

Nonmetric Dental Traits in Prehistoric Central California Populations

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요 약

사람의 이빨에는 여러 모양의 특징들이 나타난다. 이러한 특징들을 살펴 보면 생활환경이 다른 지역에 살았던 사람들이 각기 달리 갖고 있는 체질상의 관계가 비교될 수 있다. 선사시대 중부 캘리포니아 해안 지방 (Ala)과 내륙지방 (CCo/Sac)에 살았던 사람들의 이빨의 특징을 비교함으로써 서로의 닮은 정도를 찾고자 하였다.

Freeman-Turkey 방법에 따라 이들 샘플들의 관계를 조사하였다. 해안지방에서 발굴된 샘플은 내륙지방에서 나온 샘플들과 체질상 (이빨)형태가 서로 다른 것이 드러나며, 반면 내륙지방의 샘플들은 이빨의 특징들이 서로 같은 형태임을 보여 준다. 가장 뚜렷이 나타나는 이빨의 특징은 아래 사랑니에서 나타나는 "protostylid"이다. 이 특징은 내륙지방의 샘플들에서는 보이나 해안지방 샘플에서는 나타나지 않는다.

INTRODUCTION

The degree of affinity between the coastal and interior human populations of prehistoric Central California has long been debated. Analyses of skeletal materials from this region have been presented by many workers (Gifford 1926; Hrdlicka; 1906, 1927; von Bonin and Morant 1938; Fenenga 1939; Newman 1957; McHenry 1969; Grady 1967; Lenkeit 1970; La Jeunesse 1972). Using nonmetric traits of cranium, Suchey (1975) used the statistical approach suggested by Berry and Berry (1967) to determine biological distance between 22 Central California samples. She found biological heterogeneity in the Central California samples and concluded that a major distinction could be made between the coastal and interior groups.

The study of dental nonmetric traits is proving to be a significant resource for studying the affinities of human populations. Lenkeit (1970) and Le Jeunesse (1972) conducted dental analyses of various interior and coastal California samples. Lenkeit concluded that the Sacramento Valley series was distinct from San Francisco Bay and Marin County series, which were quite similar. La Jeunesse concluded that San Joaquin Valley samples were similar to San Francisco Bay and Marin Country samples. A major problem of these

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studies is that they did not compare samples of the same temporal span. The present paper provides more data on the biological relationships of prehistoric Central California populations by focusing on the nonmetric dental traits of mandibular teeth derived from the same populations that Suchey studied.

MATERIALS

Mandibles from geographically different localities (Ala 328 ; CCo-138, 139 ; Sac-60, 66, 43) were used in this study. This material, now stored in the Lowie Museum of Anthropology, University of California, Berkeley, is from burial areas of archaeological sites. To control the temporal dimension most samples were taken from the Middle Horizon, 1500 B.C. – 500 A.D. (Heizer, 1949).

