Chapter 17

Trepanation in Prehistoric South America: Geographic and Temporal Trends over 2,000 Years

JOHN W. VERANO

Department of Anthropology, Tulane University, New Orleans, Louisiana, USA

Abstract

This article surveys trepanation practices in prehistoric South America, with a specific focus on trepanation techniques, success rates, and motivations for the procedure. The study is based on the examination of more than 600 trepanned skulls housed in various museums in Peru and the United States. The skulls were collected from archaeological sites throughout the Central Andes and coastal Peru, and date from ca 400 BC to ca 1,500 AD. Trepanation techniques, possible motivations for the procedure, and survival rates are found to vary significantly across time and space. The large size of this sample allows us to examine questions such as the evolution of trepanation techniques, the association between trepanation and skull fracture, and preferences in the location of trepanations.

Keywords: Trepanation, Skull Fracture, Surgery, Peru, South America

Introduction

In 1867 Paul Broca presented to the Société d’Anthropologie of Paris a portion of a skull he believed showed evidence of a trepanation performed on a living patient in prehistoric times (Broca, 1867). In subsequent decades, many more examples would be found by anthropologists exploring burial caves and tombs in the Central Andes, confirming Broca’s assertion that a form of cranial surgery was practiced in prehistoric South America. Trepanned skulls would also be recognized from Neolithic sites in western Europe, and subsequently from other parts of the Old World (Piggot, 1940; Lisowski, 1967). However, Andean South America retains the distinction of having produced more prehistoric trepanned skulls than the rest of the world combined, estimated at as many as 1,000 specimens (Stewart, 1958).

Although it is unclear why trepanation was so common in prehistoric South America, advances have been made in documenting its geographic and temporal distribution, as well as the possible motivations for the practice. Most studies have been limited, however, to collections from a single geographic area and time period (Tello, 1913; MacCurdy, 1923; Stewart, 1958) or skulls of uncertain provenience and antiquity (Weiss, 1958; Lastres and Cabieses, 1960; Rifkinson-Mann, 1988), making it difficult to identify tem-
poral trends and regional variation in techniques, survival rates, and possible motivation for the procedure. The present study, began with colleague J. Michael Williams in 1989, was designed to overcome the limitations of previous investigations by documenting as many collections of South American trepanned skulls as possible (Verano and Williams, 1992).

To date we have photographed and recorded detailed information on more than 600 prehistoric trepanned skulls housed in various museums in Peru and the United States (Verano, 1997). The collections we studied came from archaeological sites in coastal and highland Peru and highland Bolivia, and span approximately 2,000 years – from ca. 400 BC to the early part of the sixteenth century AD. In this paper we will focus on the Peruvian sample, which is significantly larger and therefore more useful for examining temporal and geographic variation in trepanation practices.

Materials and Methods

For each trepanned skull, we recorded data on geographic provenience, cultural association, age and sex, trepanation technique, location, size, and degree of healing, and evidence of skull fracture or other visible pathology. All skulls were photographed, and drawings were made of trepanations and fractures on standardized recording forms. Where possible, non-trepanned skulls from the same populations also were examined for healed and unhealed skull fractures, to provide a reference base for evaluating the frequency of head injury in these populations. The information was entered into a computer database, which permitted rapid searching by time period, cultural phase, geographic area, age, sex, or other criteria.

Results

Geographic and Temporal Distribution

The known geographic and temporal distribution of trepanation in Pre-Columbian Peru is indicated in Figure 1 and Table 1. The earliest trepanations come from a cemetery at the site of Paracas on the south coast of Peru and date to approximately 400 BC–200 AD (Tello and Mejia Xesspe, 1979). Following this early period of experimentation, trepanation seems to fall out of favor on the south coast. Trepanned skulls from other south coast sites may post-date this early period (Allison and Pezzia, 1976), but they lack secure cultural context and dating.

During the Early Intermediate Period and Middle Horizon, ca 200–1,000 AD, trepanned skulls appear throughout a broad area of the Peruvian and Bolivian highlands, as well as in the high jungle in the Chachapoyas region of northern Peru during the Late Intermediate Period, ca 1,000–1,470 AD (Jackobsen et al., 1987). A few examples are also known from the central Coast of Peru during the period of Inca domination in the fourteenth and fifteenth centuries AD (Uhle, 1903).

