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**Dental anthropology and the origins fo two Iron Age Populations
from Northern Pakistan**

Von John R. LUKACS, Eugene, Oregon

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Introduction

The dental anthropology of Pakistan's prehistoric populations remain undescribed despite the importance of these skeletal series and the significant geographical position of this country. This paper describes the tooth crown dimensions and morphological characteristics of two Iron Age Skeletal Series from northern Pakistan. The dental crown characteristics of the inhabitants of Sarai Khola and Timargarha are compared with one another, and with other skeletal series of similar chronological and cultural contexts in southern Asia.

Prehistoric human skeletal remains from Pakistan are primarily derived from the well known Indus Valley Civilization sites of Harappa and Mohenjo-daro, or from less well known cultures of the late Bronze and Iron Age. The descriptive and interpretive analysis of the human skeletons from Harappa and Mohenjo-daro began in the 1930's in the context of a racial analytic paradigm (GUHA and BASU 1938, SEWELL and GUHA 1931). Re-analysis of these important skeletal collections continues today with the addition of evolutionary and paleodemographic research orientations (BARTEL 1979, DUTTA 1972, 1974, 1975a, 1975b, 1980; KENNEDY 1982, in press). However, the racial paradigm is still retained by certain scholars as a valid analytic model (CAPPJERI 1970; CHATTERJEE and KUMAR 1963; GUPTA et al. 1962).

Human skeletal remains from Sarai Khola and Timargarha in northern Pakistan are of more recent antiquity and have yielded evidence of iron (HALIM 1970-71, 1972). The cemetery at Sarai Khola, originally thought to date to between the 2nd and 3rd millennium B.C., (HALIM 1968, BERNHARD 1969), is now regarded as having an antiquity of 260 ± 50 years B.C. (BERNHARD 1981). The Timargarha cemetery has a somewhat greater antiquity established at between 1400-850 B.C. (BERNHARD 1967). The archaeological context of the Timargarha skeletal series, known as the "Gandhara Grave Complex" is reviewed by DANI (1966, 1967; 1980). Multivariate analysis of the craniometric data from these skeletal series was conducted by BERNHARD (1981) who reports that these Iron Age inhabitants of Pakistan have closer affinities with eastern Mediterranean people than with populations of the Indian subcontinent. Despite thorough multivariate analyses, "... it is still not clear whether the Gandhara Grave Complex, represented by the Timargarha cemetery, may be a different breeding population (from the Harappans) associated with Indo-Aryan speakers (BARTEL 1979, p. 60)."

Analysis of the dentition of prehistoric skeletal remains from Pakistan has been sadly neglected though these data may significantly improve our understanding of the biological adaptations and genetic affinities of these series. Early analysis of the human remains from Mohenjo-daro (GUHA and BASU 1938, SEWELL and GUHA 1931) provide basic comments on occlusion, attrition and caries, and measurements of the molar teeth. Comments on attrition and dental measurements were also reported by GUHA (1951) for human remains from Dharmarajika stupa at Taxila which dates to the end of the fifth century A.D. The data contained in these reports is of little anthropological value because the measurements are of heavily worn teeth and no assessment of dental crown morphology is given. Odontometric data for the molar teeth of the Harappans was reported by GUPTA et al. (1962), and a subsequent reanalysis of these data in the context of an evolutionary selection model was conducted by DUTTA (1980, 1983). However, the dental morphology of the Harappan series remains undescribed. A preliminary report on tooth crown dimensions and morphology of sixteen individuals from early Neolithic Mehrgarh, Baluchistan (LUKACS, 1983), is the only other source known on prehistoric dental variation in Pakistan.

The Iron Age skeletal series from Sarai Khola and Timargarha described by BERNHARD (1967, 1969, 1981) include numerous well preserved dental structures. A complete survey of the dentition of these collections is being conducted by Dr. M. SCHULTZ (Göttingen) and the author. Macroscopic and histological analysis of dental pathology in the Sarai Khola skeletal series are in progress and will be published separately (LUKACS and SCHULTZ, In Press; SCHULTZ and LUKACS, In Press). The dental crown dimensions and morphology of the Sarai Khola and Timargarha skeletal series were analyzed in order to:

- 1) provide basic data for an investigation of the relationship between tooth crown size and level of technological development,
- 2) determine the degree of biological relationship between the Sarai Kkola and Timargarha skeletal series, and
- 3) determine if the evidence of dental morphology confirms or negates the eastern Mediterranean affinities of the Sarai Khola series postulated by BERNHARD (1981) on the basis of craniometric studies.

Materials and Methods

The state of preservation of the two skeletal collections differs considerably. The Sarai Khola series primarily consists of complete maxillae and mandibulae; most of the thirty-one specimens employed in this study were represented by complete and well-preserved crania. Eighty specimens from the Timargarha skeletal series include dental and gnathic structures but these consisted predominantly of isolated teeth, though many specimens include fragmentary maxillae and mandibulae.

The analysis consisted of three parts, 1) odontometric, 2) morphologic and 3) pathologic. Odontometric and morphologic data were recorded on specially designed data forms to facilitate transfer of the data to computer files. Pathology notes were recorded along with notes on preservation and abnormal morphological features in the author's notebook.

