

A Metrical Study of some Periodontal Structures in the Vervet Monkey

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SUMMARY

In 20 vervet monkeys the gingival width, the distance between the cemento-enamel junction and alveolar margin and the sulcus depth were measured and the width of attached gingiva determined. There is a greater width of attached gingiva in the mandible than the maxilla and this width decreases from anterior to posterior. These patterns differ from those seen in man. The proportion of exposed root appears to be the same as in man. The vervet monkey is a suitable animal for experimental periodontal research providing that the pattern of attached gingiva is borne in mind.

OPSOMMING

Die wydte van die gingiva, die afstand tussen die sementoglasuur junksie en die alveolêre rand, en die diepte van die gingivale sulkus is in 20 blou-ape gemeet, en die wydte van die aangehegte gingiva is vasgestel. Die wydte van die aangehegte gingiva is groter in die mandibula as die maksil en hierdie wydte verminder van anterior tot posterior. Hierdie patrone verskil van die wat in die mens voorkom. Die proporsie van die blootgestelde wortel is blykbaar dieselfde as in die mens. Blou-ape is gepaste diere vir eksperimentele periodontiese navorsing mits dat die patroon van die aangehegte gingiva in gedagte gehou word.

INTRODUCTION

In periodontal research it is not always possible to experiment on man and a suitable experimental animal must be used instead. Levy (1971) considers the non-human primate to be a suitable animal for periodontal research.

One such animal that is readily available in South Africa is the vervet monkey (*Cercopithecus aethiops*). The dentition of this animal is similar to that in man (Ockerse 1959) and thus it was felt that this might also be true of the periodontium. Smukler and Dreyer (1969) have described the

arrangement of some of the fibres of the periodontal ligament around the lower incisor teeth in this species, but no reports exist as to the interrelationship of gingiva, alveolar bone and tooth. The present study was undertaken to establish the normal relationship between these structures and to determine whether the vervet monkey could be used for experimental periodontal research.

MATERIALS AND METHODS

Twenty vervet monkeys with no obvious periodontal defects were used in the study. The ages of the

animals were not known but in all but six there was a full complement of the permanent teeth including the third molars while in the remainder the third molars had not yet erupted.

The anaesthetised monkeys were sacrificed by decapitation and the oral structures were examined not more than 30 min later. Once the soft tissue measurements had been made the heads were cleared of all soft tissue and the measurements of the calcified tissues undertaken. During the cleaning process 3 heads were damaged and were discarded.

All soft and hard tissue measurements were made by the same investigator (A.V.) to the nearest 0.5 mm in good light using fine pointed dividers and vernier calipers. A periodontal pocket probe graduated in millimeters was also used. Initial observations showed that only the buccal segments were clinically similar to man and so the following measurements were made distal to the canine teeth. The buccal aspect of both sides in each jaw were examined and two measurements were made in relation to each tooth. These were in the long axis of the tooth roots which in the molar teeth correspond with the cusp-root line. In the case of the third molar only a single measurement was made at the mesial aspect of the tooth. This was because of the close proximity of the ascending ramus of the mandible, with its muscle and mucosal coverings, to the distal aspect.

The measurements were:

1. Gingival width — from the gingival margin to the mucogingival line.
2. Clinical crown height — from the gingival margin to the buccal cusp tip.
3. The distance from the cemento-enamel junction to the alveolar margin.
4. Depth of the gingival sulcus.

RESULTS

The gingival margin and mucogingival line were easily identified, the gingivae forming a fairly broad band of well defined tissue (fig 1). There was no significant difference in each jaw between the right and left sides which are mirror images of each other. The mean values of the gingival width in each jaw are listed in table I.

As the measurements of the clinical crown heights progressed it became obvious that there was great variation in the degree and pattern of attrition present even in animals of the same sex and approximate age. For this reason these measurements were discarded.