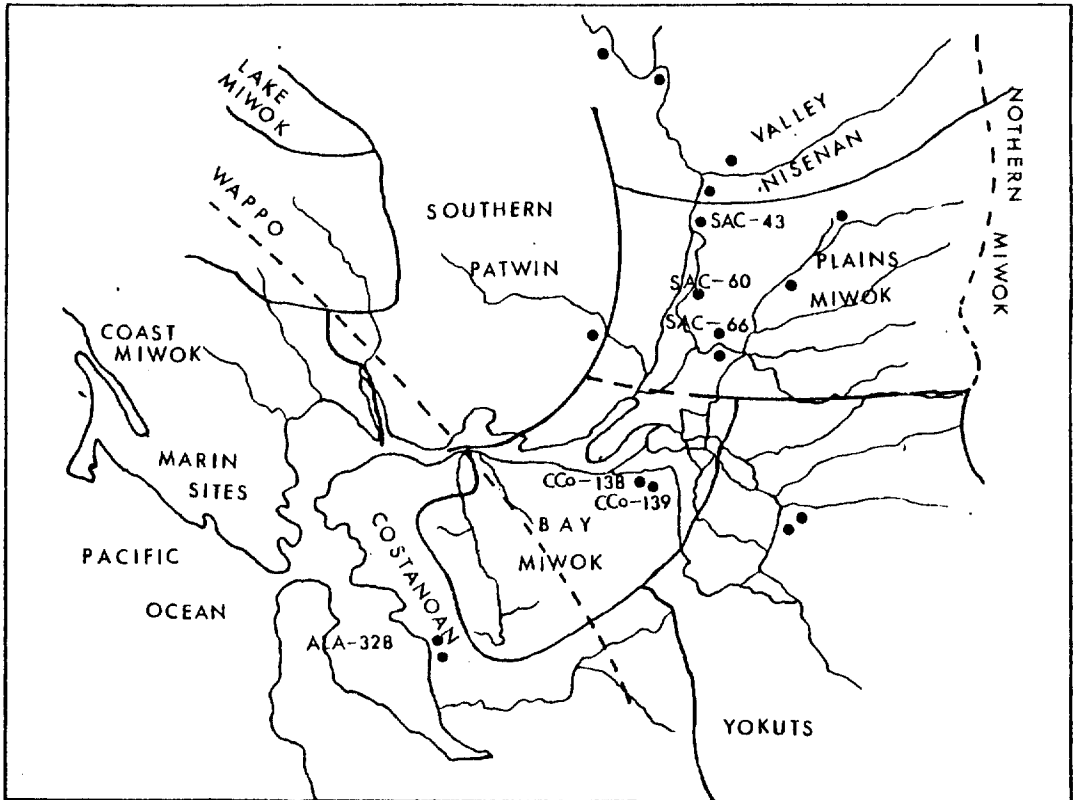


Fig. 1. Distributions of archaeological sites of Central California and ethnographic divisions of Central California at the time of European contact. Modified after Bennyhoff (1961 : 342).

The coastal zone sample (Ala-328; N=48) is from the southeastern part of San Francisco Bay in Alameda county. This area was occupied by one tribe, the Costanoan (Bennyhoff, 1961).

The CCo-138 and 139 sample (N=38) in the intermediate zone, came from west of the San Joaquin River, an area once occupied by the Bay Miwok tribe. Although CCo-138 belongs to the Late Horizon, dental traits of CCo-138 were found to be so similar to CCo-139 (the Middle Horizon) that this sample has been pooled to give a reliable sample size.

The interior zone sample (N=28) is comprised of mandibles from 3 sites, Sac-60, 66 and 43. These sites are located between the Sacramento and Mokelumne Rivers in Cosumnes county, an area that was occupied by one tribe, the Plains Miwok. The three site sample showed no significant differences among themselves and were therefore pooled.

The dashed line in Figure 1 shows the geographical boundary between the interior zone and the coastal zone (Bennyhoff, 1961).

METHODS

The classification of each crown character was based on Dahlberg's reference plaques; groove pattern, cusp number, protostylid and cusp 7 (metaconulid) were scored. Observations were restricted to those teeth with minimum wear (Brothwell's stage 4; Brothwell, 1963). Sexes were combined. Observation was made from the left side, but asymmetry in expression was scored when observed. When only one side was present and observable, it was used. Each dentition was scored for the presence or absence of the 16 dental variants listed in Table 1. All the material was scored by myself to reduce inconsistency in scoring. The basic data are presented in Table 1.

Table 1
Trait frequencies and Transformations

Traits	Ala		CCo		Sac	
	k/n	θ	k/n	θ	k/n	θ
1. Groove pattern Y on molar 1	16/26	-0.2243	14/22	-0.2642	7/11	-0.2536
2. Groove pattern X on molar 1	2/26	0.9553	0/22	1.3607	0/11	1.2780
3. Groove pattern Y on molar 2	13/48	0.4658	0/38	1.4100	2/21	0.8863
4. Groove pattern X on molar 2	8/48	0.7119	10/38	0.4799	4/21	0.6334
5. Groove pattern Y on molar 3	5/21	0.5244	3/34	0.9288	1/21	1.0497
6. Groove pattern X on molar 3	7/21	0.3242	22/34	0.2899	12/21	-0.1369
7. Cusp number less than 5 on molar 1	3/28	0.8628	2/22	0.9020	1/11	0.8574
8. Cusp number more than 5 on molar 1	1/28	1.1183	3/22	0.7711	0/11	1.2780
9. Cusp number 5 on molar 2	11/47	0.5480	10/38	0.4799	6/21	0.4220
10. Cusp number 6 on molar 2	1/47	1.2203	3/38	0.9638	0/21	1.3559
11. Cusp number 5 on molar 3	8/21	0.2295	12/32	0.2450	6/21	0.4220
12. Cusp number 6 on molar 3	0/21	1.3559	2/32	1.0158	0/21	1.3559
13. Protostylid on molar 1	0/32	1.3958	2/23	0.9166	0/11	1.2780

14. Protostylid on molar 2	0/41	1.4159	4/32	0.8154	0/21	1.3559
15. Protostylid on molar 3	0/14	1.3096	13/36	0.2738	13/23	-0.1254
16. Cusp 7 on molar 1	0/32	1.3958	1/23	1.0724	0/11	1.2780
17. Cusp 7 on molar 2	0/41	1.4159	0/36	1.4056	1/20	1.0371
18. Cusp 7 on molar 3	0/18	1.3393	2/31	1.0069	0/20	1.3508

k : The occurrence of a trait

n : The total number of observations

Statistical Analysis

a) Chi-square method

The chi-square method was used to examine the differences in distribution for each crown character (Table 2).

b) Calculation of measure of divergence.