The odontometric analysis followed the techniques outlined by MOORREES (1957); the computation of dental crown indices follows procedures of WOLPOFF (1971). Measurements were made with a needle point Helios dial caliper and rounded to the nearest 0.1 mm. Morphological variations of the dental crown and roots were compared with standards of various authors, as listed below:

Maxillary incisor teeth

- 1) Shovel shape (HRDLIČKA 1920)
- 2) Median lingual ridges (TURNER 1967)
- 3) Incisor rotation or winging (ENOKI and DAHLBERG 1958)
- 4) Marginal interruption grooves (TURNER 1967)
- 5) Lingual tubercles (TURNER and SCOTT 1977)

Canine teeth

- 6) Canine distal accessory ridge (SCOTT 1977)

Maxillary molar teeth

- 7) Cusp number (DAHLBERG 1951)
- 8) Carabelli's trait (DAHLBERG 1963, SCOTT 1980)
- 9) Metaconule variation (HARRIS and BAILET 1980)
- 10) Protoconule variation (TURNER 1967)
- 11) Paramolar cusp (DAHLBERG 1963)
- 12) Third molar presence (TURNER and SWINDLER 1978)

Mandibular Molar Teeth

- 13) Cusp number (HELLMAN 1928)
- 14) Groove pattern (HELLMAN 1928)
- 15) Variation in cusp 6 (TURNER 1970)

- 16) Variation in cusp 7 (TURNER 1970)
- 17) Protostylid variation (DAHLBERG 1963)
- 18) Paramolar cusp (DAHLBERG 1963)
- 19) Third molar presence (TURNER and SWINDLER 1978)
- 20) Three rooted first molars (TURNER 1971)

Data were gathered for all of the variations listed above according to the standards contained in the sources cited.

Observations of morphological traits and crown measurements were made on both right and left sides of the jaw but the data presented in this paper is based on observations of the left side only. The analysis of trait frequencies follows the counting procedure known as "individual count" employed by SCOTT (1977, 1980) and others. This procedure maximizes sample size in skeletal series and eliminates the redundancy of tooth count procedures.

Observer error was evaluated by replicate crown measurements and morphological observations of 29 South Asian dental casts. Measurement error averaged 0.25 with no significant difference in error between length and breadth measurements. This is well within the accepted level of measurement error reported for practicing odontometrists by WOLPOFF (1971). Morphological observations of certain features, for example cusp number, proved to be more consistent than grades of expression of continuous traits such as shovel-shape or Carabelli's trait. Nevertheless replicate observations were never more than one grade different from the initial observation, when traits were scored by their presence or absence the level of accuracy was found to be very high.

Results

Mean tooth crown diameters for the permanent teeth from Sarai Khola (SKH) and Timargarha (TMG) are presented in Table 1 with sample size and standard deviation. In computing these figures sexes were pooled and measurements from one side (left) of the jaw used.

Differences in mean crown diameter between the SKH and TMG samples were evaluated by the t-test and significant differences are noted in Table 1. Though the mean MD and BL crown diameters of the SKH series are consistently smaller than those reported for the TMG series few of these are statistically significant. Significant differences occur most frequently in the MD diameter of maxillary teeth, the values for TMG always being greater than for SKH. In only four instances were the mean crown diameters greater in the SKH series, all of these occurred in the BL diameter of mandibular cheek teeth (Pm3, M1, M2, M3), but none of the differences were significant.

Crown indices for the SKH and TMG series are given in Table 2, with sample size (n) and standard deviation (SD). Crown area and crown module are indices which provide an indication of crown size or robustness. It is therefore noteworthy that for the crown module TMG is always larger than the computed module values for SKH. In crown area, too the TMG values are consistently larger than the figures reported for the SKH series, though in two cases (Pm3, M3) the computed area for SKH exceeds that for TMG. As noted in Table 2 many of these differences are non-significant. The crown index, a measure of crown shape, shows slight differences between the SKH and TMG samples, but these differences are similarly patterned.

The frequencies of morphological traits of maxillary incisor and molar teeth and mandibular molar teeth for SKH and TMG are provided in Tables 3, 4 and 5, respectively. Though the sample size available for morphological observations was reduced by the effects of moderate dental attrition, the difference in frequencies of certain morphological traits between SKH and TMG is noteworthy. Shovel-shaped incisor

Table 1: Mean Crown Dimensions of Permanent Teeth from Sarai Khola (SKH) and Timargarha (TMG)