Unfortunately, the dating of most trepanned skulls in museum collections is uncertain,
variation in techniques, survival rates, and possible motivations for trepanning in the present study, began with colleague J. Michael Williams in 1979. The limitations of previous investigations by documenters of South American trepanned skulls as possible (Verano 1997). We have recorded detailed information on more than 600 skulls housed in various museums in Peru and the United States. The skulls we studied came from archaeological sites in coastal Peru and Bolivia, and span approximately 2,000 years – from ca. 400 BCE to ca. 1600 CE. In this paper we will focus on the significantly larger and therefore more useful for examining variation in trepanation practices.

Methods

We recorded data on geographic provenience, cultural association, technique, location, size, and degree of healing, and other visible pathology. All skulls were photographed, and images and fractures on standardized recording forms. Where possible, skulls from the same populations also were examined for healed fractures to provide a reference base for evaluating the frequency of fractures. The information was entered into a computer database, allowing for time period, cultural phase, geographic area, age, and sex.

Spatial Distribution

The temporal distribution of trepanation in Pre-Columbian Peru is not well understood. The earliest trepanations come from a cemetery at Chidaya on the coast of Peru and date to approximately 400 BCE–200 CE (Verano and Pezzia, 1979). Following this early period of experimentation, there is a period of favor on the south coast. Trepanned skulls from other sites from this early period (Allison and Pezzia, 1976), but they are not well-dated.

The Tiahuanaco period and Middle Horizon, ca 200–1,000 AD, trepanned the broad area of the Peruvian and Bolivian highlands, as well as the Chupacayas region of northern Peru during the Late Intermediate period (Verano and Pezzia, 1979). A few examples are also found in Peru during the period of Inca domination in the fourteenth century AD (Uhle, 1903).

Figure 1. Map showing regions where trepanation was practiced in prehistoric South America. See Table 1 for explanation of numbers and chronology.
as the majority were surface collected from disturbed tombs in the late-nineteenth and early-twentieth centuries, and in most cases little attention was given to identifying cultural context (Tello, 1913; Hrdlika, 1914). A small number of scientifically excavated specimens are known, however, and these allow us to assign approximate dates to collections with limited contextual data. Nevertheless, there remains some uncertainty about the earliest and latest dates for trepanning in most regions, as is indicated by the question marks in Table 1.

Demographic Composition of the Sample

Table 2 gives a breakdown of our sample by age, sex, and geographic provenience. Adult males are a clear majority, although women and children were also trepanned. Trepanations were found in several children under twelve years of age; the youngest was a child of two to three years. The higher incidence of trepanations paralleled the higher frequency of skull injuries in this group between skull trauma and trepanation.

Trepanation Technique

Four trepanation techniques were used in ancient Peru: grooving, scraping, and boring (Fig. 2) (Lastres and Calpito, 1978). Scraping was the earliest method – appearing on the southern coast – and it was apparently the tool used in the early intermediate period. Bifacial obsidian knives were apparently the tool used in the middle and late intermediate periods. The technique is also found here, as well as in the highlands of central Peru. Some central highland populations of the late Intermediate Period (Inca Empire) have been the tools used to trepan skulls, although this has been a detailed study of the cut marks themselves. Nevertheless, a study of this technique was capable of cutting bone by performing a circular cut on the living patient in 1944 using archaeological specimens (Andrade, 1944).

In general, a trend can be seen towards the reduction in trepanations through time, although there is substantial variability in the geographic areas (Table 3). Very large trepanations are typical of the early intermediate period (Fig. 3), while smaller and more consistent are the southern highlands at Inca sites (Fig. 4).

Healing

A significant percentage of Peruvian trepanned skulls showed evidence of healing following the procedure. Healing can be class...
repanned skull samples from various regions of Peru and Bolivia

Table 2. Geographic Distribution and Demographic Composition of the Sample. Adults of uncertain sex are excluded from the table.

