



Case Study

The oral pathological conditions of the Broken Hill (Kabwe) 1 cranium



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ARTICLE INFO

Article history:

Received 4 September 2013

Received in revised form 18 June 2014

Accepted 18 June 2014

Keywords:

Caries

Periodontal disease

Hypercementosis

Middle Pleistocene

Archaic *Homo sapiens*

ABSTRACT

The Broken Hill (Kabwe) 1 cranium exhibits dental caries on ten teeth, multiple periapical lesions, periodontal disease, severe anterior dental wear, and hypercementosis, conditions all little-studied in Middle Pleistocene humans and making Broken Hill 1 of great value to discussions of the antiquity of oral pathological conditions. These individual pathological conditions, however, have never previously been described in detail; the focus has been on diagnosing an overarching syndrome connecting the temporal and oral lesions. This case study examines the individual dentoalveolar pathological conditions to provide data for cross-comparison using ordinal scores (e.g., carious lesions, interdental septum condition), descriptions (e.g., hypercementosis, periapical lesions), and continuous measurements (cemento-enamel junction to alveolar crest distances). Differential diagnoses are explored including age-related hyposalivation, dental wear, lead poisoning, and diet, and are discussed within the context of past published attempts. Studies on recent humans have demonstrated correlations between oral disease, systemic health, and diet, suggesting Broken Hill 1 likely suffered from larger systemic inflammation related to its age, health, and perhaps subsistence.

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1. Introduction

The Broken Hill (Kabwe) 1 cranium continues to be of paleopathological interest given its multiple dental, alveolar, and temporal lesions. Diagnoses of its dentoalveolar abnormalities include: an ignorance of toothpicks (Puech et al., 1980), excessive honey consumption (Constable and Solecki, 1972; Sperber, 1986), an unnamed elemental deficiency (Kortizer and St Hoyme, 1979), and lead poisoning (Bartsiokas and Day, 1993; Skinner and Sperber, 1982). However, these studies have not described individual oral lesions. The pathological alterations of Broken Hill 1's dentoalveolar region are therefore described in detail and assessed in this treatment.

2. Materials and methods

Broken Hill 1 (BH1, Fig. 1) was found in 1921 at Broken Hill mines in Kabwe, Zambia (then Northern Rhodesia) (Pycraft, 1928; Woodward, 1921). BH1 remains undated, but it is assumed to be Middle Pleistocene in age, based on its possible association with Middle Pleistocene fauna and Middle Stone Age and Acheulean

artifacts and morphology similar to other Middle Pleistocene African human remains (Bräuer, 2008; Klein, 1973). It remains one of the few known archaic *Homo* fossils from the southern portion of Africa and is currently housed at the Natural History Museum, London. Dental eruption and wear indicates that BH1 was a full adult (Miles, 1963), though a consistent bias against identifying older individuals through this method (Molleson and Cohen, 1990) and the carious lesions present make a more precise age estimation difficult. Elsewhere BH1 has simply been described as “adult” (Montgomery et al., 1994; Skinner and Sperber, 1982).

Measurements were taken with digital calipers, scored visually and photographically, and digital radiographs were produced with a portable X-ray generator. The fossil is impregnated with heavy metals (Bartsiokas and Day, 1993; Oakley, 1947), obscuring fine detail in the radiographs (Fig. 2). An 8-level scoring system is used to describe the location and severity of each carious lesion (Hillson, 2001). Periodontal disease was evaluated using both average cemento-enamel junction to alveolar crest (CEJ-AC) distances (Clarke et al., 1986; Hildebolt and Molnar, 1991; Lavigne and Molto, 1995) and alveolar septa shape and porosity scores (Corruccini et al., 1987; Costa, 1982; Kerr, 1988, 1998; Ogden, 2008). Alveolar lesions are diagnosed grossly and from observing radiographs (Dias and Tayles, 1997; Dias et al., 2007; Willis and Oxenham, 2013). Dental wear scores (Smith, 1984) are considered with alveolar lesions and periodontal disease because non-carious pulpal

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Fig. 1. Occlusal view of Broken Hill 1 maxilla; Courtesy of E. Trinkaus.

exposure can result in alveolar lesions as can root and furcation exposure (Hillson, 2008). Hypercementosis, i.e., excessive deposition of annular cementum, is described by shape and severity (Pinheiro et al., 2008).