A distance statistic between pairs of samples was calculated. This method was first proposed by Berry and Berry (1967) with subsequent modifications proposed by Sjøvold (1973) and Green and Suchey (1976). The Freeman-Tukey method is much better for small sample sizes that anthropologists often work with (Green and Suchey 1976).

Freeman-Tukey's transformation equals :

$$\theta = 1/2 \sin^{-1} (1 - 2k/(n + 1)) + 1/2 \sin^{-1} (1 - 2(k + 1)/(n + 1)),$$

Where ;

k = The occurrence of a trait, and

n = The total number of observations.

The measure of divergence equals :

$$D = \sum_{i=1}^r \frac{(\theta_{1i} - \theta_{2i})^2 - (1/n_{1i} + \frac{1}{2}) + 1/(n_{2i} + \frac{1}{2})}{r}$$

Where ;

r = The number of pairs of traits considered,

θ_{1i} = Transformed frequency of the i th trait in first population,

θ_{2i} = The transformed frequency of the i th trait in the second population,

n_{1i} = The total number of observations for the i th trait in the first population, and

n_{2i} = The total number of observations for the i th trait in the second population.

The variance equals :

$$\frac{2}{r^2} \sum_{i=1}^r (1/(n_{1i} + 1/2) + 1/(n_{2i} + 1/2))^2$$

and the standard deviation equals the square root of the variance.

RESULTS

Table 2 presents the differences in distribution of each crown character among the samples from different locations. When dental traits are compared between the Ala and CCo samples, the difference is statistically significant at the 1 percent level in the groove

pattern on $M\bar{2}$ and the protostylid on $M\bar{1}$ and $M\bar{2}$. Groove pattern on $M\bar{3}$ shows significant difference at the 5 percent level. For the Sac and Ala samples, the difference is statistically significant at the 1 percent level in the protostylid on $M\bar{3}$. No differences in character frequencies were found between the CCo and Sac samples. The particularly high frequency for the $M\bar{3}$ protostylid in these samples suggests a close relationship between CCo and Sac. The protostylid occurrence is a major discrete trait that distinguishes the Ala sample from the CCo and Sac samples.

Table 3 shows that the D value for the CCo and Sac samples is insignificant, and that the Ala sample shows a statistically significant difference from both the CCo and Sac samples. If the Freeman-Tukey transformation is used to calculate θ , then when the mean measure of distance exceeds twice its standard deviation, the difference is statistically significant between 0.05 and 0.03 (Green and Suchey 1976).

Table 2
Differences in Distribution of Each Crown Character
among the Ala, CCo and Sac Samples.

Traits	Ala/CCo	CCo/Sac	Sac/Ala	CCo closer to
Groove pattern on molar 1	--	--	--	--
Groove pattern on molar 2	XX	--	--	?
Groove pattern on molar 3	X	--	--	?
Cusp number on molar 1	--	--	--	--
Cusp number on molar 2	--	--	--	--
Cusp number on molar 3	--	--	--	--
Protostylid on molar 1	--	--	--	--
Protostylid on molar 2	XX	--	--	?
Protostylid on molar 3	XX	--	XX	Sac
Cusp 7(metaconulid) on molar 1	--	--	--	--
Cusp 7(metaconulid) on molar 2	--	--	--	--
Cusp 7(metaconulid) on molar 3	--	--	--	--

-- : Difference is insignificant.

X : Significant difference at the 5 percent level.

XX : Significant difference at the 1 percent level.

CONCLUSIONS

It is possible to calculate measures of distance using nonmetric dental traits, as it is for samples of crania. In contrast to Suchey's findings, the interior Central California groups (CCo/Sac) are homogeneous. The interior (CCo/Sac) and coastal (Ala) groups are biologically heterogeneous. A distinct trait, the $M\bar{3}$ protostylid was only found in the interior groups.

Table 3
Mean Measures of Distance

	Ala	CCo	Sac
Ala		0.1437 (0.0006) <u>0.0237</u>	0.0766 (0.0011) <u>0.0328</u>
CCo			0.0056 (0.0011) <u>0.0324</u>
Sac			

: Variances are in parentheses.

: I talics show standard deviations.

Suchey (1975) suggested that nutritional differences between the coastal and interior groups might be important factors which resulted in nonmetric differences between her samples. One limitation of all research findings involving skeletal and dental nonmetric traits is the understanding about how trait frequencies respond to environmental stimuli.

The nonmetric dental traits reported here show that dental traits, traditionally considered to be under relatively greater genetic control than many other skeletal traits, are adequate to document heterogeneity among the Middle Horizon inhabitants of Central California. The dental traits provide strong support to previous findings and indicate significant biological differences between the coastal and the interior groups in Prehistoric California.

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