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Differential diagnosis: Trepanation

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ABSTRACT

Trepanation is the scraping, cutting, or drilling of an opening (or openings) into the neurocranium. World surveys reveal that a number of ancient cultures experimented with cranial surgery, and that in some areas these practices continued into modern times. Archaeological discoveries of possible trepanations continue to be made, often from geographic areas or time periods from which the practice was not previously known. Unfortunately, most of these reports describe single crania with healed defects interpreted as trepanations. When evaluating a possible trepanation in a skull that lacks medical history or comes from an archaeological context where there is no other evidence that such operations were performed, a thorough differential diagnosis is essential. Identification of unhealed trepanations is a relatively straightforward exercise, since tool marks provide direct evidence of surgical intervention. A confident diagnosis is more difficult in healed defects of the skull, where the mechanism that produced an opening may be obscured by bone remodeling. There are many possible causes of defects of the skull vault, including congenital and developmental anomalies, trauma, infection, neoplasm, and taphonomic damage. For this reason, a careful differential diagnosis is essential for identifying surgical intervention and distinguishing it from cranial defects caused by other mechanisms.

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1. Introduction

Trepanation, or trephination, is the scraping, cutting, or drilling of an opening (or openings) into the skull. Despite the risk of brain injury, hemorrhage, and infection, trepanation was surprisingly widespread in prehistory, dating back to at least 5000 BCE in

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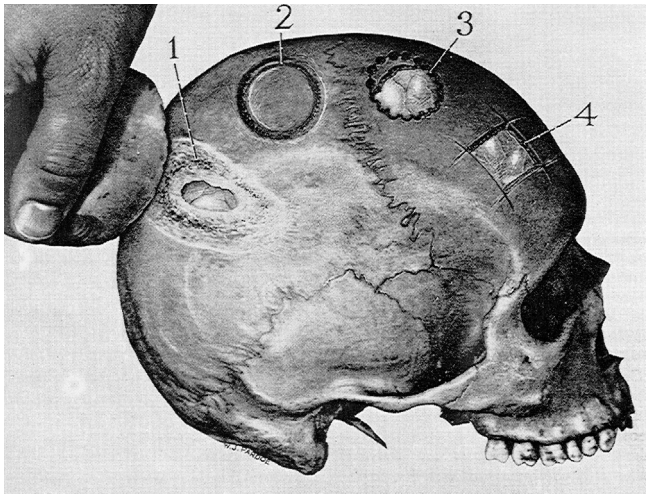

Fig. 1. Illustration of trepanation methods: (1) scraping, (2) circular grooving, (3) drilling and cutting, and (4) linear cutting with angular intersections. From Lisowski, 1967: Fig. 1, Courtesy of Charles C. Thomas Publisher, Ltd., Springfield, Illinois.

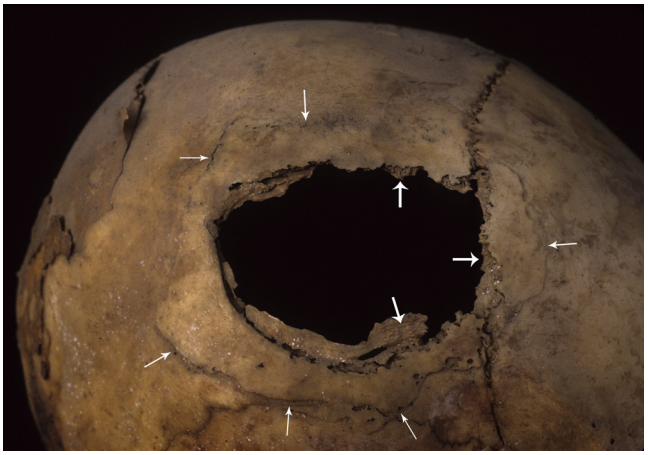

Fig. 2. Trepanation of the right parietal with short term healing. Large arrows in center mark osteoclastic activity at the margins of the opening, and (lower arrow) a portion of necrotic bone that preserves cut/scrape marks from the trepanation. The smaller arrows around the periphery mark the outer margins of necrotic bone (line of demarcation). Central highland Peru. Courtesy of Peru's National Museum of Anthropology, Archaeology and History, photo by author.

