

WHISPERING TEETH: NUTRITION AND HEALTH OF WOODEN COFFIN PEOPLE IN THE PANG MA PHA CAVE SITES, NORTHWESTERN THAILAND

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ABSTRACT

Nutritional health levels are examined from human dental remains associated with wooden coffins dated between 2000 and 500 years ago at archaeological sites in north-west Thailand. During a two-year-field season, almost 500 human teeth have been recovered. These wooden coffin people had a relatively low incidence of dental caries (4.7%), but a high incidence of tooth wear (30.4%). In short, the dental lesion patterns of these wooden coffin people were similar to those of prehistoric hunting-gathering groups in Thailand.

INTRODUCTION

This research project is part of the Highland Archaeology Project in Pang Ma Pha district, Mae Hong Son province (HAPP). The project encompasses the themes of archaeology, dendrochronology and physical anthropology that were supported by the Thailand Research Fund during 2001 to 2003.

Mae Hong Son province is located in northwestern Thailand. There are approximately 170 caves and shelters in Pang Ma Pha, and these have made the place attractive to adventure tourists (Sidisunthorn *et al.* 2006). Numerous wooden coffins also occur in the caves. However, due to the locations of these sites in difficult karstic terrain there has been little archaeological activity, with the exception of a few rockshelters excavated by Chester Gorman in the 1960s (Gorman 1972).

The aim of the dental research reported here is to find out whether there are any geographical or chronological links between past and present populations in Pang Ma Pha. Previous results have shown that

- (1) the dental morphology of ancient people in the Pang Ma Pha area is similar to that of other sundadont Southeast Asian groups, rather than East Asian sindodont groups (Nakbunlung and Wathanawareekool 2004);
- (2) average tooth lengths of ancient Pang Ma Pha people are shorter than those of modern Thais (Nakbunlung and Buttwayyawutthi 2003);

- (3) there was a very low rate of dental caries (Wathanawareekool 2003).

These characteristics are typical of hunter-gatherer societies or mixed hunter-gathering and agricultural societies, rather than fully agricultural ones.

MATERIALS AND METHODS

Five hundred and forty nine human teeth representing an estimated 58 adult and 12 infant skeletons were collected during the 2001-2003 field survey conducted by Rasmi Shoocongdej (Nakbunlung 2003). Four hundred and sixty-seven were permanent adult teeth, all separated from mandibles and maxillas. They were found on the surface and in the uppermost layers in apparent association with the wooden coffins. Pleistocene specimens are excluded from the analysis. The wooden coffins are dated by dendrochronology to between 2000 and 500 years ago, according to Poomjammong (2004), and similar ones occur in caves and cliffs in many mountainous areas of Southeast Asia (Tenazas 1983; Cherdsak 1999; Jakkarinrat 1999; Higham 2002). Morphological features are the initial focus because the teeth will be sent for further biological study and some of the techniques used, such as collagen extraction for DNA analysis, will be destructive.

The relationships between human dentition and diet have been investigated in prehistoric populations for more than a century (Diet and Dentition in Archaeology 2003). Nutrition and health of prehistoric people can be detected through dental remains, one of the best-preserved forms of biological evidence after death. The focus of this study is on dental caries and occlusal tooth wear (Ganjanawasit 1997).

Dental Caries

Dental lesions, or caries, results from decalcification of the dental enamel by bacterial waste products. Carious lesions, most commonly found on the molar teeth and in particular the occlusal and interproximal tooth surfaces, have a complex aetiology that includes oral health behaviours, diet and fluoride levels (Hillson 2001) to name a few factors. According to Ganjanawasit (1997), carious lesions can be visually studied by noting changes in

Table 1. Positions of dental caries in Pang Ma Pha teeth.

Tooth type	n1	n2	% per class					
			1	2	3	4	5	6
Anterior	7	9	11.1	0	55.6	22.2	11.1	0
Posterior	15	17	11.8	76.4	0	0	11.8	0

n¹ = number of carious teeth
 n² = number of carious locations (there may be more than one lesion on each tooth)
 Class 1 = lesions in pits and fissures in anterior and posterior teeth;
 Class 2 = lesions in the proximal areas of posterior teeth;
 Class 3 = lesions in the proximal areas of anterior teeth;
 Class 4 = lesions in the proximal areas through the incisal angles of anterior teeth;
 Class 5 = lesions in the cervical areas of anterior and posterior teeth;
 Class 6 = lesions in the incisal angles of anterior teeth and on the cusps of posterior teeth.

Table 2. Levels of dental wear in Pang Ma Pha teeth.