The height of exposed root, that is from the alveolar margin to the cemento-enamel junction is shown in table II. As with the gingival width measurements there was no significant difference between right and

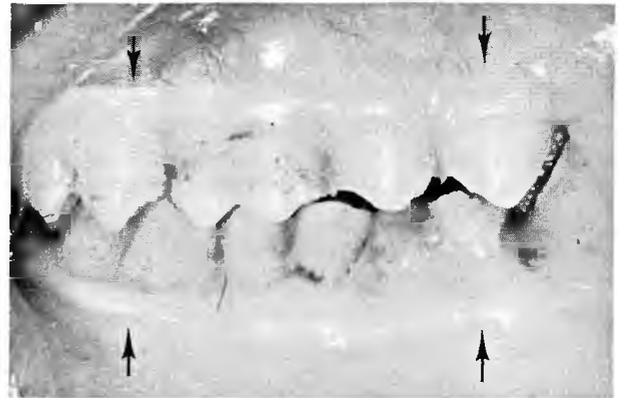


Fig. 1. The right permanent premolar and molar teeth in a vervet monkey. The mucogingival line is indicated by arrows.

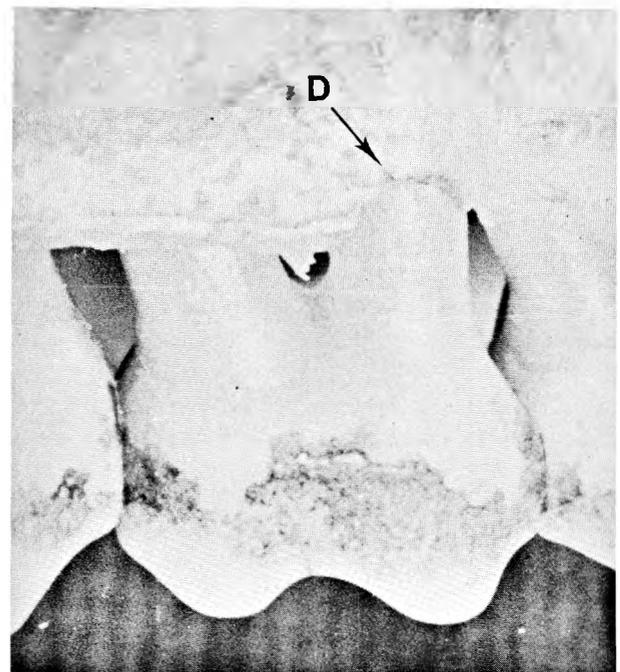


Fig. 2. An upper first permanent molar showing the lines of measurement between the cemento-enamel junction and alveolar margin, and a dehiscence (D) over the mesio-buccal root.

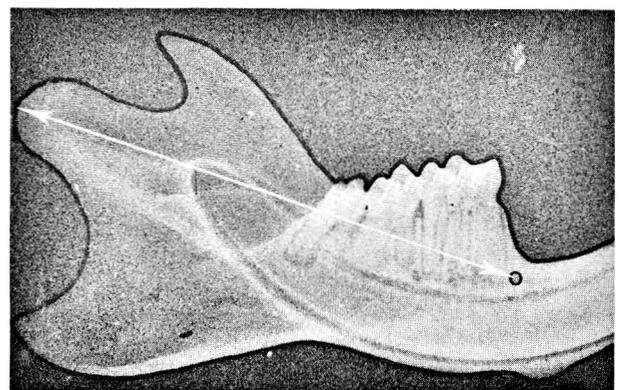


Fig. 3. Comparison of the patterns of the width of attached gingiva in the maxillas and mandibles of the vervet monkey (present study) and man (Ainamo and Loe 1966).

TABLE I
GINGIVAL WIDTH

JAW	TOOTH	RANGE (MM)	MEAN (MM±SD)
MAXILLA	P1	1.5 - 3.5	2.4 ± 0.5
	P2	1.0 - 3.5	2.3 ± 0.5
	M1	1.0 - 3.0	2.1 ± 0.5
	M2	1.0 - 2.5	1.8 ± 0.5
	M3	0.5 - 2.0	1.3 ± 0.3
MANDIBLE	P1	2.0 - 4.5	2.9 ± 0.7
	P2	2.0 - 3.5	2.6 ± 0.5
	M1	1.5 - 4.0	2.4 ± 0.5
	M2	0.5 - 3.0	1.8 ± 0.7
	M3	0.5 - 2.0	1.4 ± 0.5

