

Dental Caries in 104 Skulls about 2,200 Years Ago from the Site of the Emperor Qinshihuang's Mausoleum in China

Jinling Shao^{*1}, Yingxing Han¹, Wenxi He², Juan Dai¹ and Qingbo Duan³

¹Department of Orthodontics, School of Stomatology, The Fourth Military Medical University, Xi'an, 710032, P.R. China; ²Department of Endodontics, School of Stomatology, The Fourth Military Medical University, Xi'an, 710032, P.R. China; ³The Shaanxi archaeological institute, 31 Leyou Road Yanta Road Xi'an, China

Abstract: *Background:* Dental caries appears long time ago and attracts great attention in the paleopathological research all over the world. However, few reports presented the status of dental caries in Chinese ancient people.

Aim: To describe the prevalence of dental caries in 104 skulls about 2,200 years ago.

Materials and Methods: This cross-sectional study was performed using 104 skulls which were excavated from the archaeological sites of Emperor QinShihuang's Mausoleum and Terra-Cotta Warriors and Horses. The degree of caries lesions was identified and the distribution of tooth cavity was recorded and all the data were statistically analyzed using SPSS15.0 for Windows.

Results: Dental caries was common before 2,200 years and the prevalence of dental caries increased with age. The position of dental caries in the skeletal remains was significantly different and the sequence of prevalence of dental caries was M2 > M3 > M1 > P2 > P1 > I1 > I2 > C. The interproximal lesions were identified as the most common type and the severity of every caries lesions was not the same in every skull.

Conclusion: This investigation drew a picture of the dental caries of Chinese males living around 2,200 years ago, which will be beneficial to understanding the people's working and living conditions at that time.

Keywords: Dental caries, skull, archaeology.

INTRODUCTION

Dental caries was one of the human's oldest diseases [1]. It was also the most common dental disease [2, 3]. The archaeological research had reported that only one decayed tooth was detected in 55 skulls about the Paleolithic Age excavated in Palestine [4]. At the Neolithic Age, the prevalence of dental caries was low [5-7]. Along with the evolution of human beings, the development of economy and the ingestion of refined food, the prevalence of dental caries and the index of DMFT (decayed-missing-filled teeth) were increasing [8,9]. Here, we aimed to describe the status of dental caries in people dated about 2,200 years ago (circa 200 BC), and discuss the change of the prevalence, as well as the difference of the clinical symptom between the people at that time and nowadays. From this study, a picture of the people's dental caries 2,200 years ago could be drawn, which will be also helpful to understand the people's working and living conditions at that time.

MATERIALS AND METHODS

Subject

In February 2003, 113 male skeletons were excavated from the famous site of Emperor QinShihuang's Mausoleum

and Terra-Cotta Warriors and Horses, which were located in Xi'an city, northwest China (Fig. 1). Some of the labors who built mausoleum were buried there, whose age were between 15 and 45 years old. In this study we selected 104 skeletal remains with the identified age. The remains were further categorized by age as follows: Group I (less than 20 years old), Group II (between 20 and 30 years old) and Group III (above 30 years old).

Study Design

The clinical diagnosis standards of dental caries were referred to the latest teaching material in China, the second edition of Endodontology [4]. Only those teeth identified with obvious cavities were recorded as caries. Colour changes to the enamel that lacked well-defined cavity edges, possibly as a result of erosion, were not considered to be carious. Caries were detected on five different tooth surfaces: the occlusal surface; the interproximal, buccal and lingual (palatal) surfaces of the crown; and the root surface. The degree of caries lesions was identified and the distribution of tooth cavity was recorded (Fig. 2).

Statistical Analysis

Above measuring procedures were all performed twice over an interval of 2 wks, by two independent observers. There were high level agreements of the above parameters (all $r > 0.9$) between the two observers. The mean of the two measurements was used for further statistical analysis. Statistical analysis was performed using SPSS software for Win-

*Address correspondence to this author at the Department of Orthodontics, School of Stomatology, The Fourth Military Medical University, 145 West Changle Rd, Xi'an, 710032, P.R. China; Tel: 86-29-84776137; Fax: 86-29-84776131; E-mail: shaojl@fmmu.edu.cn



Fig. (1). The excavation site of the male skeletons with complete teeth and jaws in Emperor QinShihuang’s Mausoleum and Terra-Cotta Warriors and Horses, Xi’an.



