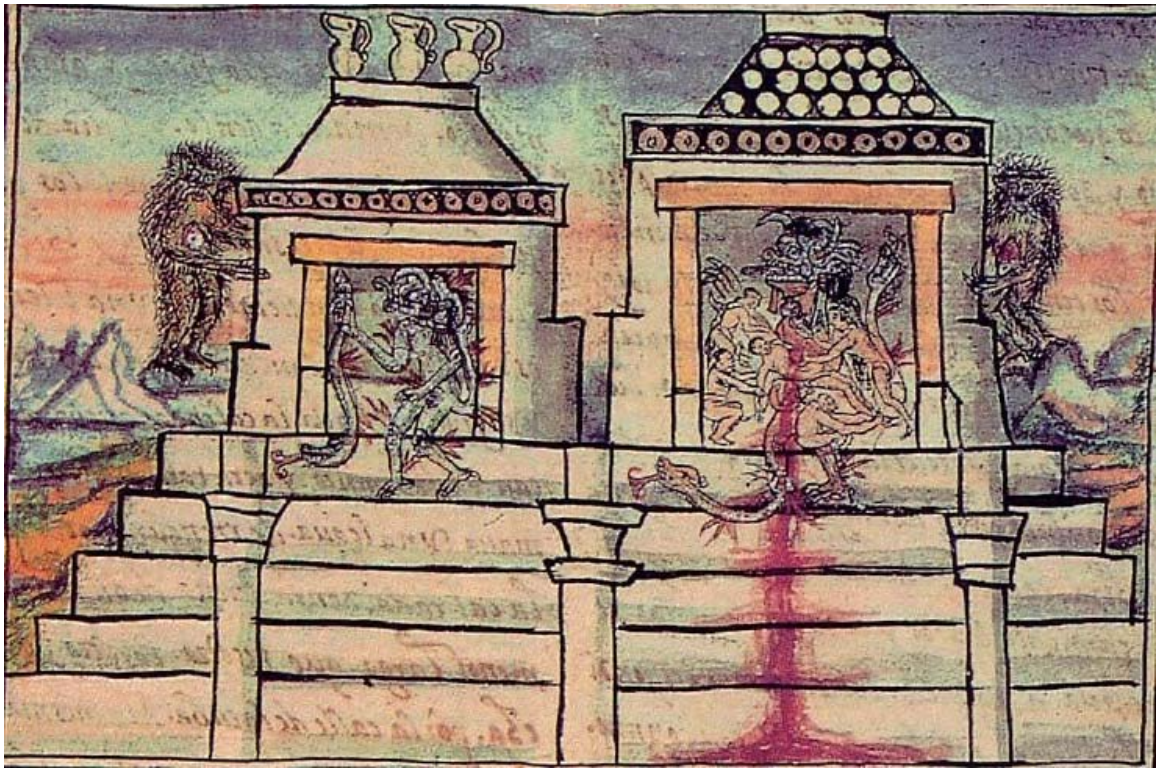


Figure 4. The Great Temple of Tenochtitlán. Sacrifice in the oratory of Huitzilopochtli, *Duran Codex*, 1995, plate 30.

With regard to mortuary treatments it is important to state that under this category we classified the cultural modifications manifested in the human remains, which in turn transform these remains into offerings as well. It is crucial to establish a distinction of the marks carved in the bones according to the conditions surrounding the death–*postmortem, perimortem or antemortem*,–since this information provides an insight into the general sequence of the ritual. In addition, a special emphasis has been made in the comparison of the archaeological evidence with the forensic information and the

[2] The funerary contexts were analyzed in a previous investigation (Chávez, 2002).

muscular and skeletal anatomy. This type of perspective allows a better understanding of the sacrificial phenomenon and the procedures carried out by Mexica priests.

Methodolgy

To analyze the materials, field reports were consulted and the remains corresponding to the same offering were studied in conjunction. This caused a delay in the analysis, for the materials deposited in the museum storeroom had to be put together, as well as those kept in permanent exhibition. In this manner, the following issues had to be overcome: problems with field records, separation of mixed remains, calculation of a minimum number of individuals and restoration of the elements. Considering that the majority of the materials were excavated around three decades ago, the preventive conservation program turned to be of utmost important since it will guarantee the conservation of the collection in the future[3]; we are therefore truly grateful to FAMSI for their generous support to make this program feasible. The following figures illustrate, in a graphic manner, this part of the present work.

Figure 5. Aspect of the original packing of bone materials of Offering 17.

[3] Approximately 90% of the collection had to be restored, thus the original chronogram of this investigation was considerably delayed.

Figure 6. Aspect of bone materials in which one can appreciate *postmortem* fractures produced by the compression of sediments in the context. Offering 17.

Figure 7. Bone materials from the storeroom and from the permanent exhibition. Offering 20, NMI 11.

Figure 8. Restoration process of a decapitated skull. Offering 17.

Figure 9. Packing of a skull mask, level 1. Offering 15.

Figure 10. Packing of a skull mask, level 2. Offering 15.

The conservation program consists of the diagnosis of every piece, cleaning and gluing together of fragments, as well as the reversion of old restoration processes when these were compromising the analysis and the stability of a piece. Each element was packed individually, using acid-free materials such as tybek and etaphon rigid supports.

Posterior to restoration, an analysis of skulls was carried out; this was divided in ostebiography and tafonomy. As part of the first, main characteristics of the individual were recorded, such as age, genre, health-disease conditions, skull deformation, and dental mutilation, among others. On the other hand, in the second group, the general sequence of mortuary treatments carried out by Mexica priests was recorded. Similarly, a sampling for DNA extraction was undertaken. The main results stemmed from these analyses are described bellow.

Osteobiography

In general terms it was corroborated that most of sacrificed individuals were males. Nevertheless, remains of infants and women have been detected with the same mortuary treatments. Likewise, the majority of sacrificed persons were between 20 and

30 years old; the absence of people elderly and infants younger than three is to be noted. Graphs summarizing this information are presented below[4].

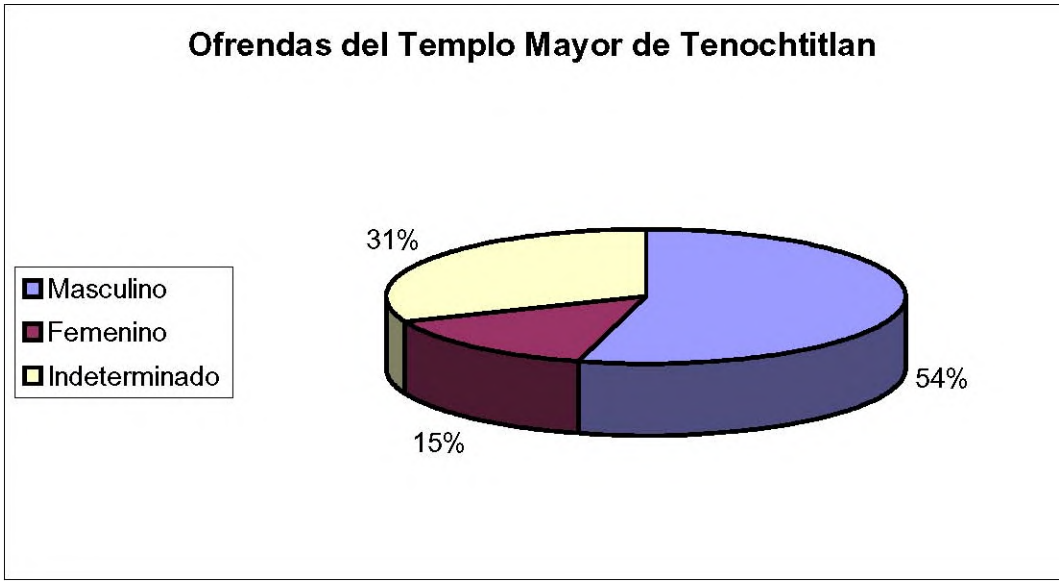
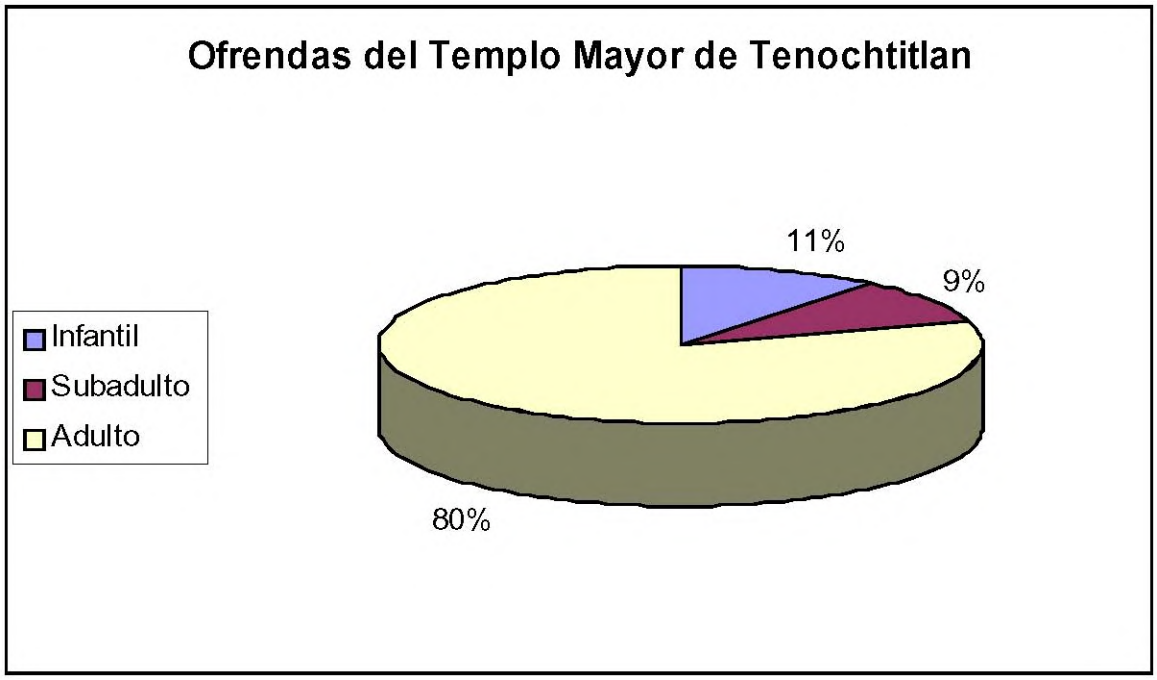