	Mesiodistal diameter				Buccolingual diameter					
	SKH \bar{x} (n)	SD	Sig. level	TMG \bar{x} (n)	SD	Sig. level	SKH \bar{x} (n)	SD	TMG \bar{x} (n)	SD
MAXILLA										
I1	8.22 (13)	0.52	**	8.73 (6)	0.42		7.04 (12)	0.36	7.16 (5)	0.17
I2	6.56 (11)	0.74	ns	6.66 (7)	0.46		6.33 (11)	0.46	6.40 (7)	0.32
C	7.38 (14)	0.34	**	7.78 (10)	0.45		8.00 (14)	0.69	8.28 (12)	0.63
Pm3	6.45 (17)	0.41	**	6.84 (14)	0.53		9.08 (17)	0.55	9.19 (15)	0.64
Pm4	6.27 (18)	0.51	**	6.58 (12)	0.51		9.05 (17)	0.61	9.27 (9)	0.60
M1	9.84 (17)	0.74	*	10.25 (14)	0.71		11.33 (17)	0.72	11.40 (14)	0.68
M2	8.89 (16)	0.50	**	9.39 (16)	0.72		11.23 (16)	0.84	11.52 (16)	0.79
M3	8.49 (13)	0.85	ns	9.24 (10)	1.17		10.87 (13)	1.14	11.01 (10)	0.99
MANDIBLE										
I1	5.27 (16)	0.43	ns	5.41 (9)	0.41		5.79 (16)	0.39	6.13 (7)	0.49
I2	5.90 (18)	0.45	ns	5.92 (9)	0.58		6.17 (18)	0.35	6.31 (9)	0.38
C	6.64 (19)	0.39	**	6.93 (14)	0.60		7.49 (17)	0.48	7.95 (15)	0.81
Pm3	6.60 (22)	0.40	ns	6.63 (12)	0.55		7.63 (22)	0.60	7.52 (13)	0.62
Pm4	6.57 (23)	0.46	**	6.92 (15)	0.69		7.91 (22)	0.67	8.18 (14)	0.74
M1	10.57 (23)	0.75	*	11.05 (21)	0.87		10.43 (23)	0.61	10.35 (20)	0.58
M2	9.97 (23)	0.65	ns	10.23 (6)	0.90		9.97 (25)	0.59	9.90 (6)	0.57
M3	10.01 (17)	1.00	ns	10.15 (4)	0.66		9.74 (17)	1.11	9.65 (4)	0.16

ns - not significant

* - significant at 0.05 level

** - significant at 0.01 level

teeth occur significantly more often in the TMG than in the SKH series ($\chi^2 = 3.11$). This is true for both central and lateral incisors. The "semi" and "full" expression of shovelling are absent in the SKH but present in the TMG series. The two skeletal series do not differ markedly in the frequency of occurrence of median lingual ridges or variations in the incisor cingulum.

Table 2: Crown Indices for Permanent Teeth from Sarai Khola (SKH) and Timargarha (TMG)

	Crown Area			Crown Index			Crown Module		
	SKH	TMG		SKH	TMG		SKH	TMG	
	\bar{x} (n)	\bar{x} (n)	SD	\bar{x} (n)	\bar{x} (n)	SD	\bar{x} (n)	\bar{x} (n)	SD
MAXILLA									
I1	57.70 (12)	61.88 (5)	3.55	116.13 (12)	120.69 (5)	5.33	7.61 (12)	7.90 (5)	0.24
I2	41.67 (11)	42.86 (6)	4.71	103.90 (11)	105.54 (6)	5.98	6.45 (11)	6.54 (6)	0.37
C	59.19 (14)	66.19 (10)	5.80	92.66 (14)	91.65 (10)	5.59	7.69 (14)	8.14 (10)	0.35
Pm3	58.71 (17)	63.50 (14)	8.94	71.21 (17)	74.10 (14)	2.51	7.77 (17)	8.04 (14)	0.57
Pm4	56.92 (17)	61.78 (9)	8.90	69.26 (17)	71.51 (9)	2.15	7.66 (17)	7.95 (9)	0.57
M1	111.86 (17)	117.22 (14)	14.17	86.82 (17)	89.95 (14)	3.94	10.58 (17)	10.83 (14)	0.65
M2	100.04 (16)	108.58 (16)	14.51	79.39 (16)	81.66 (16)	4.84	10.06 (16)	10.46 (16)	0.69
M3	92.99 (13)	102.79 (10)	21.44	78.37 (13)	83.73 (10)	4.65	9.68 (13)	10.13 (10)	1.06
MANDIBLE									
I1	30.52 (16)	33.28 (7)	5.36	91.37 (16)	88.17 (7)	3.64	5.53 (16)	5.76 (7)	0.45
I2	36.42 (18)	37.50 (9)	5.64	95.91 (18)	93.91 (9)	7.93	6.03 (18)	6.12 (9)	0.43
C	49.72 (17)	56.14 (14)	9.78	88.76 (17)	86.23 (14)	4.47	7.06 (17)	7.49 (14)	0.64
Pm3	50.41 (22)	50.42 (12)	7.93	86.94 (22)	87.61 (12)	3.67	7.11 (22)	7.10 (12)	0.56
Pm4	52.20 (22)	56.95 (14)	10.43	83.59 (22)	84.66 (14)	6.07	7.24 (22)	7.55 (14)	0.68
M1	110.52 (23)	114.18 (19)	14.39	101.43 (23)	106.02 (19)	3.99	10.50 (23)	10.67 (19)	0.67
M2	99.73 (23)	101.65 (6)	13.45	100.12 (23)	103.36 (6)	6.52	9.97 (23)	10.07 (6)	0.68
M3	98.38 (17)	98.03 (4)	7.53	103.21 (17)	105.14 (4)	5.77	9.87 (17)	9.90 (4)	0.39