<table>
<thead>
<tr>
<th>Region</th>
<th>Sample Size</th>
<th>Adult Males (%)</th>
<th>Adult Females (%)</th>
<th>Subadults (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Coast</td>
<td>60</td>
<td>65.0</td>
<td>30.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>457</td>
<td>56.7</td>
<td>31.5</td>
<td>8.3</td>
</tr>
<tr>
<td>Southern Highlands</td>
<td>86</td>
<td>61.6</td>
<td>31.4</td>
<td>7.0</td>
</tr>
<tr>
<td>Northern Highlands</td>
<td>2</td>
<td>–</td>
<td>100.0</td>
<td>–</td>
</tr>
<tr>
<td>Central Coast</td>
<td>4</td>
<td>100.0</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Lake Titicaca Area</td>
<td>12</td>
<td>50.0</td>
<td>50.0</td>
<td>–</td>
</tr>
<tr>
<td>TOTAL</td>
<td>621</td>
<td>58.1</td>
<td>31.7</td>
<td>7.6</td>
</tr>
</tbody>
</table>

a child of two to three years. The higher incidence of trepanation among adult males parallels the higher frequency of skull injuries in this group, suggesting a relationship between skull trauma and trepanation.

Trepanation Technique

Four trepanation techniques were used in ancient Peru: scraping, linear cutting, circular grooving, and boring and cutting (Fig. 2) (Lastres and Cabieses, 1960; Lisowski, 1967). Scraping was the earliest method – appearing on the south coast of Peru ca 400 BC. Bifacial obsidian knives were apparently the tool used in these early surgeries, as copper or bronze tools were unknown at this time. In contrast, the linear cutting technique is most characteristic of the central highlands, although trepanations by the scraping and boring and cutting technique are also found here, as well as in the southern highlands and high jungle of northern Peru. Some central highland trepanations show a combination of more than one technique, indicating that some experimentation occurred. Circular grooving appears late in the prehistoric record, and appears to have evolved in the southern highlands during the Late Horizon (Inca Empire). Copper and bronze knives and chisels have been recovered from central and southern highland sites, and these may have been the tools used to trepan skulls, although this has yet to be confirmed by detailed study of the cut marks themselves. Nevertheless, a Peruvian surgeon demonstrated that such tools were capable of cutting bone by performing a successful craniotomy on a living patient in 1944 using archaeological specimens (Anonymous, 1945).

In general, a trend can be seen towards the reduction in the size of trepanation openings through time, although there is substantial variability within time periods and geographic areas (Table 3). Very large trepanations are typical of the early skulls from the south coast (Fig. 3), while smaller and more consistent-sized trepanations are found in the southern highlands at Inca sites (Fig. 4).

Healing

A significant percentage of Peruvian trepanned skulls show evidence of healing, indicating survival following the procedure. Healing can be classified into three general catego-
Figure 2. Trepanation techniques in ancient South America: a. scraping, b. linear cutting. All skulls from the Museo Arqueológico de la Universidad San Antonio Abad, Cuzco, Peru.
Figure 2. Trepanation techniques in ancient South America: a. scraping, b. linear cutting. All skulls from the Museo Arqueológico de la Universidad San Antonio Abad, Cuzco, Peru.

Figure 2. Trepanation techniques in ancient South America: c. circular grooving, d. boring and cutting. All skulls from the Museo Arqueológico de la Universidad San Antonio Abad, Cuzco, Peru.
Figure 3. Large trepanation with evidence of short-term healing. Paracas, south coast of Peru. Museo Nacional de Antropologia, Arqueologia, y Historia, Lima, Peru.

Figure 4. Inca cranium with four well-healed trepanations by the circular grooving technique. Museo Arqueológico de la Universidad San Antonio Abad, Cuzco, Peru.

Table 3. Trepanation size (area in cm²).

<table>
<thead>
<tr>
<th>Geographic Region</th>
<th>Mean Area (cm²)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Coast</td>
<td>28.3</td>
<td>29.1</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>12.6</td>
<td>13.4</td>
</tr>
<tr>
<td>Southern Highlands</td>
<td>12.8</td>
<td>10.9</td>
</tr>
</tbody>
</table>

Table 4. Trepanation healing in south coast, central highlands.

<table>
<thead>
<tr>
<th>Area</th>
<th>No Healing</th>
<th>Short-term Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Coast</td>
<td>39.7</td>
<td>24.1</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>42.1</td>
<td>14.3</td>
</tr>
<tr>
<td>Southern Highlands</td>
<td>12.5</td>
<td>9.4</td>
</tr>
</tbody>
</table>

...ries, based on the degree of bony reaction to the trepanation, evidence of bony reaction, suggesting that death occurred days following the operation (Fig. 2b, d). 2. Short-term activity, bone necrosis, or hypervascularity is visible at the time of opening, indicating survival for at least several weeks. Survival, where there is evidence of extensive remodeling defect (Figs 2a, 4). Table 4 presents data on trepanations from central highlands, and southern highlands samples. It can be inferred that the earliest south coast trepanations to the later highlands trepanations, reaching an impressive long Inca times.