Figure 11. Genre determination. Values correspond to the sample pertaining offerings with NMI 74.



[4] A large quantity of individuals could not be classified according to genre; this quantity was incremented by the child and sub-adult populations, as well as by the decayed state of numerous skulls. An evaluation to undertake anthropometric techniques and DNA analysis will be pondered later.

Figure 12. Age determination (in general). Values correspond to the sample pertaining offerings with NMI 74.

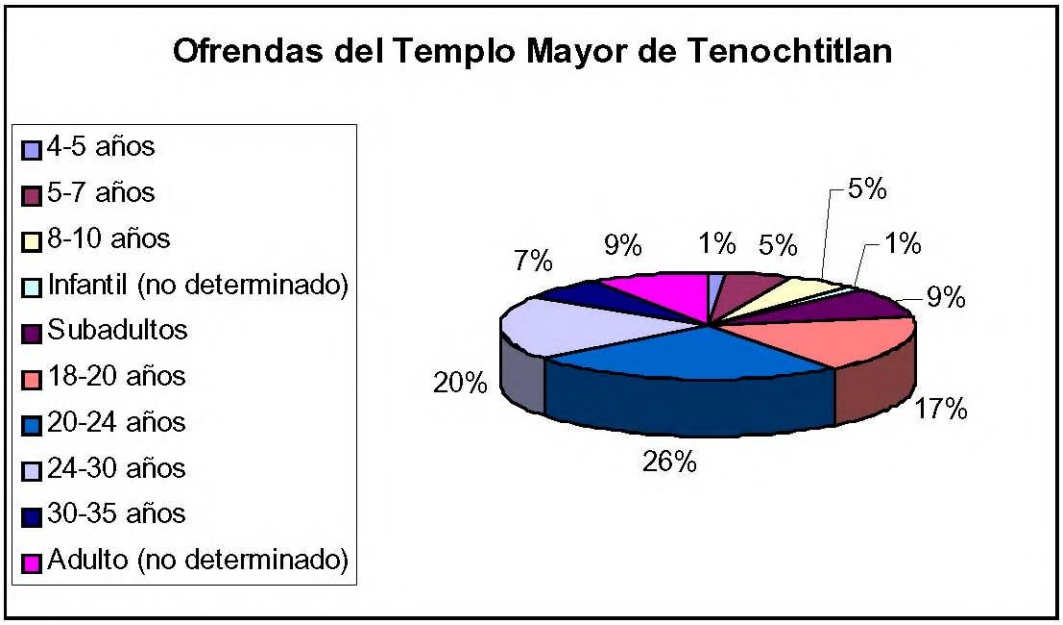


Figure 13. Age determination. Values correspond to the sample pertaining offerings with NMI 74.

A good health condition was found in the population, except for some ailments in the oral cavity, such as first and second degree caries as well as dental calculus. Few cases of porotic hyperosteosis and cribra orbitalia were registered, as well as examples of nasal fractures occurred long before death. A severe infectious process in the maxillary of a male individual stands out and a frontal *perimortem* fracture, probably causing the death of a second male. The more relevant examples are being selected to undergo helical tomography, under the auspices of CT Scanner Mexico. There is not a selection pattern based on the health-disease condition of the individuals, as was detected in children sacrificed to Tláloc (Román and Chávez, 2005). This finding is logical if we consider that one of the main sources of captives was war. It is also feasible that among the sacrificed were *nextlahualtin* ("payments"), *xipeme* (sacrificed in honor of Xipe Tótec) and *ixipitla* (God representations).

One of the observed characteristics in the collection was the presence of some cases of erected tabular skull deformations and dental mutilations, treatments associated with the elite, not very common in Tenochtitlán[5].

[5] These individuals are priority for population analysis.

Tafonomic analysis

The first aim of this part of the study was to reconstruct the general sequence of the preparation of the bodies. The marks encountered on the bones were registered and contrasted with the muscular and skeletal anatomy, which conditions the cultural modification of human remains. The marks found were mainly of the *postmortem* type; such would be the case of the following procedures: skin stripping, disjunction, flesh ripping, bone scraping, cleavage by abrasion and intentional fractures.

The contrast of materials with the muscular and skeletal anatomy was divided in two phases: observation of forensic cases and experimental (in isolated biological materials)[6]. Likewise, the observation of everyday routine carried out in the amphitheater of the Faculty of Medicine, allowed us to witness various procedures, such as flesh ripping, disjunction, and application of indirect heat to bone tissue, similar to those performed in the collection used in this study (González Reyna, personal communication, January 2006).

The experimental part carried out with isolated biological materials enabled the observation of cut wounds inflicted by diverse tools. In this manner a data bank is being formed in which indentations caused in known conditions are filed, based on the technique proposed by Velázquez (2004). In the following text, a general description of the main forms of ritual death and mortuary treatments deduced from the archaeological evidence are described.

Sacrifice by heart extraction

The infant encountered in Offering 111 was the only currently archaeological evidence of this type of sacrifice found in this building[7].

[6] This was possible thanks to the auspices of the Faculty of Medicine at the University of México (UNAM).
[7] Currently an article is in preparation with López-Luján and Quezada Ramírez as co-authors.

Figure 14. Offering 111, Great Temple. General view.

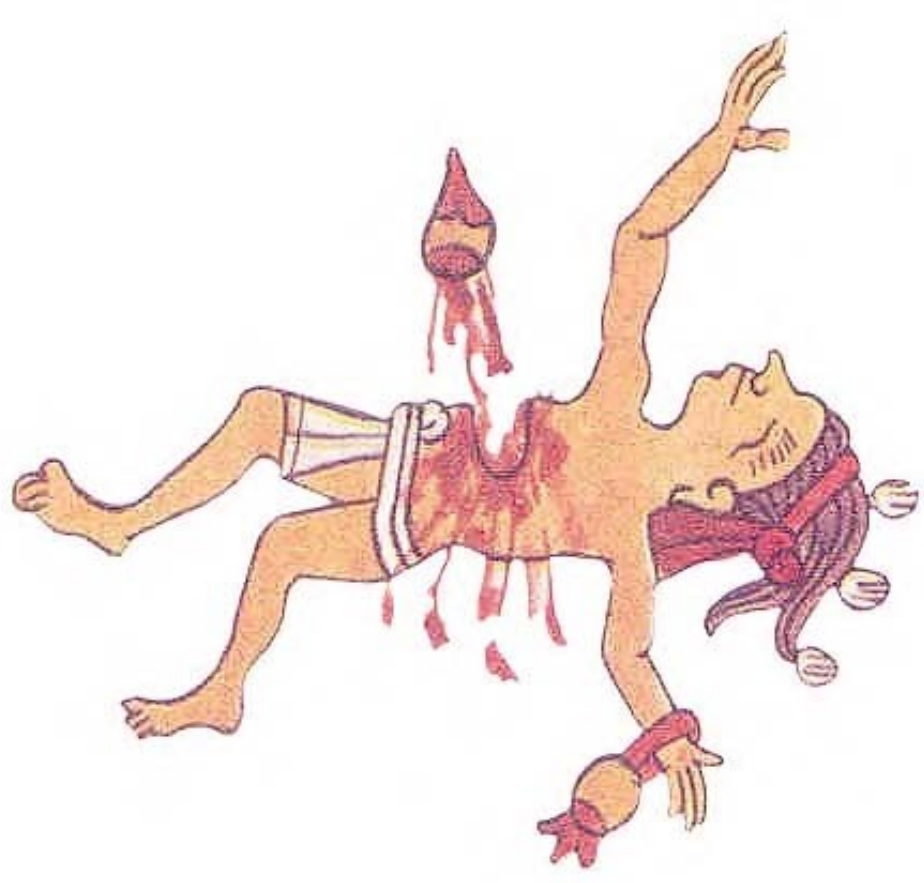


Figure 15. Sacrifice by heart extraction. *Tudela* Codex.