Table 3: Morphological Trait Frequencies of Maxillary Incisor Teeth

Trait and Variations	SKH		TMG	
	I1	I2	I1	I2
1) Shovel-shaped Incisors				
no shovel (0)	6(.67)	7(.78)	2(.29)	3(.43)
trace (1)	3(.33)	2(.22)	4(.57)	2(.29)
semi (2)	0	0	1(.14)	1(.14)
full (3)	0	0	0	1(.14)
2) Median Lingual Ridges				
absent (0)	7(.78)	9(1.0)	5(.62)	7(1.0)
one ridge (1)	1(.11)	0	1(.13)	0
two ridges (2)	1(.11)	0	2(.25)	0
3) Cingulum Variation				
absent (0)	8(.89)	8(.89)	7(1.0)	4(.68)
grooved (1)	0	1(.11)	0	1(.16)
tubercle (2)	1(.11)	0	0	1(.16)

The frequency of maxillary molar traits (Table 4) also show important differences between the two skeletal samples. In hypocone size M2 and M3 of the SKH series exhibit a higher incidence of grade 3 (hypocone absent) than in the TMG series. This correlates with smaller crown size of maxillary molar teeth in the SKH series, and reflects both metrical and morphological reduction in the SKH dentition.

Various degrees of expression of Carabelli's trait are present in 50 percent of the first molar teeth of TMG and occur in only 22 percent of SKH first molars (Figure 1). The two skeletal series are similar in their degree of expression of the metaconule and protoconule.

In lower molar morphology the frequency of four-cusped first and second molars is greater in SKH than TMG. A difference that also indicates a greater degree of dental reduction in the SKH series than in the TMG series. The primary difference between groups in groove pattern is the higher frequency of X patterns in all molar teeth of the TMG series. While in entoconulid variation the two groups are similar, with regard to metaconulid variation the TMG series exhibits a higher frequency in all molar teeth.

Morphological features not listed in Table 3-5, but which have significant biological implications are three-rooted mandibular first molar teeth (3RM1) and the deflecting wrinkle. Three-rooted mandibular first molars were absent from the SKH series ($n=15$), but occurred twice (15%) in the TMG series. In both instances the trait was present bilaterally and the size of the disto-lingual root was large (Figure 2). In the TMG series a 3RM3 was found, though the biological significance of this variation is uncertain. The deflecting wrinkle, a trait which occurs in high frequency in central and east Asian populations, is absent from the SKH dentition but occurs in 23 percent ($n=13$) of the TMG lower first molar teeth (Figure 3).

Table 4: Morphological Trait Frequencies of Maxillary Molar Teeth

Trait and Variations	SKH			TMG		
	M1	M2	M3	M1	M2	M3
1. Hypocone Size Variation						
large (4)	11(.79)	2(.15)	0	17(.77)	0	1(.09)
medium (4-)	3(.21)	3(.23)	0	5(.23)	6(.46)	2(.18)
small (3)	0	3(.23)	4(.40)	0	4(.31)	5(.46)
absent (3)	0	5(.39)	6(.60)	0	3(.23)	3(.27)
2. Carabelli's Trait						
absent (0)	7(.78)	13(.93)	12(1.0)	9(.50)	12(.92)	10(.91)
small groove (1)	1(.11)	1(.07)	0	3(.17)	0	0
pit and groove (2)	0	0	0	1(.06)	0	0
double groove (3)	0	0	0	1(.06)	0	0
Y-form (4)	0	0	0	0	0	0
small tubercle (5)	0	0	0	2(.11)	1(.08)	1(.09)
medium tubercle (6)	0	0	0	0	0	0
large tubercle (7)	1(.11)	0	0	2(.11)	0	0
3. Metaconule (C-5) Variation						
absent (0)	6(.67)	12(.96)	8(.73)	15(.80)	13(1.0)	8(.80)
small (1)	1(.11)	2(.14)	1(.09)	2(.10)	0	2(.20)
(2)	2(.22)	0	1(.09)	2(.10)	0	0
(3)	0	0	0	0	0	0
large (4)	0	0	1(.09)	0	0	0
4. Protoconule (C-6) Variation						
absent (0)	8(.89)	12(.92)	9(.82)	10(.67)	12(1.0)	8(.89)
small (1)	1(.11)	1(.08)	1(.09)	4(.27)	0	1(.11)
(2)	0	0	1(.09)	1(.06)	0	0
large (3-5)	0	0	0	0	0	0

Discussion

Two sets of dental data are suitable for comparison with the data reported here for Sarai Khola and Timargarha. One skeletal sample is derived from Megalithic monuments near Nagpur in Central India. The archaeological setting of this Iron Age site is discussed by DEO (1973, 1978) who estimates its antiquity at about 800 B.C. The dental pathology, morphology and crown dimensions of fifteen individuals from Mahurjhari were reported by LUKACS (In Press).

The second sample is a skeletal series of sixteen individuals from Neolithic levels at Mehrgarh. The human remains from Mehrgarh though geographically nearer to Sarai Khola and Timargarha are considerably earlier chronologically (6000-7000 B.C.), and are associated with 1) a more primitive material culture, and 2) the transition from hunting and gathering to agriculture as a mode of subsistence.

The archaeological context of the early Neolithic skeletons from Mehrgarh and the significance of this site in the prehistory of the Indo-Pakistan border lands is thoroughly documented (JARRIGE 1981, JARRIGE and LECHEVALIER 1979, 1980; JARRIGE and MEADOW 1980; LECHEVALIER and QUIVRON 1981; MEADOW 1981).

