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Original Research Article

Evaluating the width of attached gingiva in various areas of the oral cavity and gingival sulcus depths in periodontally healthy adult subjects among eastern Indian population

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ABSTRACT

Background: The width of attached gingiva varies from tooth to tooth and also among individuals with mixed opinions regarding an "adequate" or "sufficient" dimension of the gingiva. Although the need for a so-called adequate amount of keratinized tissue for maintenance of periodontal health is questionable, the mucogingival junction serves as an important clinical landmark in periodontal evaluation. There are various methods of locating the mucogingival junction namely the functional method and the visual method with and without histochemical staining, which aid in the measurement of the width of attached gingiva.
Aims and Objectives: The objectives of the present study were to evaluate the width of attached gingiva as well as to determine the gingival sulcular depth in adult subjects from Eastern India.
Materials and Methods: Attached gingival width and sulcus depth were determined by a visual method, using a William's periodontal probe. There were 120 subjects (60 males) and 60 (females) who represented a healthy population of undergraduate students, interns and post graduate students of Buddha Institute of Dental Sciences and Hospital and the patients reporting to OPD of the Institute.
Results: Highest widths of attached gingiva in central incisors of maxillary (3.22±0.59) and mandibular arches (2.18±0.50) were found respectively. The present study found no significant differences in mean width of attached gingiva of maxillary and mandibular arches between male and female subjects. The mean gingival sulcus depth recorded in the present study was 1.04±0.13 mm. This was not significantly associated with age or gender. The mean value for the highest depth of gingival sulci for maxillary first molar was 1.07 ± 0.23 mm and lateral incisors of mandibular arches 1.05 ± 0.19 mm were found respectively.
Conclusion: This study has defined baseline values for the attached gingival width and sulcus depth among Eastern Indian population. This would help to determine deviation from the normal or this population and may help to identify individuals at risk for periodontal disease.

1. Introduction

The normal periodontium provides the support necessary to maintain teeth in function. It consists of four principal components: gingiva, periodontal ligament, cementum, and alveolar bone. Each of these periodontal components is distinct in its location, tissue architecture, biochemical composition, and chemical composition, but all of these components function together as a single unit.[1]

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The gingiva is that part of the masticatory mucosa which covers the alveolar process and surrounds the cervical portion of the teeth.[2] According to Glossary of Terms (2001) of the American Academy of Periodontology, attached Gingiva is that portion of the gingiva that is firm, dense, stippled, and tightly bound to the underlying periosteum, tooth, and bone.[3]

The attached gingiva is an important anatomic and functional landmark. There used to be a widespread assumption that a minimal width of attached gingiva was required to maintain optimal gingival health.

The gingival sulcus is the shallow crevice or space around the tooth bounded by the surface of the tooth on one side and the epithelium lining the free margin of the gingiva on the other side. It is V-shaped and barely permits the entrance of a periodontal probe. The clinical determination of the depth of the gingival sulcus is an important diagnostic parameter.[1]

One of the important characteristics of this sulcus is its depth. In almost all the dental procedures, the clinician is concerned for the gingival sulcus depth. Its knowledge is merely not only important for periodontal point of view for assessing the extent of periodontal detachment but also for restorative treatments. Therefore, the aim of the study was to evaluate the width of attached gingival and the depth of gingival sulcus in periodontally healthy subjects.

2. Materials and Methods

The study was approved by the Institutional Ethical Committee·One hundred twenty systemicallyhealthy subjects above the age of 18 years who met the inclusion criteria were recruited. The subjects consisted of undergraduate dental students, and otherwise healthy subjects presenting for check-up. The subjects were recruited from the eastern states of India i.e., Bihar, Jharkhand and West Bengal who had history of at least three ancestral generations belonging to these states.

A statistician was consulted to determine the appropriate minimum sample size for the study. The sample size for this study was calculated based on the previously published article for Mean Width of Attached gingiva (WAG) within age 25-40 is 2.82± 0.54 in Indian population[4] and in Nigerian population.[5]

2.1. Study protocol

The primary objective of the study was to evaluate the width of attached gingival and the depth of gingival sulcus in periodontally healthy subjects in Eastern Indian population.