From the osteologic information, the following general sequence could be drawn. It is feasible that the infant was laid in the sacrificial stone as mentioned by historical sources. The indentations in the inner part of the ribs show that the entrance to the thorax was by way of the abdominal cavity. The priest must have slid his hand behind the heart for there is the presence of marks near the costo-condral joint. Subsequently, he cut the arteries and veins, by using the inner side of the ribs as support surface; a repetitive print pattern is evident[8]. Finally, the child was placed at the feet of the staircase leading to the oratory of Huitzilopochtli.

[8] The experimental work showed that these marks exhibited an exceptional resemblance with those made with the live edge of obsidian slivers.

Figure 16. Cut marks in the inner part of the ribs. Offering 111.

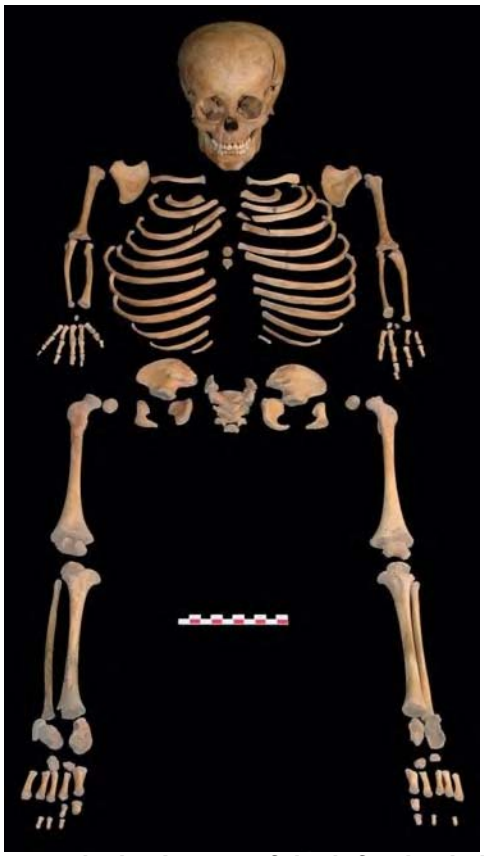


Figure 17. Laboratory analysis. Aspect of the infant's skeleton. Offering 111.

Figure 18. General sequence followed in the infant's sacrifice, Offering 111.

Decapitation: Trophy skulls, Tzompantli skulls and elaboration of skull masks

The registered marks indicate that Mexica priests handled diverse decapitation techniques. Some marks corresponded to cuts inflicted on the articular facet with fine tools, probably obsidian knives[9]. Meanwhile, other marks identified blunt force trauma made with tools, probably flint or other hard stone. These indentations usually presented a "v" section and were localized in the vertebrae, which suggests the intention of severing the spinal cord by cutting the vertebral disks[10].

All cases of decapitation were performed with the individual lying on his back. No matter the applied technique, it is a fact that priests possessed a privileged anatomical knowledge, reflected in their level of specialization. For this motive, they generally decapitated between the fifth and sixth cervical vertebrae[11].

[9] In a similar manner to what has been reported for Teotihuacán (Sugiyama and López-Luján, 2006).
[10] Experimentally, a bifacial flint knife may cause indentations of this type.
[11] We have to bear in mind that the first cervical vertebrae are designed for a special biomechanical function, head movement and support.

Figure 19. Example of a mark corresponding to short blunt trauma on the vertebral surface.

Figure 20. Example of a cut mark on the articular facet (C5).

By considering the anatomical characteristics, the depth of the marks and the absence of metallic instruments, it was concluded that the cause of death was not decapitation. Sliced throat, blunt force trauma, or heart extraction, just to mention a few, could have been the cause of death of these individuals. One case stands out; it refers to a male person presenting a depressive fracture and blood infiltration, corresponding to a blunt force blow on the frontal lobe. It suggests a *perimortem* wound linked to either a violent confrontation or a sacrificial practice.

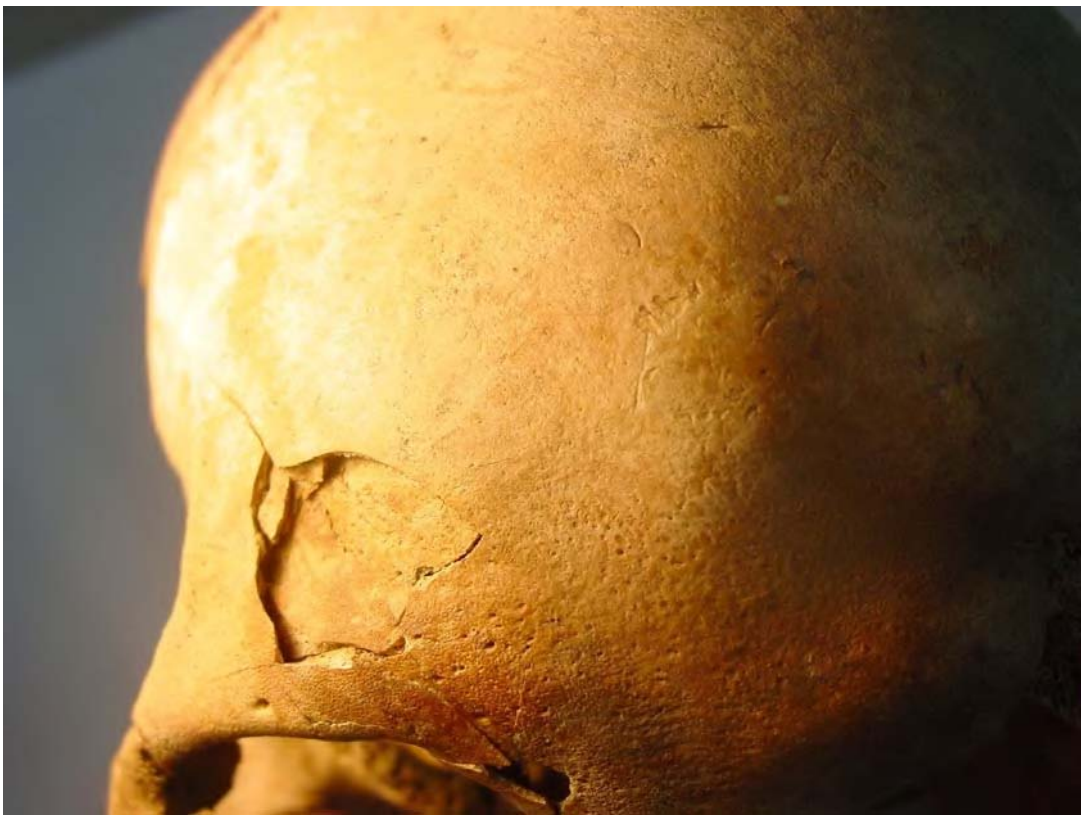


Figure 21. *Perimortem* fracture probably related to the cause of death.

Figure 22. Individual with *perimortem* fracture (lateral view), in which the *postmortem* treatment can be appreciated.

Figure 23. Trophy skulls. Last deposit level in Offering 98, Stage IVb.

The deposit of trophy skulls is related to the consecration of the buildings as it is illustrated in the *Borgia Codex*. In the case of the Main Temple, skulls were deposited keeping the flesh intact, inside a cavity containing the offering.

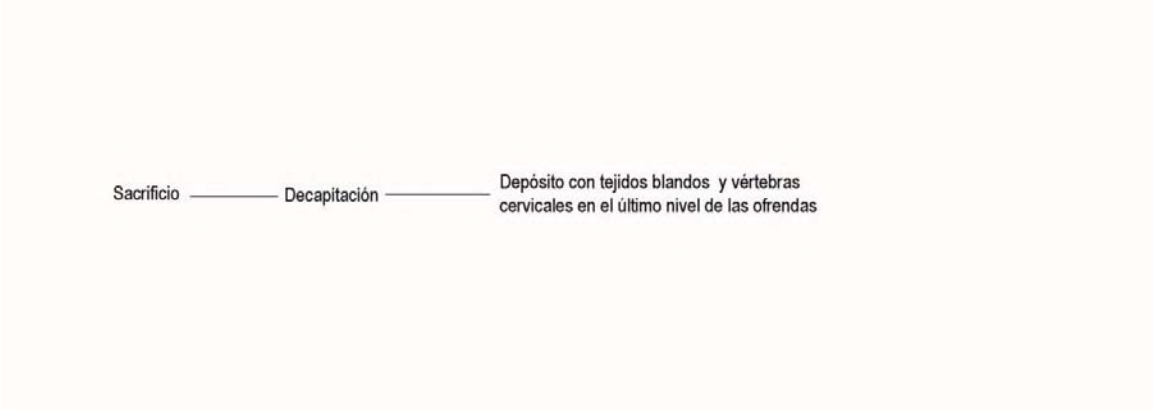


Figure 24. General sequence in the trophy skull deposit.