Trepanations by scraping and circular grooving generated (with the exception of the early Paracas examples), cutting and drilling-and-cutting show the lowest. This preclinical penetration of the dura mater was more frequent. The most impressive cases of multiple trepanations with from the Late Horizon, where as many as seven healed in a single skull (Brothwell, 1959).

Head Injury

Depressed skull fractures are common in some skeletal collection, and we have noted particularly high frequencies in the case of these injuries were probably produced by blows from clubs or other accidents. The American physical anthropological collection of skulls from Peru and the central highlands, twentieth century (Hrdlika, 1914), and these are particu...
Table 3. Trepanation size (area in cm²).

<table>
<thead>
<tr>
<th>Geographic Region</th>
<th>Mean Area (cm²)</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Coast</td>
<td>28.3</td>
<td>29.1</td>
<td>1.0</td>
<td>82.0</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>12.6</td>
<td>13.4</td>
<td>0.9</td>
<td>69.6</td>
</tr>
<tr>
<td>Southern Highlands</td>
<td>12.8</td>
<td>10.9</td>
<td>0.8</td>
<td>52.7</td>
</tr>
</tbody>
</table>

Table 4. Trepanation healing in south coast, central highlands, and southern highlands samples.

<table>
<thead>
<tr>
<th>Area</th>
<th>No Healing</th>
<th>Short-term Survival</th>
<th>Long-term Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Coast</td>
<td>39.7</td>
<td>24.1</td>
<td>36.2</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>42.1</td>
<td>14.3</td>
<td>43.6</td>
</tr>
<tr>
<td>Southern Highlands</td>
<td>12.5</td>
<td>9.4</td>
<td>78.1</td>
</tr>
</tbody>
</table>

ries, based on the degree of bony reaction to the trepanation: 1. *None*—where there is no evidence of bony reaction, suggesting that death occurred during or within a matter of days following the operation (Fig. 2b, d); 2. *Short-term Survival*—where osteoclastic activity, bone necrosis, or hypervascularity is visible around the margins of the trepanation opening, indicating survival for at least several weeks (Figs 3, 5), and 3. *Long-term Survival*, where there is evidence of extensive remodeling of the margins of the trepanation defect (Figs 2a, 4). Table 4 presents data on trepanation healing for south coast, central highlands, and southern highlands samples. It can be seen that success rates improved from the earliest south coast trepanations to the later central highlands and southern highlands trepanations, reaching an impressive long-term survival rate of 78% by Inca times.

Trepanations by scraping and circular grooving generally show the highest success rates (with the exception of the early Paracas examples), whereas trepanations by straight cutting and drilling-and-cutting show the lowest. This probably reflects the fact that accidental penetration of the dura mater was more frequent with the latter two methods. The most impressive cases of multiple trepanations with long-term healing are known from the Late Horizon, where as many as seven healed trepanations have been found on a single skull (Brothwell, 1959).

**Head Injury**

Depressed skull fractures are common in some skeletal collections from prehistoric Peru, and we have noted particularly high frequencies in the central highlands. The majority of these injuries were probably produced by blows from clubs and sling stones, weapons widely used in the Andes in prehistoric times, although some may have resulted from falls or other accidents. The American physical anthropologist Aleš Hrdlika made extensive collections of skulls from Peruvian central highland sites in the early part of the twentieth century (Hrdlika, 1914), and these are particularly valuable in assessing the
Table 5. Frequency of healed depressed fractures in crania from Peruvian central highland sites where trepanation was practiced. Hrdlika Collection, National Museum of Natural History, Smithsonian Institution.

