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THE RELATIONSHIP BETWEEN TOOTH MATERIAL AND THE SUPPORTING STRUCTURES OF THE TEETH IN A GROUP OF KALAHARI BUSHMEN

A COMPARATIVE STUDY

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INTRODUCTION

HOWES[1, 2] studied the teeth and jaws of a group of American Whites and described a set of measurements to be made on models of the maxillary and mandibular teeth and their supporting structures. The variation which occurs in the measurements and calculations devised by Howes is comparatively small provided that cases are selected which show no evidence of malocclusion.

A similar study was conducted on a group of Bantu[3] and although the values obtained for this group differ in some respects from those of the American Whites, the variation in values is also comparatively small. This paper describes a Howes analysis on a group of young Kalahari Bushmen selected on the same basis as used in other similar investigations. A comparison is made between the results obtained in the present study and those of the American Whites and Bantu.

MATERIALS AND METHODS

In the winter of 1959, the University of the Witwatersrand Kalahari Research Committee sent an expedition into the central Kalahari. During this expedition impressions were taken of the teeth and supporting structures of 103 Bushmen.

The models of 17 young adults showing no evidence of malocclusion were selected for this study. The selection was made for a number of reasons: first, the absence of malocclusion is considered to be a normal characteristic of all racial groups; secondly, it excludes dentitions in which abnormalities of a local or general systemic nature have given rise to a malocclusion and maldevelopment of the supporting structures of the teeth; next, such a selection may possibly exclude hybrids;[4] and finally in young adults relatively little attrition and associated dimensional changes of the dentition have occurred.

The first measurement described by Howes[2] is called tooth material$^{(TM)}$ and is the sum of the mesio-distal diameters of the incisors, canines, premolars and first molar teeth. The second measurement, the first bicuspid coronal arch width$^{(CAW)}$,