Figure 25. Burial of a trophy skull inside a temple. *Borgia Codex*, plate 4.

In reference to tzompantli skulls, their preparation implicated decapitation, flesh ripping, excision of cephalic mass and the removal of other soft tissues. Subsequently, two circular perforations were made, fracturing the temporal and part of the parietal bones by percussion. It seems that this procedure was carried out with a sharp instrument as shown in the archaeological evidence.

Figure 26. Marks left by the instrument used to fracture the temporal and parietal bones.

Figure 27. Marks left by the instrument used to fracture the temporal and parietal bones.

Figure 28. Skull exhibiting indirect exposure to fire. It was probably discarded as a consequence of bursting.

Other treatment practiced was the indirect heat exposure (boiling). It was probably used to help in the removal of soft tissues and excising the encephalic mass.

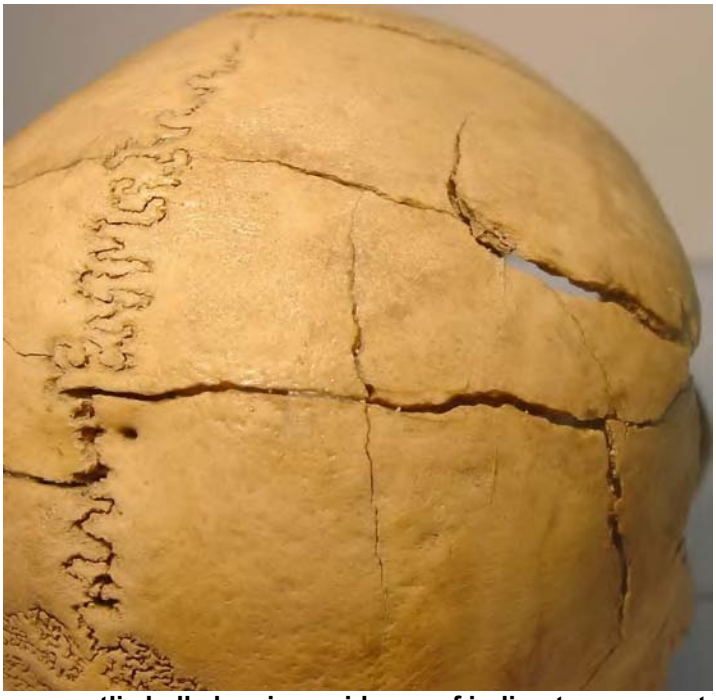


Figure 29. Tzompantli skull showing evidence of indirect exposure to fire. Detail.

All individuals registered marks corresponding to the main muscular insertions, thus implicating that they were ripped of their flesh before taking them to the Tzompantli.

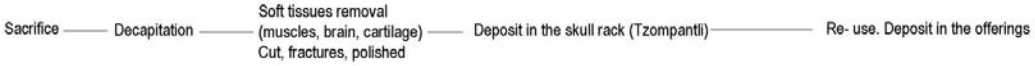


Figure 30. General sequence showing the preparation of a Tzompantli skull.

Skull masks

The majority of the masks presented evidence of two perforations in the temporal area identical to those carried out in the tzompantli. This might implicate re-utilization, when

they still kept certain plasticity and were modifiable. For the preparation, the parietals, occipital and part of the temporal areas were suppressed; to achieve this, combined techniques, such as percussion and cleavage by abrasion, were employed. In some cases conch and pyrite incrustations were embedded in the orbits, as well as flint knives in the oral and nasal cavities. Skull masks occupied the same level in the offerings where the effigies of gods were placed. Given its extraordinary iconographic resemblance, these masks are associated with death deities.

Figure 31. Mictlantecuhtli, God of death. *Borgia Codex*.

Figure 32. Skull mask from Offering 6. This mask shows the same lateral perforations encountered in Tzompantli skulls.

Figures 33 and 34. Mask elaborated by using the cut by abrasion method.

Some examples were found showing no circular perforations. In contrast, portions of frontal end temporal bones were suppressed using the cut by abrasion technique.

Figure 35. General sequence of masks pertaining to Tzompantli.

In all cases, masks showed signs of flesh scraping; such marks corresponded with muscular insertions and ligaments. As a result of the complexity of facial anatomy, these marks were more evident in the insertions of masticatory muscles.

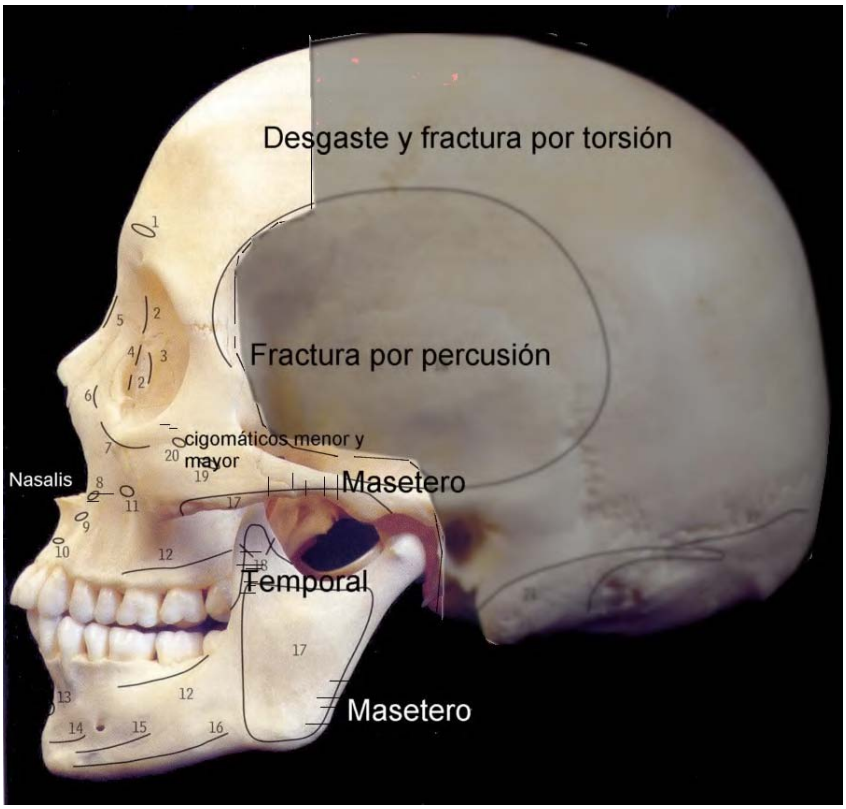


Figure 36. Example of the anatomical correspondence between cut marks and fractures.

Other relevant finding was the presence of masks composed of two individuals. In these cases, the mandible keeps a certain proportion with the mask; this implies that the maker had a variety of human remains so he could choose the more appropriate.

Figure 37. Skull mask composed of an adult female mandible and the facial skull of a child between 5 and 7 years old.

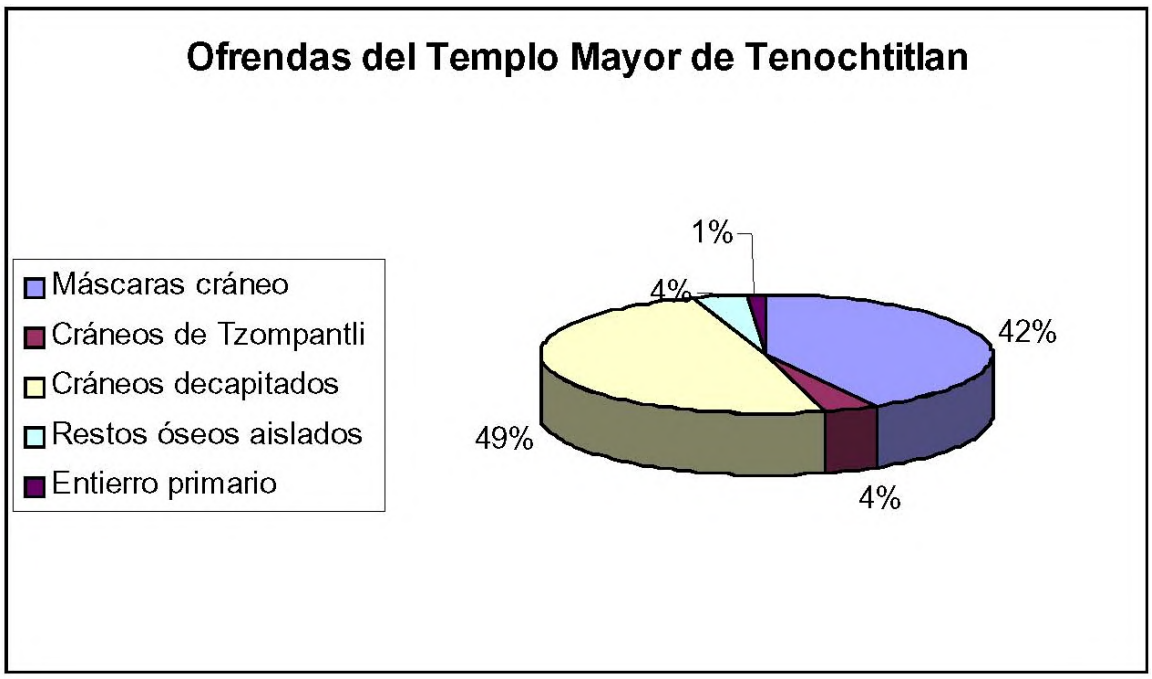


Figure 38. Bone material comprising the offerings in the Great Temple. Based on MNI 74.