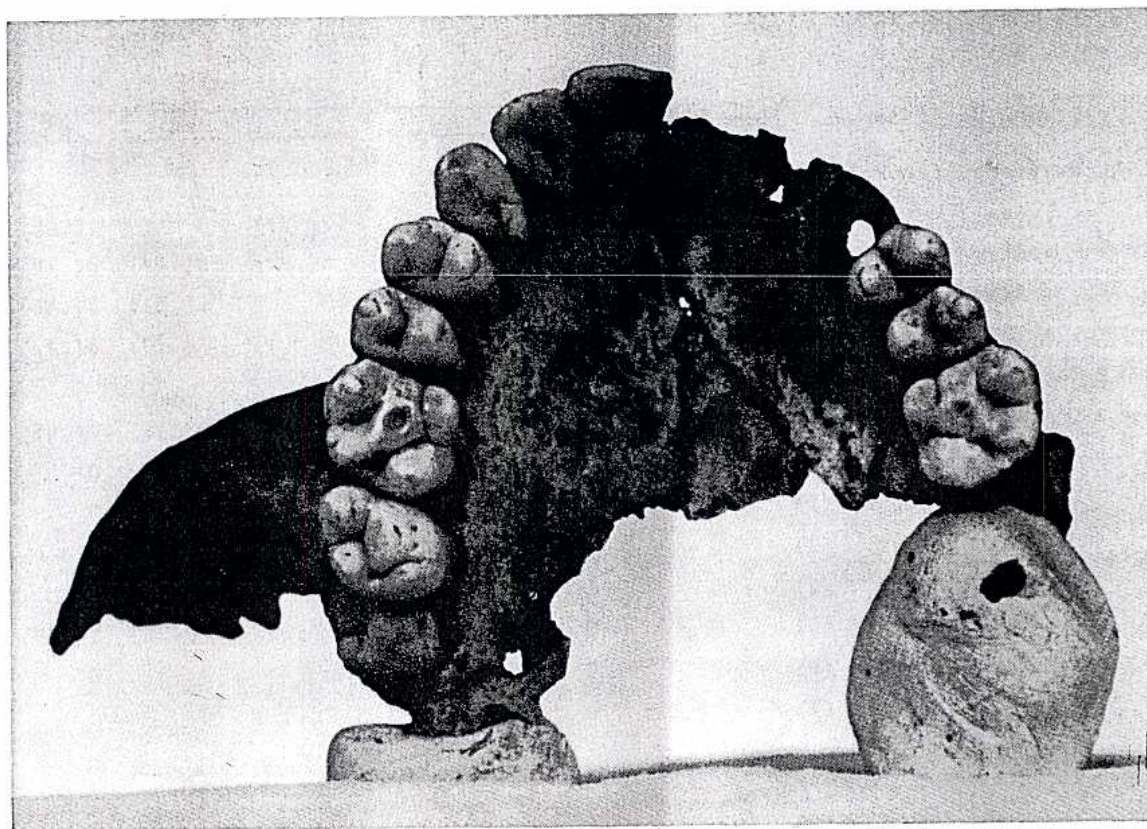


Figure 1: Occlusal aspect of the maxilla of SKH-16 showing fully developed Carabelli's cusp on maxillary first molar teeth.

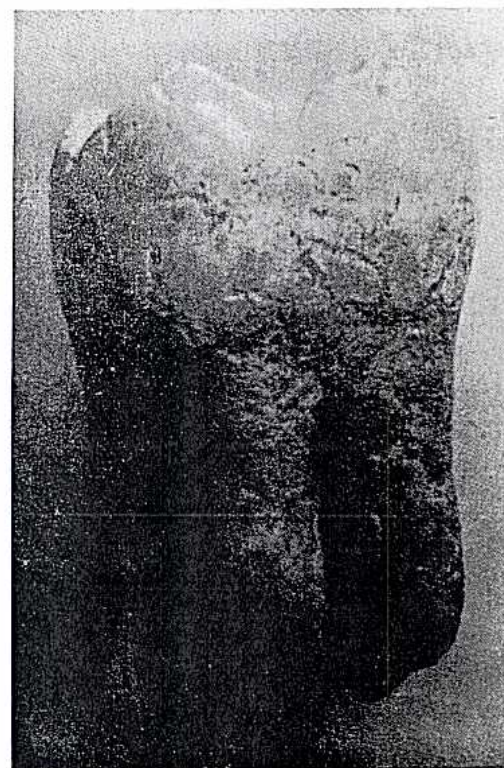
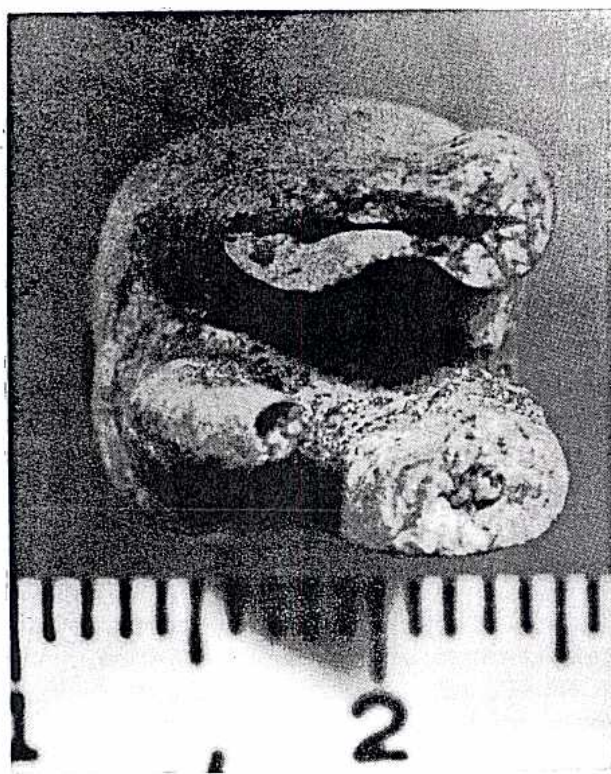