TABLE II

CEMENT-ENAMEL JUNCTION — ALVEOLAR MARGIN

JAW	TOOTH	RANGE (MM)	MEAN (MM) ± SD
MAXILLA	P1	0.0 - 1.5	0.9 ± 0.3
	P2	0.0 - 1.5	0.9 ± 0.4
	M1	0.5 - 2.0	1.5 ± 0.5
	M2	0.5 - 2.0	0.9 ± 0.3
	M3	0.5 - 1.0	0.7 ± 0.2
MANDIBLE	P1	0.5 - 2.0	0.8 ± 0.3
	P2	0.0 - 1.5	0.8 ± 0.4
	M1	0.5 - 2.0	1.1 ± 0.3
	M2	0.0 - 1.5	0.8 ± 0.3
	M3	0.0 - 1.5	0.5 ± 0.4

TABLE III

WIDTH OF ATTACHED GINGIVA

JAW	TOOTH	RANGE (MM)	MEAN (MM±SD)
MAXILLA	P1	0.7 - 2.7	1.6 ± 0.4
	P2	0.2 - 2.7	1.5 ± 0.4
	M1	0.2 - 2.2	1.3 ± 0.4
	M2	0.2 - 1.7	1.0 ± 0.4
	M3	0.0 - 1.2	0.5 ± 0.3
MANDIBLE	P1	1.2 - 3.7	2.1 ± 0.7
	P2	1.2 - 2.7	1.8 ± 0.5
	M1	0.7 - 3.2	1.6 ± 0.5
	M2	0.0 - 2.2	1.0 ± 0.7
	M3	0.0 - 1.2	0.6 ± 0.5

left sides. A common finding was a minor dehiscence on the mesiobuccal root of the upper first molar (fig 2) which accounts for the increased root exposure associated with the maxillary first molar.

The depth of the gingival sulcus lies between 0.5 and 1.0 mm in all areas measured, the mean value being 0.8 mm.

The width of attached gingiva was then determined by subtracting the depth of the gingival sulcus from the distance between the margin of the free gingiva and the mucogingival junction (Bowers 1963) and the values obtained are shown in table III.

DISCUSSION

Bowers (1963) in his study of the attached gingiva in man found a greater width of attached gingiva in the maxilla than the mandible. Also, he found that in the maxilla the attached gingiva increased in width from the first premolar distally, while in the mandible it increased from the premolar region towards the first molar and then decreased again. These findings were confirmed in a similar study by Ainamo and Löe (1966).

In the vervet monkey however the width of attached gingiva in the maxilla is less than in the mandible namely 1.2 mm ± 0.6 compared to 1.4 ± 0.8 mm and the difference between these values is highly significant ($P < 0.00001$). The width of gingival tissue in both jaws decreases from the first premolar distally. This rate of decrease is greater in the mandible. The attached gingiva follows exactly the same pattern. Thus, when compared to man the pattern of attached gingival width from the canines posteriorly is reversed, in that the mandibular tissue is greater than the maxillary. Secondly there is in man an increased width towards the posterior while in the vervet monkey there is a decrease (fig 3).

It was not possible to compare the values of gingival width (i.e. from the gingival margin to the mucogingival line) found in the present study with the findings in similar studies. This is because although both Bowers, and Ainamo and Löe measured the full gingival width they did not record these figures in their articles. They recorded only the attached gingival widths which were calculated from pocket depth and full gingival width. Bernimoulin, Son and Regolati (1971) used a different point of measurement and studied only the lower incisor region. Their study can also not be used as a comparison. With the exception of Bernimoulin *et al* the previous authors have not defined the exact points at which the gingival width and sulcus depth were measured and therefore where the attached gingival width lies. This does suggest the need for standard points of measurement for future studies.

Gargiulo, Wentz and Orban (1961) in their study of human autopsy specimens measured a variety of parameters at different stages of eruption. Among these was the distance from the cemento-enamel junction to the alveolar bone margin. This they found ranged from 1.08 to 1.71 mm as normal eruption progressed. In the present study the overall value was 0.9 mm. The teeth in the adult vervet monkey are approximately one half the size of that in an adult man. It does appear therefore that approximately the same proportion of exposed root is present in both species.

In the final analysis, in spite of obvious differences to man, it seems that the vervet monkey may be used in experimental periodontal research providing that

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the pattern of attached gingiva described is taken into account. It is suggested that if experimental periodontal surgery is contemplated, only the buccal segments should be used.

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