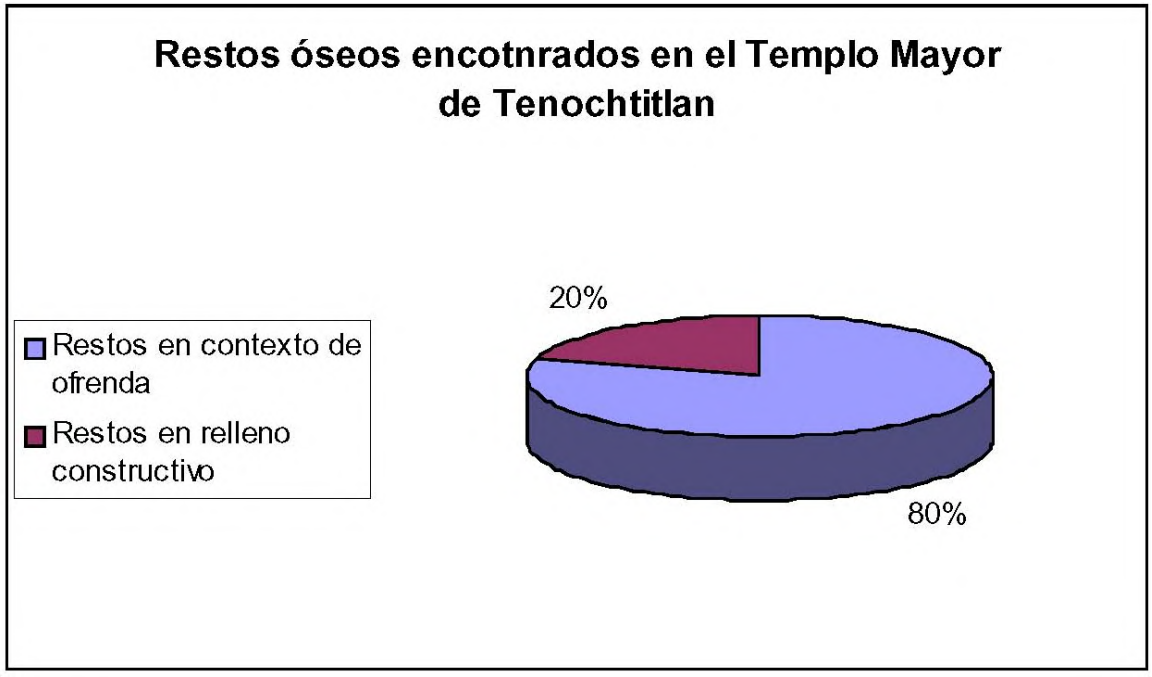


Figure 39. Bone material pertaining to all the individuals found in the Great Temple (offerings and materials used as construction fillings). Based on MNI 93.

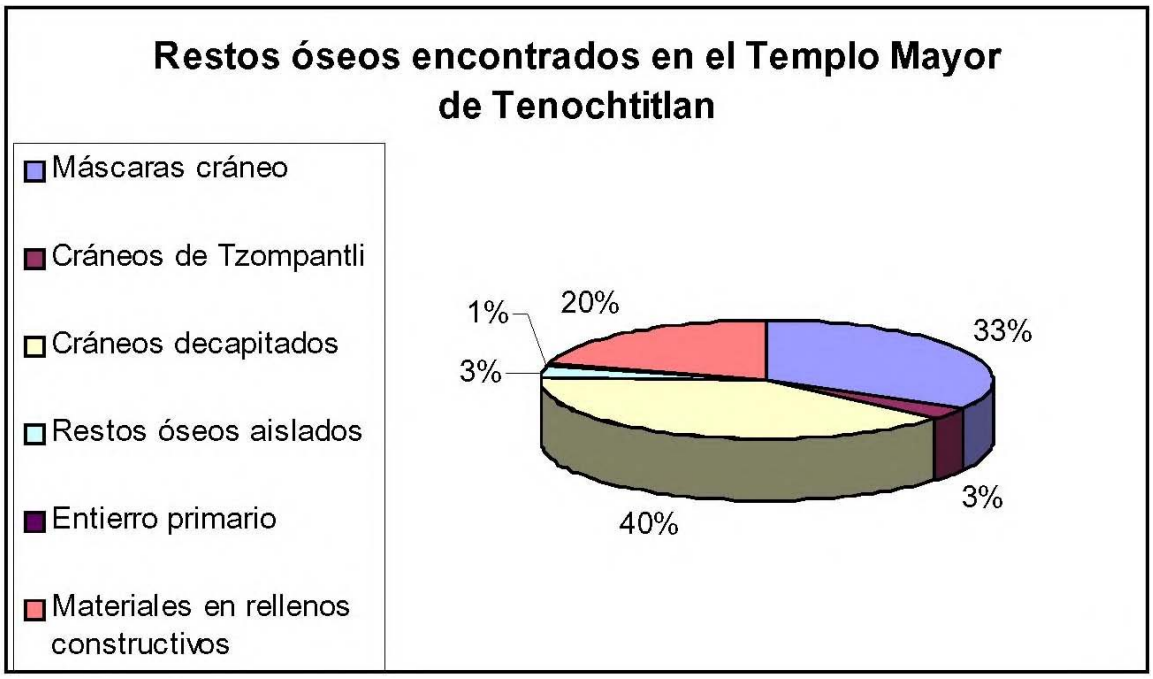


Figure 40. Bone material pertaining to all the individuals encountered in the Great Temple (offerings and in construction fillings). Based on NMI 93.

Population analysis based upon DNA extraction

A collaboration agreement was established with the Laboratory of Molecular Biology in CINVESTAV in charge of Dr. Lourdes Muñoz. One of the aims of this collaboration was to optimize costs when analyzing the whole collection. This analysis was performed by the archaeologist Diana Bustos as part of her degree thesis. The objective of this thesis was to build a phylogenetic tree based on mitochondrial DNA extraction and analysis of the bone collection to identify their ethnical groups. To accomplish this, DNA segments corresponding to the four founding haplotypes and two hypervariable regions were looked for, using the polymerase chain reaction technique (PCR) and specific primers.

Contamination was one of the main problems in the study of this collection; this refers to substances derived from the chemical exchange between bone and soil or from DNA belonging to other organisms. This hinders the activity of the enzyme Taq polymerase essential in any PCR procedure. Besides, exogenous human DNA represented the main problem, since most of the sample was excavated in the 80s and was handled without adequate measures. Preliminary trials were attempted and it was concluded that some problems could be overcome by using dental pieces. A lower incidence of contamination has been reported in DNA extractions from pulp chamber, as well as a higher yield in genomic extract. In some cases, it was possible to get samples from both bone and teeth; these will be used to establish comparisons of yield efficiency and inhibitor incidence between both types of tissue, to evaluate the techniques.

The outcome of these findings will be conveniently published. The extraction method in a chloroform-phenol mixture showed a high efficiency in the recovery of DNA fragments in good condition, therefore, good results were accomplished during the amplification and sequencing steps and the further integration of phylogenetic relations. With this method it was possible to recover fragments of up to 500 bp and at the same time eliminated a large amount of contaminants (Pääbo, 1983).