Europe and to around 500 BCE in the New World (Verano, 2016). New cases continue to be reported in the paleopathological and archaeological literature, with particular attention given to possible trepanations found in geographic regions or time periods without prior evidence of such practices (Ferembach, 1962; Alt et al., 1997; Lillie, 1998; Han and Cheng, 2007; Crubézy et al., 2001; Bazarsad, 2003; Murphy, 2003; Lv et al., 2013). At issue with any new discovery is the reliability of the diagnosis, particularly given the variety of mechanisms other than trepanation that can produce defects in the neurocranium. Careful differential diagnosis is essential for properly distinguishing between trepanations and defects resulting from congenital and developmental anomalies, trauma, infection, neoplasm, and taphonomic damage (Bennike, 2003; Campillo, 2007; Kaufman et al., 1997; Merbs, 1989). Healed cranial defects present the greatest interpretive challenge, since the causative mechanism may be obscured by bone remodeling. With reference to such cases, Donald Ortner has noted: "One of the factors contributing to the controversy is the difficulty of conclusively identifying a trephination in an archaeological specimen" (Ortner 2003: 170). This problem continues, particularly when one is faced with a possible trepanation from a geographic area or time period where other convincing cases have not been found. Following a brief review of trepanation methods and their diagnostic features, this article will review the various categories of cranial defects that may be incorrectly diagnosed as trepanations. It will then examine specific examples from archaeological contexts where a diagnosis may or may not be straightforward.

2. Trepanation: definition and diagnostic features

Trepanation can be performed by a variety of methods, and with various tools. The most commonly reported methods are (1) scraping, where the outer Table and diploe are gradually abraded away, exposing the inner table, which may be scraped through or carefully broken out, (2) grooving, where a circular or oval portion of bone is circumscribed by repeated cuts until a disc of bone can be removed, (3) intersecting linear cuts, usually defining a rectangular piece of bone that is also removed, (4) boring and cutting, where a circle of small drilled holes are made and the bone bridges between them cut to allow removal of a disc of bone (Fig. 1). Additional methods include small clusters of drilled holes (a rare technique) and the classic "burr hole" made with a crown trepan or a modern drill. Scraping is the most common method seen in prehistoric crania, whereas linear cutting, boring and cutting, and drilling are the least common (Lisowski, 1967; Campillo, 2007). It should be noted, however, that in trepanations showing long term healing evidence of the specific method may be obscured by bone remodeling and retraction of the edges of trepanation openings (Lastres and Cabieses, 1960). It is primarily in cases where there is no visible

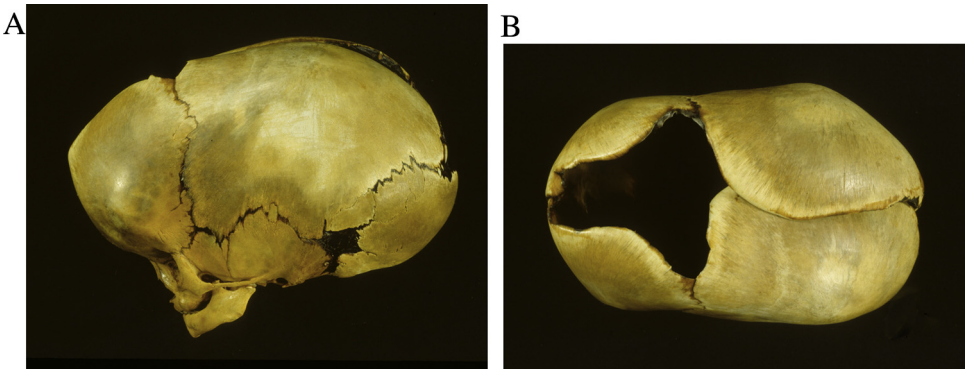

Fig. 3. a,b. Lateral and superior views of the skull of an infant diagnosed with hydrocephalus, showing great expansion of the cranial vault with forward projection of the frontal bones and an enlarged anterior fontanelle. University of Nebraska, Lincoln, Anthropology Department, with permission of Karl Reinhard. Anatomical specimen, photo by author.