Figure 2: Three-rooted mandibular first left molar of TMG-134:
a) apical view of roots—anterior (mesial) root at top photo;
b) 3/4's view of accessory root from distolingual perspective.

Table 5: Morphological Trait Frequencies of Lower Molar Teeth

Trait and Variations	SKH			TMG		
	M1	M2	M3	M1	M2	M3
1) Cusp Number						
(6)	1(.07)	1(.07)	1(.07)	2(.08)	1(.06)	1(.17)
(5)	8(.53)	0	4(.29)	17(.68)	2(.12)	1(.17)
(4)	6(.40)	14(.93)	8(.57)	6(.24)	14(.82)	2(.33)
(3)	0	0	1(.07)	0	0	2(.33)
2) Groove Pattern						
(Y)	5(.71)	5(.36)	1(.08)	12(.71)	3(.17)	1(.17)
()	2(.29)	6(.43)	7(.58)	3(.18)	2(.11)	1(.17)
(X)	0	3(.21)	4(.34)	2(.11)	13(.72)	4(.66)
3) Entoconulid(C-6) Variation						
(0)	13(.93)	15(1.0)	12(.86)	22(1.0)	17(.94)	5(.83)
(1)	1(.07)	0	1(.07)	0	1(.06)	1(.17)
(2)	0	0	1(.07)	0	0	0
(3-5)	0	0	0	0	0	0
4) Metaconulid Variation						
(0)	14(.93)	15(1.0)	14(1.0)	22(.92)	18(.90)	5(.83)
(1)	0	0	0	1(.04)	1(.05)	0
(2)	1(.07)	0	0	1(.04)	1(.05)	0
(3-4)	0	0	0	0	0	1(.17)

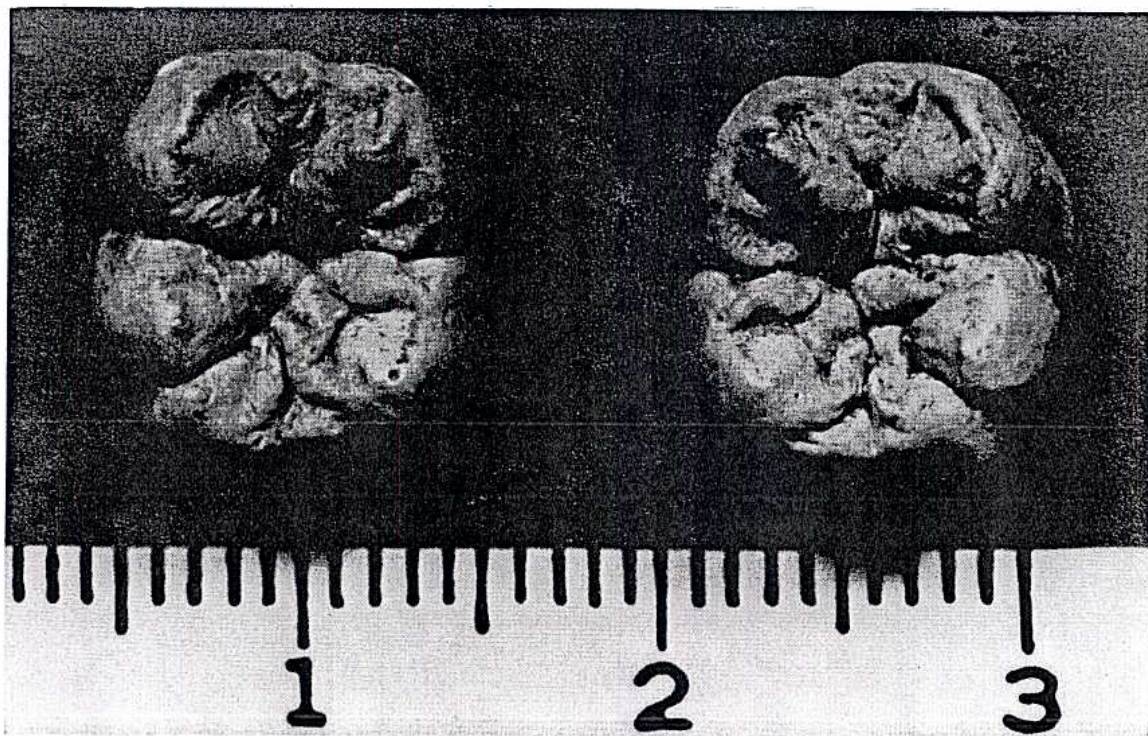


Figure 3: Deflecting wrinkle of mandibular first molar teeth of TMG-250-b.