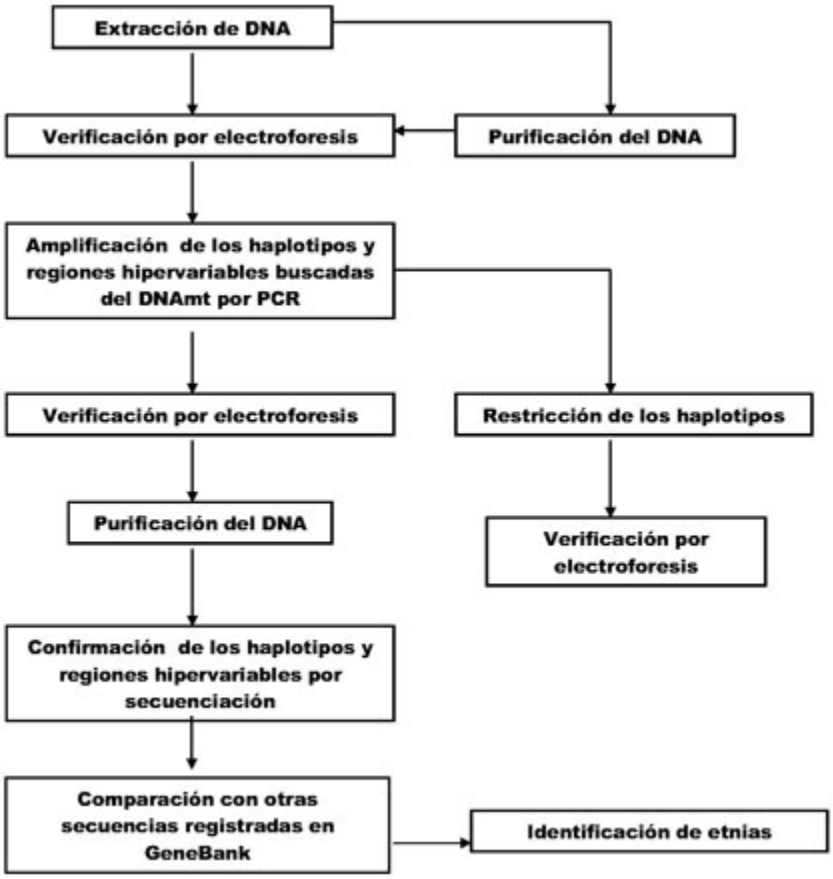


Figure 41. General methodology followed in population analysis.

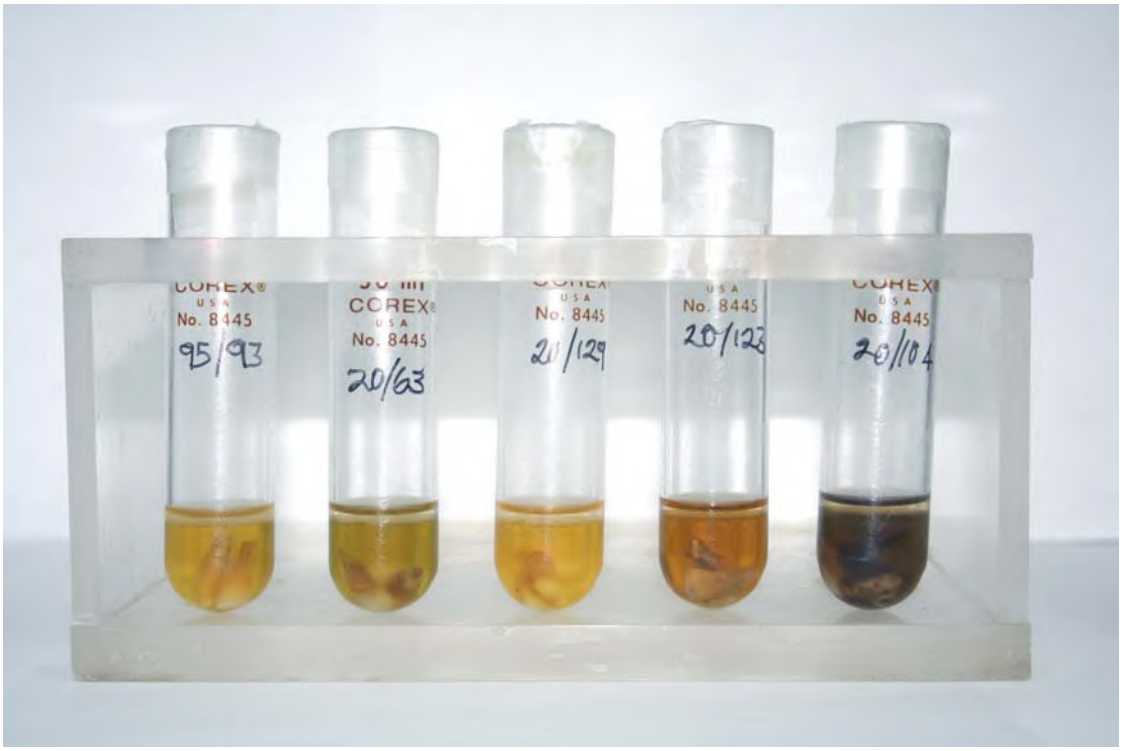


Figure 42. Dental pieces immersed in the phenol phase.

Preliminary results

Even though in the case of the dental pieces found in the Great Temple, mostly fragments of around 200 bp were obtained, the yield rate was rather good; 88.6% of the bone collection contained DNA in optimal conditions for analysis. This achievement was due to the improvement in the methodology concerning the preparation of dental pieces, following the method suggested by Calvo *et al.* (2001). To comply with this method, we cut the dental pieces into slices with a microtome[12].

[12] To avoid overheating of the piece (DNA denatures at 94° C), the sagittal sections were made starting from the root, working in short time intervals, and restarting sectioning once the tooth was completely cold.

Figure 43. Molars sectioned with a microtome.

To reach our aims we had to work with DNA extracts containing a minimum of inhibitors, as well as to establish specific conditions in the thermocycling parameters and quantity of reagents to try and preserve old and damaged DNA. Working with this type of DNA requires a strong support with regards to materials involved in the experimental part as well as longer time periods to produce good results as that when one uses modern DNA. We have obtained good results in this enterprise in a considerable short time due to the academic and technical support provided by Dr. Muñoz and her group, as well as for the financial capacity in the acquisition of reagents and materials that FAMSI's grant made possible.

In some experiments the extracted DNA yielded negative results because it was partially denatured or mixed with a large amount of contaminants. However, a pre-purification step or an amplification of DNA material yielded positive results.

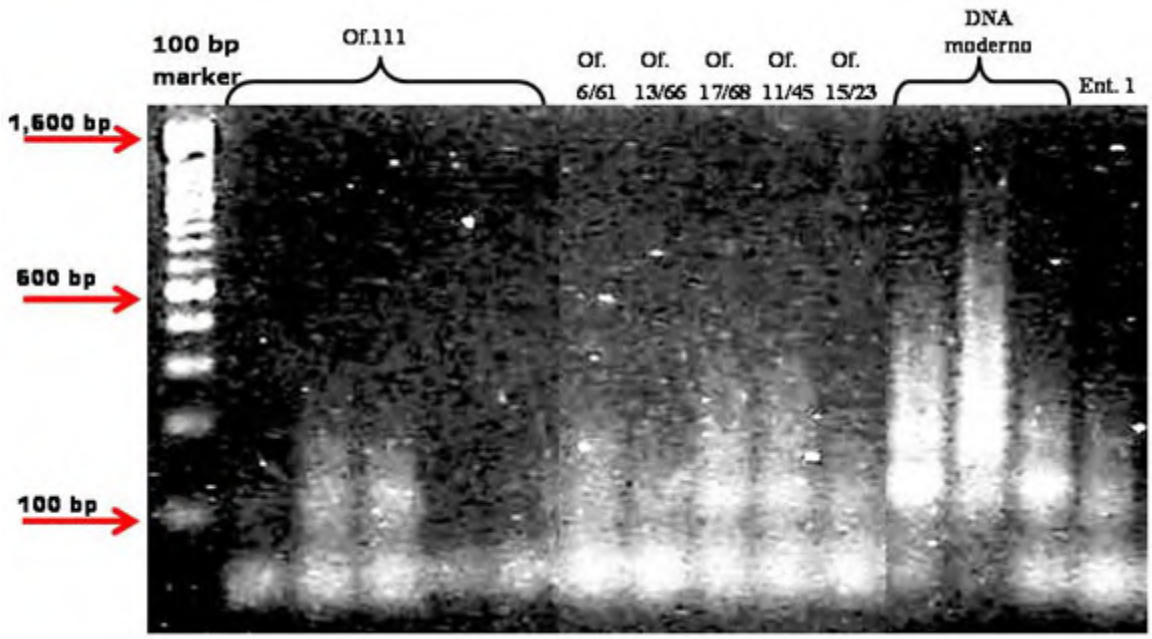


Figure 44. Example of 120 bp DNA sequences posterior to amplification to identify haplotype A.