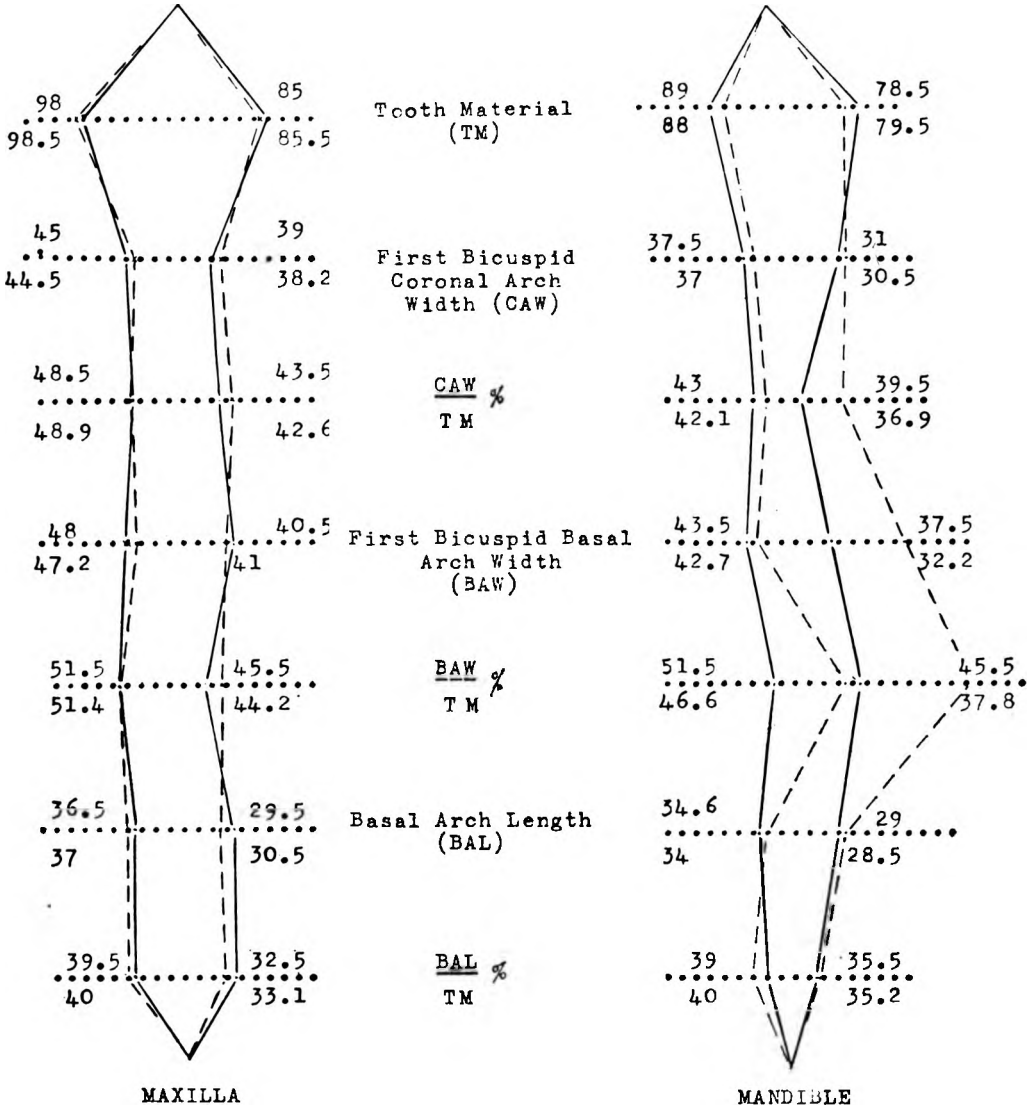


FIG. 1.—Polygon constructed in the manner described by Howes to compare maximum and minimum Bushmen values (in broken line) with those of the American Whites. Bushmen values appear below the values of the American Whites.

is the distance between two points just inside the crest of the buccal cusps of the first premolar teeth and indicates the width of the dental arch. The next measurement is the first bicuspid basal arch width(BAW) which is the distance between the most medial points over the apices of the roots of the first premolar teeth and indicates the amount of lateral growth of the jaw. Lastly, the basal arch length(BAL) which is the midline horizontal distance between two vertical planes, one of which passes through a line joining the most posterior points of the first molar teeth and the other through the most posterior point on the tissue over the apices of the central incisor teeth. This measurement represents the length of the jaws anterior to the second molar teeth.

All values are expressed in millimetres. In addition to these measurements, three calculations are made expressing the CAW, BAW and BAL individually as percentages of the tooth material.

RESULTS

These are summarized in Tables 1, 2, 3, as well as Figures 1 and 2.

DISCUSSION

In all three of the groups studied the range of measurements and calculations is comparatively small (Table 3). The maxillary tooth material has a wider range of values than any of the other measurements and calculations and is 13 mm. in all the groups. In the Bushmen this finding is reflected in the standard deviation from the mean which is 3·4. This is an unexpected result in a sample of individuals selected for the reasons already given. Statistical analysis of the results of the American Whites and Bantu groups is not available, but the scatter of the tooth material values is also wide.

The similarity in tooth material values of the selected group of Kalahari Bushmen and American Whites is considered elsewhere.[4] The teeth of Bantu have a greater mesio-distal width than that of American Whites and Bushmen. This difference is greatest in the mandibular teeth where the maximum measurements of American Whites and Bushmen are only 2 and 1 mm. greater than the minimum measurements of the Bantu.

This finding and the fact that there is less individual variation in the mandibular tooth material values of the Bushmen, suggests that tooth material may be used as a distinguishing feature between Bushmen and Bantu.

A comparison between the first bicuspid coronal arch width of the three groups shows that the maximum, mean and minimum values in the maxilla and mandible of the American Whites and Bushmen are very similar but the comparable values of the Bantu group are larger. The dental arches of the Bantu group are thus slightly wider than those of the other two groups.

The percentage ratio of the first bicuspid coronal arch width to tooth material is similar in all three groups studied. Therefore a direct correlation exists between the mesio-distal width of the teeth and dental arch width. This finding suggests that an increase in breadth and not the length of the dental arch is utilized to accommodate the large teeth of the Bantu.

The measurements of the first bicuspid basal arch width of the three groups overlap considerably. However, the values of the Bantu are slightly larger than those which occur in the other two groups and the mandibular values of the Bushmen are smaller than those of the other two groups. The narrowness of the jaws of the Bushmen in this region may in part be due to the possibility of this group having comparatively smaller anterior teeth which results in the measurement being taken more anteriorly.