<table>
<thead>
<tr>
<th>Site</th>
<th>N</th>
<th>Adult Males with fractures (%)</th>
<th>Adult Females with fractures (%)</th>
<th>Subadults with fractures (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Damian</td>
<td>141</td>
<td>58.9</td>
<td>27.0</td>
<td>21.0</td>
</tr>
<tr>
<td>Cinco Cerros</td>
<td>35</td>
<td>47.4</td>
<td>46.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Matucana</td>
<td>23</td>
<td>55.6</td>
<td>36.4</td>
<td>66.7</td>
</tr>
<tr>
<td>Huarochiri</td>
<td>13</td>
<td>50.0</td>
<td>33.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>212</td>
<td>55.7</td>
<td>31.6</td>
<td>26.9</td>
</tr>
</tbody>
</table>

The frequency of head injury in these trepanation-practicing groups. Data on healed depressed skull fractures for four central highlands sites collected by Hrdlika is presented in Table 5. It can be seen that head injuries were very common, not only in adult males, but in females and subadults (adolescents and children) as well. The high frequency in individuals of all ages and both sexes suggests conflicts involving whole villages, rather than organized warfare by men alone. This is consistent with a tradition of ritual battles still practiced in some isolated highland groups in Peru and Ecuador today, where slingstone fights involve participants from a broad segment of the population (Topic and Topic, 1997).

Trepanation and Skull Fracture

One of the objectives of our study was to examine the relationship between skull fracture and trepanation, an observation that had been made in previous studies of Peruvian trepanations (Tello, 1913; Daland, 1935; Stewart, 1958). Indeed we observed many cases where a trepanation was clearly associated with skull injury (Fig. 6). The highest frequency was found in the central highlands sample, where 26.2% of 457 trepanations were associated with visible skull fracture. In contrast, only 6.8% of Paracas trepanations and 11.8% of Southern Highlands trepanations had associated skull fracture. Interestingly, we found a number of examples in central highlands skulls of a trepanation begun at the site of a depressed fracture but not completed (Fig. 6), presumably because the patient died during the procedure or the trepanation was aborted for some reason and the patient died shortly afterward. Incomplete procedures such as these suggest that in other cases evidence of the fracture may have been removed by the trepanation itself.

This is particularly likely in cases in which large portions of the cranial vault were removed, such as in the early crania from Paracas (see Table 3). Therefore, our estimate of the number of trepanations associated with skull fracture should be considered a minimum one; the true incidence is no doubt higher.

The objective of trepanation following head injury presumably was to elevate depressed fractures, remove bone fragments and smooth broken edges, and possibly to drain epidural hematomas. Although there is no soft tissue evidence to confirm this, practitioners probably learned through experience to avoid, due to the high risk of infection and physical damage, trepanation in prehis.

Location

At the preliminary stages of this study, predictions were unlikely sites for trepanation procedures. We predicted that central highland Peruvian trepanned skulls with higher frequency of trepanations on the left side of the skull, reflected the treatment of skull fractures received from reasonable to assume that trepanations performed to re what was learned about head injury treatment. Results of this study also indicated that skull damage was frequent in the area of the skull but without a substantially larger and more geographically and temporally diverse dataset, they might have been removed by the surgeon, the fact that we are limited to skeletal evidence alone, th
fractures in crania from Peruvian central highland sites (collection, National Museum of Natural History, Smithsonian

<table>
<thead>
<tr>
<th>Infant Males with fractures (%)</th>
<th>Adult Females with fractures (%)</th>
<th>Subadults with fractures (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>27.0</td>
<td>21.0</td>
</tr>
<tr>
<td>4</td>
<td>46.7</td>
<td>100.0</td>
</tr>
<tr>
<td>6</td>
<td>36.4</td>
<td>66.7</td>
</tr>
<tr>
<td>9</td>
<td>33.3</td>
<td>0.0</td>
</tr>
<tr>
<td>7</td>
<td>31.6</td>
<td>26.9</td>
</tr>
</tbody>
</table>

were trepanation-practicing groups. Data on healed decedent highlands sites collected by Hrdlika is presented and injuries were very common, not only in adult males, (descents and children) as well. The high frequency in sexes suggests conflicts involving whole villages, women and men. This is consistent with a tradition of ritual isolated highland groups in Peru and Ecuador today, participants from a broad segment of the population.

Fracture

was to examine the relationship between skull fracture that had been made in previous studies of Peruvian (1935; Stewart, 1958). Indeed, we observed many early associated with skull injury (Fig. 6). The highest fracture. In contrast, only 6.8% of Paracas trepanations had associated skull fracture. Inter-examples in central highlands skulls of a trepanation fracture but not completed (Fig. 6), presumably because of the trepanation was aborted for some reason and incomplete procedure such as these suggest that it may have been removed by the trepanation itself. As in which large portions of the cranial vault were taken from Paracas (see Table 3). Therefore, our estimate associated with skull fracture should be considered a minimum. Following head injury presumably was to elevate débragments and smooth broken edges, and possibly to ensure there is no soft tissue evidence to confirm this.