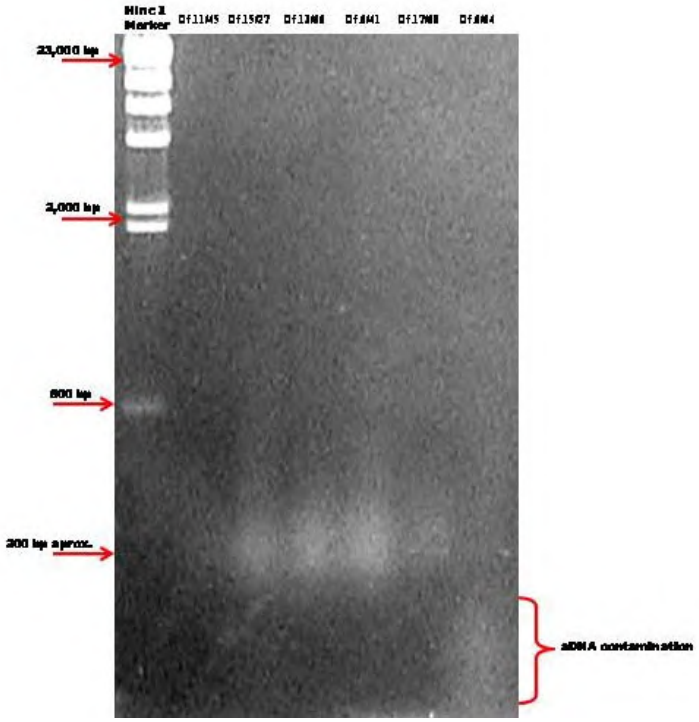


Figure 45. DNA total extraction. In certain cases DNA was not detectable until an amplification step was performed, as in the case of offering 11/45, which gave positive for haplotype A.

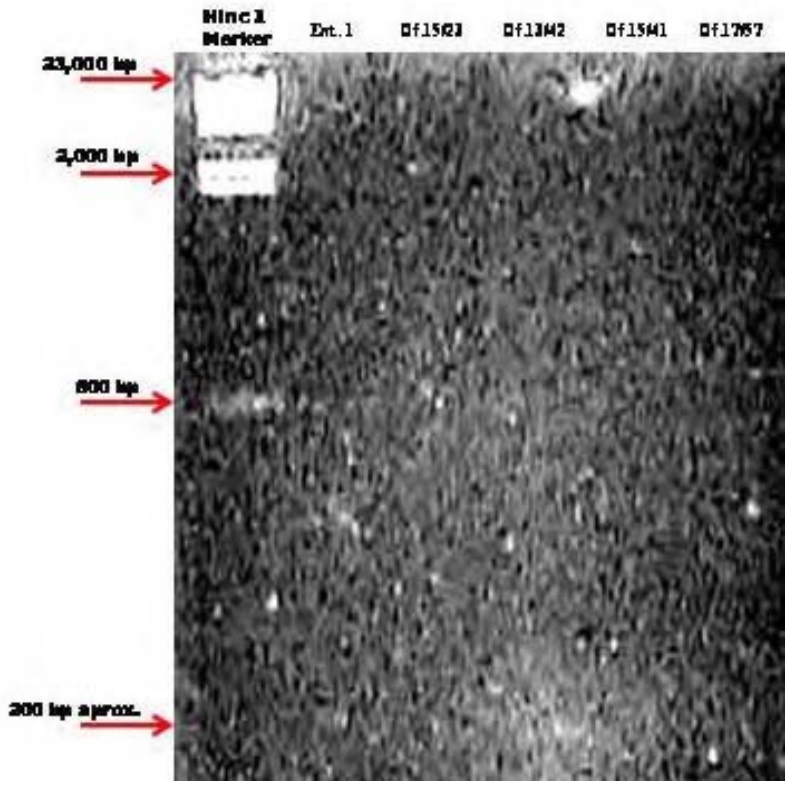


Figure 46. No total DNA extraction was detected for Burial 1 and offering 15/23. After DNA amplification both gave positive for haplotype A (120 bp).

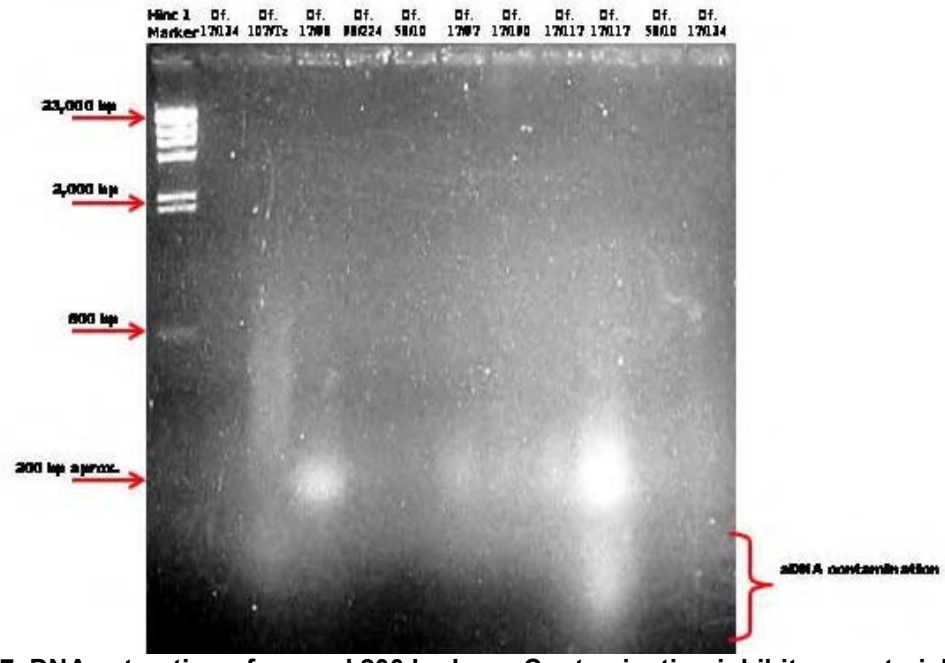


Figure 47. DNA extraction of around 200 bp long. Contaminating inhibitory material may be appreciated below.

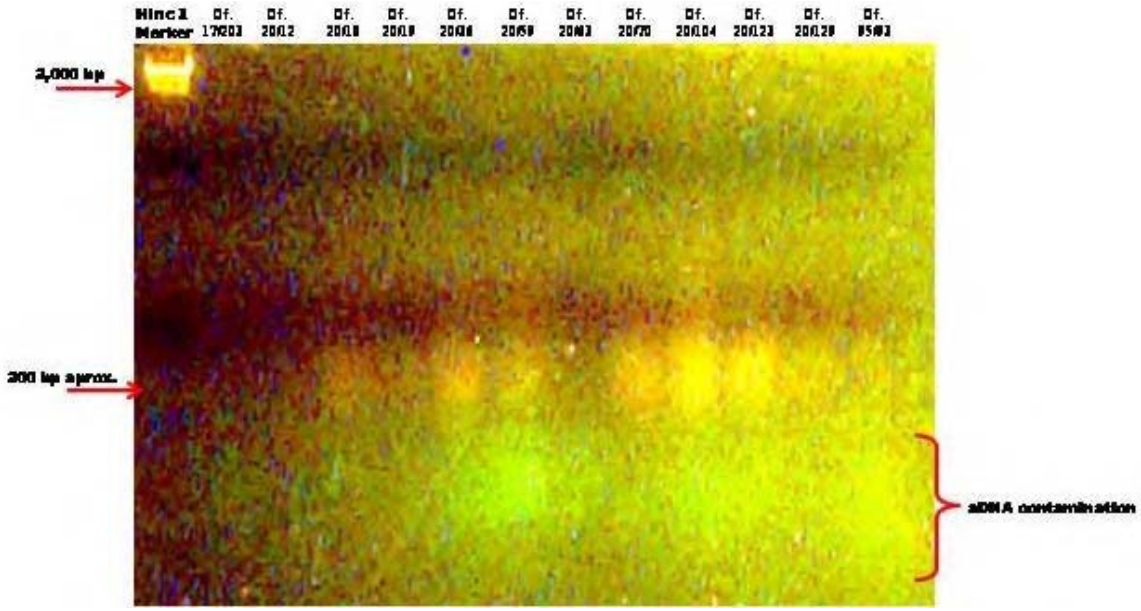


Figure 48. Under UV illumination, DNA fluoresces in a different color than the contaminating inhibitory material (green color).