The subjects for the study were selected based on inclusion criteria. The inclusion criteria consisted of the subjects above the age of 18 years with clinically healthy gingiva on an intact periodontium with full set of permanent dentition. Patients with systemic illnesses, pregnant or lactating women, patients on medications that could modify the gingiva such as calcium channel blockers, moderate to severe gingival inflammation, presence of gingival recession, and presence of clinical attachment loss were excluded.

The subjects were informed about the study protocol and those, who agreed for the study were made to sign a consent form and were finally included. The gingiva was assessed clinically to ensure its health using the gingival index (GI, Löe and Sillness, 1963).[3,6] A form consisting of two sections was used for data collection. The first section was used to document information on participants' demographic characteristics while the second section was used to record the findings from a periodontal examination. The periodontal examination was performed using UNC-15 periodontal probe on the mid facial surface of all teeth except third molars**.** The width of keratinized gingiva in the mid facial region and depth of the gingival sulcus were recorded.

Fig. 1: Measurement of width of attached gingiva

Fig. 2: Measurement of depth of gingival sulcus

Fig. 3: Magnfying loops

3. Clinical Examination

The lips were extended by retractors, the gingival tissues were dried with gauze and the buccal and labial zones of attached gingiva were measured with UNC-15 probe. Magnifying loops with 2.5x magnification were used in determining the measurements since it helps in enhancing visualization of fine detail and it compensates for the loss of near vision.

All measurements in fraction were rounded off to the nearest whole number of millimeters.

Two measurements were recorded:

1. Depth of gingival sulcus
2. Distance from the margin of free gingiva to the mucogingival junction, which was demarcated clinically from the adjacent alveolar mucosa.

The width of the attached gingiva was calculated by measuring the distance from the crest of the gingival margin to the mucogingival junction and then subtracting the probing depth of the gingival sulcus from this distance on the particular tooth. The measurements were recorded in the case history proforma and the data obtained were summarized in the master chart and sent to the statistician for analysis.

4. Statistical Analysis

Data obtained was compiled on a MS Office Excel Sheet (v2019, Microsoft Redmond Campus, Redmond, Washington, United States) The data were entered in the excel sheet and were presented as percentage or Mean ± SD. Unpaired t test was applied to compare the mean difference between the male and female subjects and Pearson Correlation test was applied to test the correlation between subjects of two genders using Statistical analysis software SPSS (version 22) & Graph Pad (version 5). P value ≤0.05 was considered as significant. Descriptive statistics like Mean & SD, Median for numerical data have been depicted.

4.1. Width of attached gingiva

Table 1: Reveals the mean width of attached gingiva. A total of 120 healthy subjects participated in the study with equal proportion of 60 males and 60 females.

WAG (mm)	Maxillary arch (N=120)	Mandibular arch (N=120)
Central incisor	3.22±0.59	2.18±0.50
Lateral incisor	2.85±0.70	2.05±0.53
Canine	1.97±0.61	1.34±0.46
First premolar	1.65±0.52	1.20±0.33
Second premolar	1.49±0.48	1.33±0.38
First Molar	1.73±0.46	1.66±0.44
Second Molar	1.65±0.50	1.65±0.52

Among the maxillary teeth, the central incisors had the highest average attached gingival width 3.22±0.59 (mm), while the second premolar had the least 1.49±0.48 mm. Regarding specific tooth types, the average attached gingival width for maxillary central incisors was 3.22±0.59 mm, while for mandibular central incisors it was 2.18±0.50 mm (Table 1)). The average attached gingival width for mandibular lateral incisors was 2.05±0.53 mm respectively. The maxillary first molars had an average attached gingival width of 1.73±0.46 mm, while that of the lower first molars was 1.66±0.44 mm. Lowest width of attached gingiva in second premolar and first premolar of maxillary arch and mandibular arch were found respectively. Highest widths of attached gingiva in central incisors of maxillary and mandibular arches were found respectively.

4.2. Gingival sulcus depth

The average gingival sulcus depth was 1.04±0.13 mm. (Table 3). It was not significantly associated with the age, gender. Lowest depth of gingival sulcus in canine and first premolar of maxillary arch and mandibular arch were found respectively. However, highest depths of gingival sulci in first molar of maxillary and lateral incisor of mandibular arches were found respectively.