In the maxilla, the ratios of the first bicuspid basal arch width to tooth material expressed as a percentage are very similar in the three groups studied. Although the Bantu have a larger range of values, the mean values of all three groups differ by less than two per cent. This ratio shows that all three groups have a correlation between their tooth material and the degree of lateral growth of the maxilla. In the mandible, the values of this ratio differ by less than one per cent for Bushmen and Bantu, but the corresponding values of the American Whites are from four to eight per cent higher. Thus in relation to tooth size the Bushmen and Bantu have relatively less lateral growth of

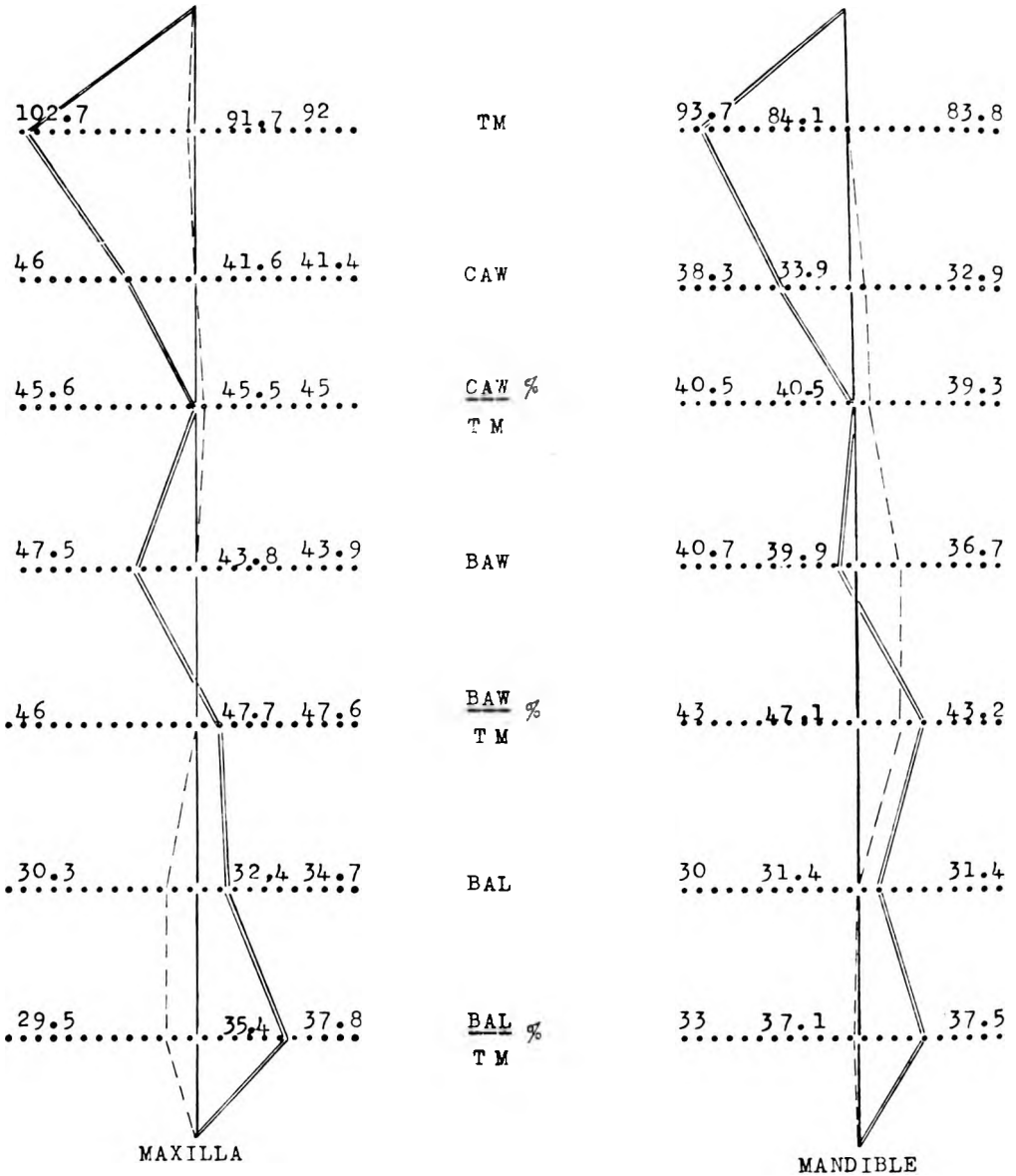


FIG. 2.—Polygon constructed in the manner described by Howes to compare the mean values of the three groups studied. Bantu values are represented by the double line; the values of the American Whites in centre by the single line; Bushmen values by the broken line.

their mandible in the first premolar region than the American Whites.