Tooth type	n1	% per class							
		1	2	3	4	5	6	7	8
lower first molar	23	4.4	0	17.4	17.4	30.4	13	13	4.4

n¹ = lower first molars
 Class 1 = no trace of dental wear;
 Class 2 = lesion on cusp tip (not through dentine);
 Class 3 = lesion on cusp tip (through dentine);
 Class 4 = lesion on at least 2 cusp tips continuously (through dentine);
 Class 5 = lesion as a continuous flat surface on 2 cusps (through dentine);
 Class 6 = lesion as a continuous flat surface on 3-4 cusps (through dentine), but with an enamel ring still present;
 Class 7 = enamel rim worn away;
 Class 8 = only the dental root remains.

Table 3. Comparison of incidences of dental caries in Thailand prehistoric sites.

	# of teeth with caries	Total no. teeth studied	Percentage
Pang Ma Pha ¹	22	467	4.7
Khok Phanom Di ²	139	1282	10.8
Non Nok Tha ²	34	1233	2.8
Ban Chiang ²	76	1067	7.1

¹this study ²Douglas 1996

Table 4. Comparison of incidence of advanced tooth wear between Thailand prehistoric groups.

	Teeth with advanced wear	Total no. teeth studied	Percentage
Pang Ma Pha ¹	1	23	4.3
Khok Phanom Di ²	112	1272	8.8
Non Nok Tha ²	11	253	4.3
Ban Chiang ²	28	210	13.3

¹this study ²Douglas 1996

dental surfaces. Black's criteria (cited in Summitt 1996) are applied here. He proposed six lesion types for both anterior teeth (incisor and canine) and posterior teeth (premolar and molar).

Tooth Wear

Loss of tooth enamel and dentine through wear is generally seen on the occlusal and interproximal surfaces of the teeth. Dental wear may result from chewing food, grit introduced with food, bruxism (tooth grinding) and ero-

sion from acidic foods (Gandjanawasit 1997; Neville *et al.* 1995). The clinical study of dental lesions usually focuses on aspects of prevention and treatment (Summitt 1996). However, dental anthropologists are interested in studying human teeth to determine age-at-death, life-ways, diet, disease and extramasticatory activities in the past (Rattarasan 1989; Hillson 1996; Buikstra and Uebelaker 1997).

Smith's tooth wear scoring system (cited in Hillson 1996) has been used in this study on first molars only. A total of 23 mandibular molars were assessed for wear.

RESULTS

Carious Lesions

Twenty-two out of four hundred and sixty-seven teeth show carious lesions (4.7%), these being 7 anterior and 15 posterior teeth. Most show caries in the interproximal region where adjacent teeth make contact with each other. Table 1 shows that the proximal area is the position where dental caries occur the most, 55.6% and 76.4% for the anterior and posterior teeth respectively. Lesions are present on the proximal area through the incisal angle in 22.2% of the sample, 11.1% show dental caries in pits, and another 11.1% on the cervical areas of the anterior teeth. Lesions in pits and fissures in the posterior teeth are present in 11.8% of the sample, and lesions on the cervical area of the posterior teeth in a further 11.8%.

A comparison with other prehistoric groups in Thailand, shown in Table 3, demonstrates that Ban Chiang has a high percentage of dental caries (7.1%). The Pang Ma Pha and Khok Phanom Di populations have lower percentages (4.7% and 3.2% respectively), whereas Non Nok Tha has the lowest (1.8%).

According to Lasen (cited in Douglas 1996), the occurrence of dental caries in hunter-gatherer societies is usually less than 10%, lower than rates usually found in groups of agriculturalists. The low frequency of caries at Pang Ma Pha could be interpreted as a result of a hunter-gatherer economy based on meat, rather than on a carbohydrate diet as the main staple. However, Oxenham *et al.* (2006) have noted that caries rates among Southeast Asian agricultural populations are very low by global standards and may be due to the non-carious nature of rice-based diets.

Tooth Wear

Some degree of tooth wear is present on 95.6% of the 23 mandibular molars assessed. Most dental wear exposed the dentine on the occlusal surfaces of at least two cusps (47.8%). Table 2 shows that the highest percentage of tooth wear occurs at level 5 (30.4%), which is the type that exposes the dentine on the occlusal surface of at least two cusps and results in a continuous flat surface. Next come levels 3 and 4 with 17.4% each. Levels 6 and 7 have 13.0% each. Extreme wear to the level of the dental root (level 8) is present on 4.4% of the sample.

Such wear may result from abrasion (grit in processed soft foods), or chewing tough unprocessed foods. Table 4 compares the percentages of teeth with advanced tooth wear among four prehistoric groups. The results are 4.4% in the wooden coffin sample, 13.3% for Ban Chiang, 21.2% for Khok Phanom Di, and 4.3% for Non Nok Tha.

These results suggest that Pang Ma Pha had relatively low levels of tooth wear, although it is unclear from these data what the main dietary component may have been if looking at wear alone. Further, the isolated nature of the dental sample makes assessment of age-at-death all but impossible from tooth wear scores.