Figure 5. Trepanation with short-term healing, evidenced by areas of osteoclastic reaction around a central focus of necrotic bone (arrows). Museo Nacional de Antropología, Arqueología, y Historia, Lima, Peru.

practitioners probably learned through experience to avoid penetration of the dura mater, due to the high risk of infection and physical damage to the brain.

Location

At the preliminary stages of this study, predictions were made about the most likely and unlikely sites for trepanation procedures. We predicted that areas of the skull overlain by substantial muscle tissue, such as the nuchal area and the temporal fossa would probably be avoided, and our data tend to confirm this. We also searched for side preferences. An earlier study of central highland Peruvian trepanned skulls by Stewart (1958) found a higher frequency of trepanations on the left side of the skull. Stewart concluded that this reflected the treatment of skull fractures received from a right-handed assailant. It is reasonable to assume that trepanations performed to relieve depressed skull fractures would be placed at or near the site of injury. Results of our own examination, based on a substantially larger and more geographically and temporally varied sample than Stewart’s, produce surprisingly similar results, with the greatest number of trepanations located on the left side of the skull (Table 6). It should be noted, however, that many openings are not associated with visible skull fracture, although as indicated previously, such evidence might have been removed by the surgery itself. Unfortunately, given the fact that we are limited to skeletal evidence alone, the specific motivation for most
Table 6. Location of trepanations relative to the mid-sagittal plane.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Number of Crania</th>
<th>Number of Trepanations</th>
<th>Left Side</th>
<th>Right Side</th>
<th>Mid-Sagittal</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Coast</td>
<td>60</td>
<td>69</td>
<td>46.4%</td>
<td>33.3%</td>
<td>20.3%</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>457</td>
<td>551</td>
<td>49.9%</td>
<td>34.8%</td>
<td>15.2%</td>
</tr>
<tr>
<td>Southern Highlands</td>
<td>86</td>
<td>126</td>
<td>51.6%</td>
<td>38.6%</td>
<td>19.8%</td>
</tr>
<tr>
<td>Total</td>
<td>603</td>
<td>746</td>
<td>49.9%</td>
<td>33.6%</td>
<td>16.5%</td>
</tr>
</tbody>
</table>

Figure 6. Incomplete trepanation at the site of a depressed skull fracture in a skull from Cinco Cerros, central highland Peru. National Museum of Natural History, Smithsonian Institution.

TRETRANAPATION IN PREHISTORY

Conclusions

Trepanation was an indigenous surgical procedure practiced over a period of approximately 2,000 years. It clearly served to treat depressed skull fractures, although it also might have evolved for headaches or other neurological disorders. Skeletal evidence suggests that the frequent association between trepanation and skull fractures may identify the motivation for many trepanation procedures on a single patient.

Ancient Peruvian trepaners experimented with various techniques in skulls. Although it is unknown how surgical knowledge and success rates increased through time, eventually resulting in a high level of accuracy among Inca practitioners of the southern highlands. Additional research, however, to better document the practice of trepanation, a database project, by locating collections scattered in various locations and recording them in a systematic fashion, should continue to generate long-standing questions about trepanation in ancient South America.

Acknowledgements

Financial support for aspects of research reported in this article was obtained in Peru (1989, 1996) granted by the Council for the International Exploration of Human Evolution. Funding was provided by the Research Opportunities Fund of the National Museum of Natural History, Smithsonian Institution. I am grateful to the following museums that photograph their collections: In Peru, the Museo Nacional de Antropología, and the Museo Arqueológico de la Universidad San Andrés, the National Museum of Natural History, Smithsonian Institution, New York, the Peabody Museum of Archaeology and Ethnology, Cambridge, and the Field Museum of Natural History, Chicago. Additional support was provided by the author.

Note

1. Age and sex were estimated using standard osteological methods (1987) and Ubelaker (1989). Children were assigned to broad age categories (young/middle/old) on the basis of tooth wear.

References

relative to the mid-sagittal plane.