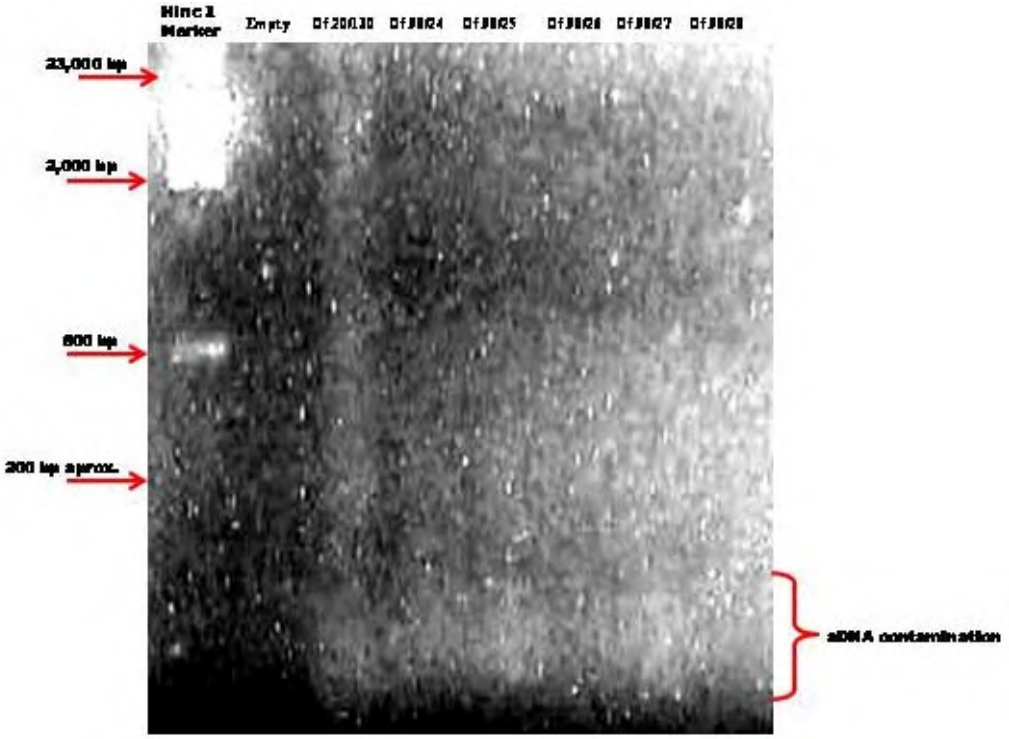


Figure 49. DNA extract is evident in the first three lanes, though we can not discard DNA presence in the remaining lanes. At the moment we are working with the amplification of this material.

As has been mentioned, the extraction of high molecular weight DNA, that is, DNA in good conditions and uncontaminated is a hard process. Extraction of this kind of DNA has been possible as can be seen in the Table summarizing the main current results:

	Muestra	Peso	Tipo de muestra	Estado del DNA
1	Ent. 1	1.10 g	diente	Amplificación del haplotipo A
2	Of. 6/41	1.2 0 g	hueso	Extracción
3	Of. 6/64	1.10 g	hueso	Extracción (muy degradado)
4	Of. 11/7	1.09 g	diente	Extracción
5	Of. 11/45	1.50 g	diente	Extracción (muy degradado)
6	Of. 11/54	1.57 g	diente	No amplifica
7	Of. 11/83A	0.96 g	diente	Secuenciación de haplotipo A y HVII
8	Of. 11/83B	0.95 g	hueso	Amplificación de haplotipo A y HVI
9	Of. 13/42	1.40 g	diente	Extracción
10	Of. 13/58	0.93 g	hueso	Amplificación de haplotipo A y HVI
11	Of. 13/64	0.88 g	hueso	Amplificación de haplotipo A
12	Of. 13/66	1.50 g	hueso	Extracto (no obtuvimos DNA en un primer intento con diente de 1.77 g)
13	Of. 15/23	1.90 g	diente	Amplificación de haplotipo A
14	Of. 15/27	1.50 g	hueso	Extracción
15	Of. 15/41	1.60 g	diente	No se observa extracto
16	Of. 17/57	1.50 g	diente	No se observa extracto
17	Of. 17/68	1.40 g	diente	Extracción
18	Of. 17/97	1.70 g	diente	Extracción
19	Of. 17/98	1.98 g	hueso	Extracción
20	Of. 17/117	3.10 g	hueso	Extracción
21	Of. 17/190	1.41 g	diente	Extracción
22	Of. 17/134	0.72 g	diente	No se observa extracto
23	Of. 17/203	0.69 g	diente	No se observa extracto
24	Of. 20/12	1.49 g	diente	No se observa extracto
25	Of. 20/18	1.80 g	diente	Extracción
26	Of. 20/19	1.60 g	diente	Extracción (muy degradado)
27	Of. 20/36	1.01 g	diente	Extracción
28	Of. 20/59	2.75 g	diente	Extracción
29	Of. 20/63	0.91 g	diente	No se observa extracto
30	Of. 20/70	1.59 g	diente	Extracción
31	Of. 20/104	2.00 g	diente	Extracción
32	Of. 20/123	1.28 g	diente	Extracción
33	Of. 20/129	0.70 g	diente	Extracción
34	Of. 20/130	1.80 g	hueso	Extracción
35	Of. 58/10	1.42 g	diente	Extracción (muy degradado)
36	Of. 95/93	1.30 g	diente	Extracción (muy degradado)
37	Of. 98/24	1.50 g	diente	Extracción
38	Of. 98/25	1.60 g	diente	Extracción
39	Of. 98/26	1.09 g	diente	Extracción (muy degradado)
40	Of. 98/27	2.29 g	diente	Extracción (muy degradado)
41	Of. 98/28	1.70 g	diente	Extracción (muy degradado)
42	Of. 98/224	1.70 g	diente	Extracción (muy degradado)

43	Of. 107/Tz	0.30 g	hueso	Extracción (muy degradado)
44	Of. 111	0.92 g	hueso	Amplificación de haplotipo A, y HVI; Secuenciación de HVII (1er fgto.)
45	Momia infantil		Diversas muestras	Amplificación de haplotipo A, y HVI; Secuenciación. Comparación con el GeneBank

With regard to the studies of the child mummy found in Querétaro and with an antiquity of more than 2300 years, it was decided to include it in the sample, given its importance to understand early settlements and also to conform an information bank to make comparisons with the rest of the sample.

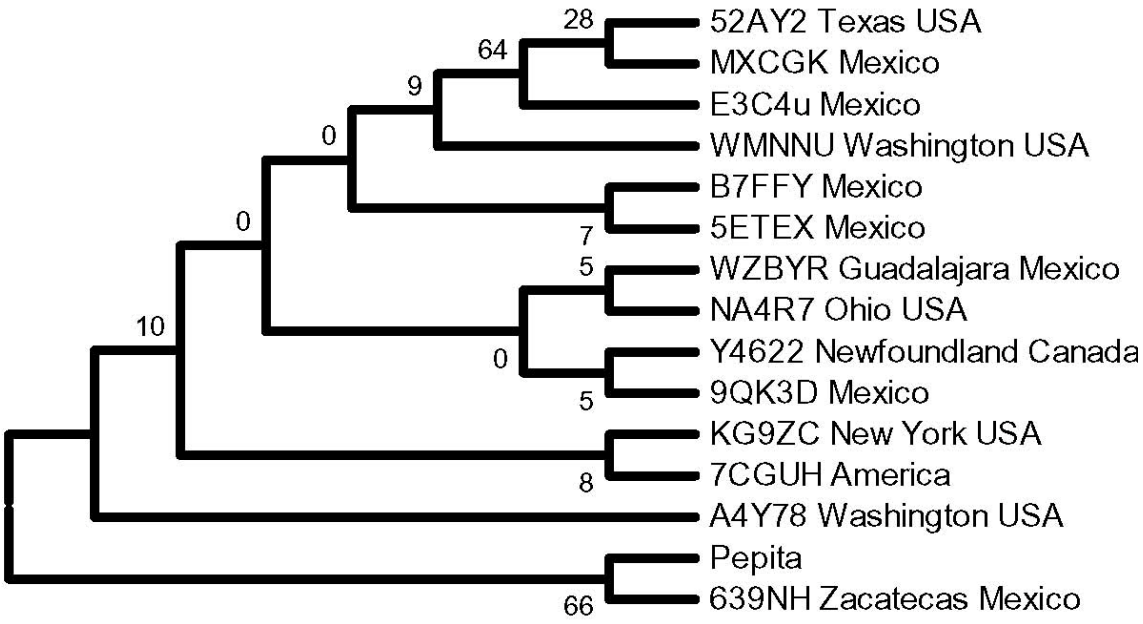


Figure 50. Phylogenetic analysis for the hypervariable region II of mitochondrial genomes close to mummy Pepita using the Neighbor-Joining method, with Kimura 2-p nucleotide substitution model and Bootstrap repetition numbers equal to 1000. MEGA version 3.1 software; MitoSearch data base.

As the DNA investigation progresses, outcoming information will be utilized for the integration and development of studies concerning the mapping of ancient and contemporary populations in México. The field of molecular anthropology is incipient within the research carried out in this country and needs to be further explored from an archaeological point of view. This will shed some light into understanding Mesoamerican migration movements.

Final considerations

The original chronogram was modified due to the complexity, unexpected size of the sample and its bad state of conservation. Nevertheless, the present study is planned to be finished by the middle of 2007, which implies the conclusion of the population analysis. From the comparisons made with our results and those of anthropometry, some cases will be selected to perform oxygen isotope analysis; this will enable a higher precision in establishing the origin of the individuals. Besides, other type of studies will be completed, such as helical tomography (up to the present moment two studies have been performed) and scanning electron microscopy.

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