CONCLUSIONS

In this study, caries and tooth wear have been used as indicators for the nutrition and health of the Pang Ma Pha archaeological populations. The frequency of caries is well below 10%, the suggested boundary between non-agricultural and agricultural groups. This may indicate either a hunter-gatherer subsistence orientation or a reliance on non-carious rice agriculture. This study also shows that tooth wear was at a relatively low level at Pang Ma Pha. However, archaeobotanical evidence should be also taken into account in future studies, as should other techniques concerning nutritional analysis.

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REFERENCES

- Buikstra, J.E. and D.H. Ubelaker (ed.) 1997. *Standards for Data Collections from Human Skeletal Remains*. Arkansas: Arkansas Archeological Survey.
- Cherdsak Triyapiwat 1999. The selection of funeral ground for wooden coffin culture. Research paper presented at the conference: Cave Survey and Data Base Project, Mae Hong Son and Ganjanaburi Provinces. Supported by the Thailand Research Fund. (in Thai)
- Diet and Dentition in Archaeology. 2003. [Online]. Available: http://www.uic.edu/classes/osci/osci590/4_5DietAnd%20DentitionInArchaeology.txt.htm (9/1/2003)
- Douglas, M.T. 1996. *Paleopathology in Human Skeletal Remains from the Pre-Metal, Bronze and Iron Ages, north-eastern Thailand*. Ph.D. Dissertation in Anthropology. Michigan: UMI Dissertation Service.
- Ganjanawasit, P. 1997. *Treatment for the Small-Sized Dental Lesion*. Chiang Mai Dental Journal. (in Thai)
- Gorman, C.F. 1972. Excavations at Spirit Cave, North Thailand: some interim explanations. *Asian Perspectives* 13: 79-107.
- Hillson, S. 1996. *Dental Anthropology*. Cambridge: Cambridge University.
- Hillson S. 2001. Recording dental caries in archaeological remains. *International Journal of Osteoarchaeology* 11:249-289.
- Higham, C. 2002. *Early Cultures of Mainland Southeast Asia*. Bangkok: River Books.

- Jakkarinrat N. 1999. Wooden coffin: a unique characteristic of local culture. Research paper presented at the conference: Cave Survey and Data Base Project, Mae Hong Son and Ganjanaburi Provinces. Supported by the Thailand Research Fund. (in Thai)
- Nakbunlung, S. 2003. Report #6: Physical Anthropology. In Shoocongdej, R., S. Nakbunlung, and N. Pumjammong, *The Highland Archaeological Project in Pang Ma Pha District, Mae Hong Son Province*. Final Research Report presented to Thailand Research Fund. (8 volumes in Thai)
- Nakbunlung, S. and S. Wathanawareekool 2004. Talking teeth: dental non-metric traits of wooden coffin people in the Pang Ma Pha cave sites, Northwestern Thailand. *Bulletin of Indo-Pacific Prehistory Association* 24: 139-142.
- Nakbunlung, S. and M. Butrawayawutthi 2003. Permanent tooth size of ancient people at Pang Ma Pha. Research Paper presented at the Conference: People, Culture, and Ancient Environment in Pang Mapha Highland, Mae Hong Son Province. February 20-21, 2003. (in Thai)
- Neville, B.W., D.D. Damm, C.M. Allen and J.E. Bouquot 1995. *Oral and Maxillofacial Pathology*. Philadelphia: W.B. Saunders Company.
- Oxenham, M., L. Nguyen and K. Nguyen 2006. The oral health consequences of the adoption and intensification of agriculture in Southeast Asia. In M Oxenham and N Tayles (ed), *Bioarchaeology of Southeast Asia*, pp. 263-289. Cambridge: Cambridge University Press.
- Poomjammong, N. 2004. Tree-rings and palaeo-environment. Research paper presented at the conference: Progress Report of the Second Year Research Project. Held by the Highland Archaeology Project in Pang Ma Pha District, Mae Hong Son Province. December 23rd - 24th, 2004. (in Thai)
- Rattarasan, S. 1989. *Disease in Prehistoric period: Lesson and Exercise from Skeletal Remains*. Bangkok: Thammasat University. (in Thai)
- Sidisunthorn P., S. Gardner, and D. Smart 2006. *Caves in Northern Thailand*. Bangkok: River Books.
- Summitt, J.B. 1986 Nomenclature and instrumentation. In R.S. Schwartz, J.B. Summitt and J.W. Robbins (eds.), *Fundamentals of Operative Dentistry: A Contemporary Approach*, pp. 67-108. Chicago: Quintessence.
- Tenazas, R.C.F. 1983. The boat-coffin burial complex in the Philippines and its relation to similar practices in Southeast Asia. *SPAFA Digest* IV (1).
- Wathanawareekool, S. 2003. Dental lesions of ancient people in wooden coffin culture. Research paper presented at the conference: People, Culture, and Ancient Environment in Pang Mapha Highland, Mae Hong Son Province. February 20 - 21, 2003. (in Thai)