Fig. (2). The severity of every caries lesions was varies in every skull.

dows, version 15.0 (SPSS, Chicago, IL, USA). In all cases, P values less than 0.05 were considered to be statistically significant.

RESULTS

Status of the Dental Caries

As shown in Table 1, the prevalence of dental caries in the skeletal remains was 47.12%. There were 156 decayed teeth in 49 objects, which were 6.36 per cent in the whole teeth. The mean DMFT of 104 subjects was 1.50. Although

the carious teeth were identified in nearly half of the skulls, the number of carious teeth in each skull was few.

The number of skulls with carious teeth increased with age. The DMFT of the three groups were 0.88, 1.61 and 2.52, respectively. The highest prevalence of dental caries (71.43%) was detected in group III, while group I exhibited the lowest prevalence (30.95%). There was a significant difference in the prevalence of dental caries among the three groups by χ^2 test ($P < 0.01$). Moreover, the proportion of carious teeth in the three groups was different, with the highest

Table 1. The Prevalence of Dental Caries Among Groups

Groups	Number of Total Skulls	Number of Total Teeth	Number of Carious Teeth	Rate of Caries (%) ^a	Caries Prevalence (%) ^b	DMFT
Group I (<20)	42	993	37	3.73	30.95	0.88
Group II (20-30)	41	956	66	6.90	51.22	1.61
Group III (>30)	21	503	53	10.54	71.43	2.52
Total	104	2452	156	6.36	47.12	1.5

^aRate of caries: number of carious teeth/number of teeth present × 100.

^bCaries prevalence (%): number of individuals with caries/number of individuals × 100.

Table 2. The Prevalence of Dental Caries in Different Tooth Position Among Groups

Groups	Number of Carious Teeth	Tooth Position									Oral Quadrant			
		Anterior Teeth			Premolars		Molars				Upper Teeth		LowerTeeth	
		I ₁	I ₂	C	P ₁	P ₂	M ₁	M ₂	M ₃	A	B	C	D	
Group I (<20)	37	0	1	0	3	3	7	12	11	6	8	15	8	
Group II (20-30)	66	6	1	0	4	6	13	19	17	19	13	22	12	
Group III (>30)	53	0	0	0	6	9	11	16	11	13	10	16	14	
Total	156	6	2	0	13	18	31	47	39	38	31	53	34	

proportion in Group III (10.54%) and lowest in Group I (3.73%).

Relation of the Dental Caries and Tooth Position

The position of dental caries was significantly different. The sequence of prevalence of dental caries was $M_2 > M_3 > M_1 > P_2 > P_1 > I_1 > I_2 > C$ (Table 2). There were 47 second molars infected with caries, which had the highest percentage (30.13%). The third molars had the second highest percentage of caries (25.00%). No decay was found in the canines. The proportion of decayed teeth in the molars group (75.00%) was much more than that of the premolars group (19.87%). The premolars also had more caries than that of the anterior teeth group (5.13%). The prevalence of dental caries in upper teeth was 5.53%, while that in lower teeth was 7.22%. There was no significant difference between the upper and lower dentition by χ^2 test ($P=0.098$).

The Distribution of Carious Cavity in the Tooth Surface

The residual roots and residual crowns affected by the caries were distributed into the indistinct group since their decayed position was not distinct. They were excluded in the number of decayed teeth. As shown in Table 3, the interproximal lesions were the most common type with 81 cavities, which was 55.10% of the total teeth cavities. Apart from interproximal lesions, remaining of caries were buccal lesions (27.21%), root lesions (10.88%) and occlusal lesions (6.12%). Only one lingual lesion was found. In group I, the buccal lesions (59.46%) were the most common type, which were much more than the caries lesions in other positions. However, in group II, as well as group III, the interproximal lesions were the most common type, with the proportion of 70.69% and 59.62% respectively. In Group III, the prevalence of root caries was 23.08%, which was much more than those of other groups. Not only could the caries lesions be

found at all surfaces of the tooth, but also the complex caries lesions could be found. There were nine teeth which had caries in two surfaces with two in Group I, four in Group II and three in Group III.