Table 6: Tooth Crown Areas of Individual Teeth from Iron Age Mahurjhari and Neolithic Mehrgarh

	MAXILLA				MANDIBLE							
	Mahurjhari		Mehrgarh		Mahurjhari		Mehrgarh					
	\bar{X}	(n)	SD	\bar{X}	(n)	SD	\bar{X}	(n)	SD			
I1	64.64	(3)	5.44	64.72	(6)	7.53	33.39	(5)	2.90	31.91	(6)	2.89
I2	43.60	(5)	4.93	48.96	(5)	2.97	39.36	(2)	0.42	37.87	(6)	3.13
C	66.61	(6)	7.53	62.58	(7)	4.89	53.17	(5)	3.45	50.42	(6)	6.73
Pm3	65.40	(3)	7.87	67.43	(7)	9.08	54.00	(6)	3.78	55.53	(8)	7.18
Pm4	62.71	(3)	7.41	70.10	(6)	5.08	58.10	(6)	4.48	58.53	(7)	5.44
M1	121.72	(7)	7.85	120.95	(6)	5.75	119.83	(10)	5.27	123.11	(8)	8.06
M2	102.79	(8)	7.67	116.06	(7)	5.69	111.96	(11)	8.14	112.54	(5)	5.69
M3	112.31	(6)	17.71	99.14	(5)	16.57	110.45	(6)	11.92	108.66	(5)	6.48

The comparative evaluation of the Sarai Khola and Timargarha dentitions allows a diachronic contrast with the Mehrgarh sample and a roughly synchronic contrast with the Mahurjhari sample.

Tooth crown areas of SKH and TMG can be compared with data for individual teeth from Mahurjhari and Mehrgarh presented in Table 6. Comparative evaluation of tooth crown areas is facilitated by the summarized crown areas for each group. These are presented in Table 7 and clearly show that in total crown area SKH is the smallest. The difference in crown area between Mahurjhari (MHR) and Mehrgarh is minimal, they both exhibit relatively large tooth sizes. TMG is intermediate in crown area, larger by 65.96 mm² than SKH, but substantially smaller than the areas reported for Mahurjhari and Mehrgarh.

Maxillary anterior teeth and maxillary molar teeth of SKH are 7.2 percent smaller than figures for these tooth groups for the TMG sample. Mandibular anterior teeth in the SKH series are 8.1 percent smaller than in TMG, but mandibular molars are only 1.7% smaller. The difference in total crown area between SKH and TMG can be attributed to differences in size of anterior teeth (upper and lower) and maxillary molars.

In total crown area the SKH sample is 5.6 percent smaller than TMG, 9 percent smaller than Mahurjhari (MHR) and 10 percent smaller than Mehrgarh. The TMG

Table 7: Summed Crown Areas for Three Iron age Skeletal Series and Neolithic Mehrgarh (in mm²)

	<u>MAXILLA</u>			
	<u>MHR</u>	<u>SKH</u>	<u>TMG</u>	<u>Mehrgarh</u>
1) Anterior teeth (I1 - C)	174.85	158.56	170.93	176.26
2) Molar teeth (M1 - M3)	336.82	304.89	328.59	336.15
3) Posterior (Check) Teeth (Pm3 - M3)	464.93	420.52	453.87	473.68
4) Total Crown Area (1 plus 3 above)	639.78	579.08	624.80	649.94
			<u>MANDIBLE</u>	
5) Anterior teeth (I1 - C)	125.92	116.66	126.92	120.42
6) Molar teeth (M1 - M3)	342.24	308.63	313.86	344.31
7) Posterior (Check) Teeth (Pm3 - M3)	454.34	411.24	421.22	458.37
8) Total Crown Area (5 plus 8 above)	580.26	527.90	548.14	578.79
9) Grand Total Crown Area: Maxilla and Mandible (4 plus 8 above)	1220.04	1106.98	1172.94	1228.73

sample is 4.4 percent smaller than Mehrgarh and 4.0 percent smaller than Mahurjhari in total crown area.

Taken individually each of the differences in morphological trait frequency discussed above can be considered minor, especially given the small number of observations. However, when considered together these differences suggest that the SKH and TMG samples are probably derived from different gene pools.

The TMG series exhibits a number of similarities in dental morphology to the Neolithic occupants of Mehrgarh. Most noteworthy are correspondences in the frequency of shovel-shaped incisor teeth and the presence of protostylids, metaconulid, and 3 RM 1 in both series. An important distinction between TMG and Mehrgarh is in the frequency of Carabelli's trait which is common in the former and absent in the latter. These similarities in dental morphology between TMG and Mehrgarh are as important as the differences in trait frequency between TMG and SKH.

These data on tooth size and morphology suggest the possibility of a genetic continuum between the people of Mehrgarh and TMG. Caution must be exercised here because of the large temporal gap separating these two skeletal samples. The morphological characteristics of the TMG dentition suggest that this skeletal sample is indigenous to Pakistan and not a recent immigrant population derived from the west.

The dental morphology of the SKH sample exhibits several important differences when contrasted with the ancient Mehrgarh series and with the roughly contemporaneous TMG series. These differences include reduction in maxillary and mandibular molar cusp number, the absence of "semi" and "full" grades of expression of shovel-shaped incisor teeth and the absence of 3RM1 and the deflecting wrinkle, and are best interpreted as indicating the genetic separateness of SKH from the TMG and Mehrgarh samples.