3. Results by maxillary tooth/alveolus

3.1. Right third molar (RM^3)

The crown of RM^3 is completely destroyed by caries resulting in a caries score of 8 (Hillson, 2001) and wear level 8c (Smith, 1984) (Table 1). The root is exposed (average CEJ–AC distance: 6.8 mm), and the alveolar bone surrounding the third molar is concave and porous (Table 2). There is a 1.5 mm diameter perforation in the cortical bone distal to the right zygomatic arch above RM^3 . It cannot be definitively connected to RM^3 using both new and published radiographs (Skinner and Sperber, 1982). The carious affliction of RM^3 is extensive, so it is possible that the perforation is a sinus from an acute abscess, which would leave little bony resorption (Dias and

Table 1
Caries & wear scores for right and left sides of maxilla.

Tooth	Wear (Smith, 1984)	Caries score (Hillson, 2001)	Notes/surfaces affected
Right maxilla			
I ¹ (11)	7	0	
I ² (12)	N/A	–	Missing postmortem
C (13)	Broken	–	
P ³ (14)	Broken	–	
P ⁴ (15)	8b	8	Crown completely missing from caries
M ¹ (16)	5a	8	Mesial interproximal & occlusal surface
M ² (17)	3c	7, 7, 5	7-Distal interprox. & occlusal; 7-mesial interprox.; 5-possible occlusal
M ³ (18)	8c	8	Crown completely missing from caries
Left maxilla			
I ¹ (21)	8	0	
I ² (22)	6	8	Distal interprox. & occlusal surface
C (23)	6	7	Mesial interprox. (matches neighboring)
P ³ (24)	6b	7	Distal interprox., occlusal, CEJ surfaces
P ⁴ (25)	8c	8	Crown completely missing from caries
M ¹ (26)	8b	8	Crown completely missing from caries
M ² (27)	4b	8	Mesial interprox. & occlusal surface
M ³ (28)	4a	0	

Tayles, 1997). There is also buccal bony expansion between the RM^2 and RM^3 alveoli.

3.2. Right second molar (RM^2)

There are two separate carious lesions on RM^2 . Both are interproximal score 7 lesions, with the distal one also affecting the occlusal surface and the mesial one extending onto the root. The deep dentin exposure on the mesial occlusal surface may also be carious (score 5) (Fig. 3). The alveolar bone is porous and concave—on average 4.5 mm of root is exposed. RM^2 has the least amount of occlusal wear (level 3c), which may explain the presence of a possible occlusal carious lesion unrecovered by wear (Maat and Van der Velde, 1987).

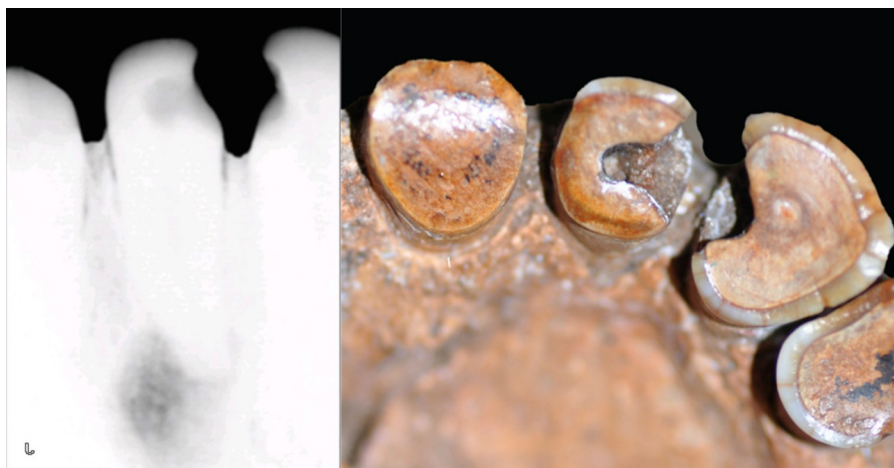


Fig. 2. Radiograph, left, and photograph, right, of left lateral incisor periapical lesion and incisor and canine caries.

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