<table>
<thead>
<tr>
<th>Number of</th>
<th>Left Side</th>
<th>Right Side</th>
<th>Mid-Sagittal</th>
</tr>
</thead>
<tbody>
<tr>
<td>69</td>
<td>46.4%</td>
<td>33.3%</td>
<td>20.3%</td>
</tr>
<tr>
<td>551</td>
<td>49.9%</td>
<td>34.8%</td>
<td>15.2%</td>
</tr>
<tr>
<td>126</td>
<td>51.6%</td>
<td>28.6%</td>
<td>19.8%</td>
</tr>
<tr>
<td>746</td>
<td>49.9%</td>
<td>33.6%</td>
<td>16.5%</td>
</tr>
</tbody>
</table>

Conclusions

Trepanation was an indigenous surgical procedure practiced in Andean South America over a period of approximately 2,000 years. It clearly served as a practical treatment for depressed skull fracture, although it also might have evolved through time as a treatment for headaches or other neurological disorders. Skeletal collections from Peru document the frequent association between trepanation and skull fracture, although it is difficult to identify the motivation for many trepanation procedures, particularly cases of multiple operations on a single patient.

Ancient Peruvian trepanners experimented with various techniques to make openings in skulls. Although it is unknown how surgical knowledge was acquired and passed on, success rates increased through time, eventually resulting in an impressive surgical record among Inca practitioners of the southern highlands. Additional research remains to be done, however, to better document the practice of trepanation across space and time. Our database project, by locating collections scattered in various museums around the world and recording them in a systematic fashion, should contribute to resolving some of the long-standing questions about trepanation in ancient South America.

Acknowledgements

Financial support for aspects of research reported in this article came from Fulbright Lectureships in Peru (1989, 1996) granted by the Council for the International Exchange of Scholars, and travel funding from the Research Opportunities Fund of the National Museum of Natural History, Smithsonian Institution. I am grateful to the following museums for permission to study and photograph their collections: In Peru, the Museo Nacional de Antropología, Arqueología y Historia, Lima, and the Museo Arqueológico de la Universidad San Antonio Abad, Cuzco; in the United States, the National Museum of Natural History, Smithsonian Institution, the American Museum of Natural History, New York, the Peabody Museum of Archaeology and Ethnology, Harvard University, and the Field Museum of Natural History, Chicago. All photographs in this article were taken by the author.

Note

1. Age and sex were estimated using standard osteological and dental criteria outlined in Bass (1987) and Ubelaker (1989). Children were aged by dental calcification and eruption; adults were assigned to broad age categories (young/middle/old) on the basis of cranial suture closure and tooth wear.

References

Bass WM (1987): Human Osteology: A Laboratory and Field Manual of the Human Skel-


Chapter 18

Pre-Columbian Skull Trep: North America

JAMES L. STONE1 AND JAVIER URCID2
1Division of Neurosurgery, Cook County Hospital, Hekto Research, and Loyola University, Chicago, Illinois, USA
2Anthropology, Brandeis University, Waltham, Massachusetts

Abstract

Evidence for pre-Columbian trepanation in North America is sp of the practice have been discovered in Oaxaca, Mexico and on 20 trepanned skulls recovered in Mexico, most of which (ca 900 AD), have been reviewed. Twelve were found in the ancient five in nearby areas. Similarly we have reviewed reports on be pre-Columbian, recovered in the United States and Canada (Columbia, usually the Vancouver-Fraser River region) and 8 from Considering the total group; average age was approximated at divided, location on the skull was usually parietal, perforations and evidence of trauma was present in seven skulls. Multiple open skulls. The predominant trepanation method was gradual scrapping of the surrounding bone, and drilling technique was used. Bone remodeling was 80% of Mexican and 90% of Canadian/USA skulls. Perhaps and dental drilling contributed to cranial drilling in Mexico. For been recently reported from the Valley of Oaxaca which appears trepanation activity in this region of the New World. The reason remain largely conjectural.

Keywords: Primitive surgery, Northwest Pacific Coast Indian Zapotec culture, Oaxaca, drilling technique

Introduction

Skull trepanation in early times was independently practi with the highest New World concentrations in Peru and ac Lisowski, 1967; Margetts, 1967; O’Connor and Walker, ican Indians, trepanation was most common in ancient Columbian (ca 1492 AD) era and still more uncommon (ca 1520s) and in the post-Columbian era (Lisowski, 196 surgery by the early Indian peoples of present day Mexico. Canada is relatively scarce, we believed it would be of i