The Degree of Caries Lesions

The severity of every caries lesions was not the same in every skull. From the small carious lesions to the missing teeth, each kind of caries could be found (Table 4). There were 102 teeth had moderate lesions, which was 67.11% of the whole decayed teeth. There were 14 teeth remained only residual roots or residual crowns and 4 teeth missing. There were 14 of 152 caries teeth (9.21%) appeared periapical disease with vertical resorption of periapical alveolar bone. Except for the residual roots and residual crowns, the proportion of moderate lesions, deep lesions and periapical diseases were increased by age.

DISCUSSION

There are few reports about the status of dental caries in people dated about 2,200 years ago. Claassen [10] reported that the prevalence of caries was 2.2 - 5.4% in people dated about 2,500 years ago. Neiburger [11] had reported that the prevalence of dental caries was 2% in Ancient Mesopotamia (southern Iraq) in 2000 B.C. The subjects in our study were dated about 2,200 year ago. It was uncommon that so many skulls were excavated in one place and in one time in the archaeological field. The prevalence of dental caries was 6.36%, which was higher than them and similar with the report by Lukacs [12]. It may be because the ancient Chinese samples were labors. Their working and living conditions were worse than the ordinary people.

Comparing the three groups, it can be found that a higher prevalence of dental caries was identified as the increase of age. The prevalence of dental caries and DMFT in the group

Table 3. The Distribution of Caries Lesions in the Tooth Surface Among Groups

Groups	Number of Carious Teeth	Tooth Surface					
		Occlusal	Interproximal	Buccal	Lingual	Root	Indistinct
Group I (<20)	37	3	9	22	1	2	2
Group II (20-30)	58	5	41	10	0	2	12
Group III (>30)	52	1	31	8	0	12	4
Total	147	9	81	40	1	16	18

Table 4. The Degree of Caries Lesions Among Groups

Groups	Number of Total Teeth	Number of Carious Teeth	The Degree of Caries Lesions				Periapical Disease
			Moderate Lesions	Deep Lesions	Pulp Penetrating Lesions	Residual root and Residual Crown	
Group I (<20)	993	36	25	4	6	1	2
Group II (20-30)	956	65	43	4	7	11	5
Group III (>30)	503	51	34	5	10	2	7
Total	2452	152	102	13	23	14	14

that was less than 20 years old in our study was 30.95% and 0.88. These figures were lower than that of an authoritative report in China in 1995, which claimed that the prevalence of dental caries and DMFT at the same age was 49.53% and 1.60 [4]. But the data (71.43% and 2.52) of our study in the group that was above 30 years old had higher prevalence than the data of that report, which showed 59.92% and 2.11 [4]. The reasons leading to the above results may be that the people at that time had not formed the good habits in oral health, especially the habit of cleaning the teeth by the tooth brush. This habit was believed to become common after A.D. 1,200 [13]. Besides, it is the softer food involving too much sucrose that causes the rise of prevalence of dental caries in the adolescent of the contemporary era. The prevalence rises slowly when they formed good habits in oral health and could get dental treatment [14-16].

As the distribution of caries lesions in the tooth surface showed, the interproximal lesions were the most common in the people at that time, which was similar with the Neolithic people in Xia-wang gang, Da-dun zi and Hua-xian in China [17]. But in the modern society, the occlusal lesions were the most common [18, 19]. In that time, the prevalence of dental caries of the second molar was higher than that of the first molar. This result was also similar with the people during the Neolithic age. But in the modern society, the first molar had the highest prevalence [20, 21]. It was generally believed that the tooth attrition in that time was more severe than now for the rough food. So that before the pits developed to pit and fissure caries, they had been wear out. The chance of occlusal lesions got few naturally. According to our observation, the first molar of the subjects has the most serious tooth wear. Maybe it was the reason that the prevalence of dental caries of the first molar was not the highest.

CONCLUSION

The position and type of dental caries were different between the people at that time and today. The rising velocity of dental caries with age in the ancient was also higher than that of modern society. This investigation drew a picture of the dental caries of Chinese males living around 2,200 years ago, which will be beneficial to understanding the people's working and living conditions in the ancient time.

ACKNOWLEDGEMENT

This study was supported by No.GG05165 from social development fund in Xi'an.

CONFLICT OF INTEREST

This study was a collaborative research programme and supported by No.GG05165 from social development fund in Xi'an. There is no conflict of interest among each author.

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Received: March 19, 2009

Revised: May 26, 2009

Accepted: May 31, 2009

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