While the data at hand are meager, the evidence of dental morphology suggests that the SKH series may indeed represent recent immigrants to northern Pakistan, whose genetic affinities lie with peoples to the west.

Conclusions and Summary

This analysis of the dentition of skeletal series from the Iron Age sites of Sarai Khola (SKH) and Timargarha (TMG) reveals that:

- 1) In tooth size, as measured by summed tooth crown areas, SKH is smaller than TMG. The SKH sample is also smaller in tooth size than two other skeletal samples from South Asia (Mahurjhari and Mehrgarh) for which summed tooth crown areas exist.
- 2) In dental morphology SKH and TMG samples differ in the frequency of maxillary incisor shovelling, hypocone size, Carabelli's trait and in lower molar cusp number. Important morphological differences between these groups include the presence of 3RM1 and deflecting wrinkle in TMG and the absence of these features from the SKH sample.
- 3) The reduction in size and morphological complexity of the SKH dentition, vis-a-vis the TMG dentition, suggests that these skeletal samples are derived from separate genetic populations.
- 4) Specific morphological traits found in the TMG dentition are also found in the dentition of the early Neolithic skeletons from Mehrgarh. These similarities in tooth size and particularly dental morphology suggest the possibility of a biological (genetic) continuum between the Mehrgarh people and the people of Timargarha.
- 5) The differences in dental morphology between the SKH and TMG samples and the evolutionarily progressive character of the SKH dentition indicates that the closest affinities of this group may be with people of southwest Asia or the Eastern Mediterranean.

- 6) Though meager, the dental data suggest that the TMG sample represents an indigenous population showing kinship with earlier occupants of Pakistan, but that the SKH sample is likely to represent a recent immigrant population in Pakistan as suggested by Professor Bernhard.

Zusammenfassung

Die Analyse der Dentition eisenzeitlicher Skelette von Sarai Khola (SKH) und Timargarha (TMG), beide Pakistan, kommt zu folgenden Ergebnissen: 1. Die Zahngröße ist bei SKH geringer als bei TMG und auch als bei zwei anderen südasiatischen Serien (Mahurjari und Mehrargh). 2. In bezug auf morphologische Zahnmerkmale unterscheiden sich SKH und TMG u. a. in der Häufigkeit von schaufelförmigen oberen Incisiven, von Carabelli's Höckerchen, der Höckerzahl bei den unteren Molaren und der Hypocon-Größe. 3. RM 1 and treten nur bei TMG auf, sie fehlen bei SKH. 3. Die Reduktion von Größe und morphologischer Komplexität der SKH-Dentition im Vergleich mit der von TMG könnte darauf hinweisen, daß die beiden Stichproben von verschiedenen genetischen Populationen abzuleiten sind. 4. Spezifische morphologische Merkmale der TMG-Dentition finden sich auch bei den frühneolithischen Skeletten von Mehrargh. Ein biologisches (genetisches) Kontinuum zwischen der Mehrargh- und der Timargarha-Bevölkerung erscheint daher möglich. 5. Die Unterschiede zwischen SKH und TMG und der progressive Charakter der SKH-Dentition weisen auf besonders enge Beziehungen dieser Gruppe zu Bevölkerungen Südwest-Asiens oder des östlichen Mittelmeerraumes hin. 6. Trotz des geringen Umfangs der Zahndaten weisen diese darauf hin, daß TMG eine einheimische Bevölkerung darstellt, die mit früheren Bevölkerungen Pakistans verwandt ist, während es sich bei SKH wahrscheinlich um eine jüngere Einwanderergruppe handelt, wie auch W. BERNHARD annahm.

Résumé

L'analyse de la dentition de squelettes de l'âge de fer provenant de Pakistan, c'est à dire de Sarai Khola (SKH) et de Timargarha (TMG) a abouti à des résultats suivants: 1. Les dents sont plus petits à SKH qu'à TMG et aussi plus petits que chez deux autres séries du sud de l'Asie (Mahurjari et Mehrargh). 2. En ce qui concerne la morphologie dentaire, SKH et TMG se distinguent l'un de l'autre par la fréquence d'incisives maxillaires en forme de pelle, le tubercule de Carabelli, le nombre de cuspides molaires inférieures et la grandeur du hypocone. 3. RM 1 et le "deflecting wrinkle" se trouvent seulement à TMG, ils manquent à SKH. 3. La réduction de grandeur et de complexité morphologique de la SKH-dentition en comparaison avec celle de TMG fait penser que les deux échantillons dérivent de populations génétiquement séparées. 4. Des caractères morphologiquement spécifique de la TMG-dentition se trouvent aussi dans la dentition des squelettes ancien-néolithiques de Mehrargh. Cette similarité suggère la possibilité d'un continu biologique (génétique) entre la population de Mehrargh et de Timargarha. 5. Les différences entre SKH et TMG et le caractère progressif de la SKH-dentition indiquent des affinités particulièrement étroites de ce group avec les populations du sudouest de l'Asie ou avec celles de l'est de la Méditerranée. 6. Malgré pauvres, les données dentaires indiquent que l'échantillon de TMG représente une population indigène qui montre parenté avec des populations plus anciennes de Pakistan, tandis que SKH représente vraisemblablement un group d'immigrants plus récent, ce qui a admis W. BERNHARD.

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