In the maxilla the maximum, mean and minimum BAL values of the Bushmen are the largest. The mean and minimum values of the Bantu are about 5 mm. less than the corresponding values of the Bushmen. In the mandible the differences in these values are not as marked as in the maxilla. The Bantu have a greater spread of values than the other two groups and the minimum mandibular value is 6 mm. less than the corresponding values of the American Whites.

The ratios of basal arch length to tooth material expressed as a percentage, are similar in Bushmen and American Whites in both maxilla and mandible. The values of the Bantu are generally smaller than those of the other two groups, the greatest difference being in the minimum values which are over 11 per cent less in both jaws than the corresponding Bushmen values. The Bantu have in addition a greater spread of values. These ratios indicate that the Bantu have relatively less basal arch length, especially in the mandible, in relation to tooth material than the other two groups. In order to accommodate the large tooth material on the relatively small basal arch length, the dental arch width is increased and the teeth are labially inclined, producing a true dental prognathism.[3]

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Table 1.—Maxillary values for Ashley E. Howes Analysis in a group of selected Bashmen, American Whites and Bantu expressed in millimetres.

	Bushmen			*American Whites*			*Bantu*		
	Max.	*Mean*	*Min.*	*Max.*	*Mean*	*Min.*	*Max.*	*Mean*	*Min.*
Tooth Material (TM)	98·5	92	85·5	98	91·7	85	109	102·7	96
1st Biscuspid Coronal Arch Width (CAW)	44·5	41·4	38·2	45	41·6	39	50	46	42
CAW / TM %	48·9	45	42·6	48·5	45·5	43·5	49·9	45·6	41·9
1st Bicuspid Basal Arch Width (BAW)	47·2	43·9	41	48	43·8	40·5	50	47·5	41
BAW / TM %	51·4	47·6	44·2	51·5	47·7	45·5	52·1	46	40·2
Basal Arch Length (BAL) ..	37	34·7	30·5	36·5	32·4	29·5	34	30·3	26
BAL / TM %	40	37·8	33·1	39·5	35·4	32·5	35·1	29·5	24·3

TABLE 2.—Mandibular values for Ashley E. Howes Analysis in a group of selected Bushmen, American Whites and Bantu expressed in millimetres.

	Bushmen			*American Whites*			*Bantu*		
	Max.	*Mean*	*Min.*	*Max.*	*Mean*	*Min.*	*Max.*	*Mean*	*Min.*
Tooth Material (TM)	88	83·8	79·5	89	84·1	78·5	100	93·7	87
1st Bicuspid Coronal Arch Width (CAW)	37	32·9	30·5	37·5	33·9	31	43	38·3	35
CAW / TM %	42·1	39·3	36·9	43	40·5	39·5	43·6	40·5	35·3
1st Bicuspid Basal Arch Width (BAW)	42·7	36·7	32·2	43·5	39·9	37·5	45	40·7	38
BAW / TM %	46·6	43·9	37·8	51·5	47·1	45·5	47·1	43	38·3
Basal Arch Length (BAL) ..	34	31·4	28·5	34·6	31·4	29	34	30	23
BAL / TM %	40	37·5	35·2	39	37·1	35·5	37·7	33	23·3

TABLE 3.—The scatter of differences between maximum and minimum values in millimetres.

Measurement or Ratio		*Bushmen*	*American Whites*	*Bantu*	*Standard Deviation of Bushmen Values*
TM	Maxilla	13	13	13	3·44
	Mandible	8·5	10·5	13	2·96
CAW	Maxilla	6·3	6	8	1·67
	Mandible	6·5	6·5	8	1·62
CAW / TM %	Maxilla	6·3	5	8	—
	Mandible	5·2	4·5	8·3	—
BAW	Maxilla	7·2	7·5	9	2·1
	Mandible	10	6	7	2·55
BAW / TM %	Maxilla	7·2	6	11·9	—
	Mandible	8·8	6	8·8	—
BAL	Maxilla	6·5	7	8	2·41
	Mandible	6·5	5·6	11	1·67
BAL / TM %	Maxilla	6·9	7	10·8	—
	Mandible	4·8	3·5	12·4	—