Table 4 epresents the mean depth of gingival sulcus in female and male subjects. In females the greatest depth of gingival sulcus were noted in the maxillary first molar1.05±0.20 mm and the least were noted in the first premolar 1.00 mm. Among males the greatest depth of gingival sulcus were noted in first molar 1.08±0.26 mm while the least depths were noted in maxillary central incisors 1.03±0.16 mm Non-significant difference in mean depths of gingival sulci of maxillary arch and mandibular arch were observed between male and female were found.

Table 2: Mean width of attached gingiva in female and male subjects (mm)

WAG (mm)	Maxillary arch		P value	Mandibular arch		P value
Gender	Female (n=60)	Male (n=60)		Female (n=60)	Male (n=60)	
Central incisor	3.24±0.56	3.20±0.63	0.7022	2.14±0.47	2.21±0.54	0.4718
Lateral incisor	2.88±0.62	2.83±0.78	0.6973	2.06±0.49	2.05±0.57	0.9318
Canine	1.93±0.55	2.01±0.67	0.5023	1.42±0.44	1.27±0.47	0.0758
First premolar	1.67±0.47	1.63±0.57	0.7256	1.21±0.35	1.18±0.32	0.6822
Second premolar	1.44±0.46	1.53±0.49	0.2959	1.33±0.39	1.34±0.37	0.8112
First Molar	1.67±0.47	1.80±0.44	0.1112	1.62±0.45	1.71±0.43	0.2560
Second Molar	1.58±0.48	1.73±0.52	0.1221	1.59±0.46	1.72±0.57	0.1907

Non-significant difference in mean width of attached gingiva of maxillary arch and mandibular arch between male and females were found.

Table 3: Mean depth of gingival sulcus (mm)

GSD (mm)	Maxillary arch (N=120)	Mandibular arch (N=120)
Central incisor	1.03±0.14	1.03±0.16
Lateral incisor	1.04±0.17	1.05±0.19
Canine	1.02±0.11	1.03±0.16
First premolar	1.03±0.13	1.02±0.11
Second premolar	1.05±0.20	1.03±0.16
First Molar	1.07±0.23	1.04±0.19
Second Molar	1.06±0.22	1.04±0.18

Table 4: Mean depth of gingival sulcus in female and male subjects (mm)

GSD (mm)	Maxillary arch		P value	Mandibular arch		P value
Age	Female (n=60)	Male (n=60)		Female (n=60)	Male (n=60)	
Central incisor	1.02±0.13	1.03±0.16	0.5248	1.02±0.09	1.05±0.20	0.2411
Lateral incisor	1.03±0.11	1.06±0.21	0.2741	1.02±0.09	1.08±0.25	0.0515
Canine	1.00±0.00	1.03±0.16	NA	1.01±0.06	1.06±0.21	0.0776
First premolar	1.02±0.09	1.03±0.16	0.4752	1.00±0.00	1.03±0.16	NA
Second premolar	1.03±0.14	1.08±0.24	0.1692	1.00±0.00	1.06±0.23	NA
First Molar	1.05±0.20	1.08±0.26	0.4358	1.02±0.13	1.07±0.23	0.1501
Second Molar	1.05±0.20	1.08±0.24	0.5367	1.03±0.14	1.06±0.21	0.3084

Table 5: Correlation between mean width of attached gingiva and age

		Wag	Age
Wag	Pearson Correlation	1	-.028
	Sig. (2-tailed)		.759
	N	120	120
Age	Pearson Correlation	-.028	1
	Sig. (2-tailed)	.759	
	N	120	120

No correlations (r= -0.028, p=0.759) between mean width of attached gingiva and age were found (Table 5)

5. Discussion

Attached gingiva and gingival sulcus are important anatomical components of the periodontium, each having great clinical implications. In normal healthy periodontium variations exist in the width of attached gingiva in different patients and in different areas of the oral cavity of the same patient. Keeping in mind the very large population of diverse races of varying ethnicities of our country, a regional data base of these values in healthy subjects is important to be maintained. This would be helpful in getting reference values for each particular area and comparing with those of other parts of the country and other countries as well, for diagnosis, treatment planning and determination of prognosis of periodontal diseases and conditions. The present study has attempted to contribute to such a database of periodontal parameters for the Eastern Indian population (subjects from the eastern states of India i.e., Bihar, Jharkhand and West Bengal who had history of at least three ancestral generations belonging to these states).

Thus, the objectives of the present study were to evaluate the width of attached gingiva as well as to determine the gingival sulcular depth in adult subjects (subjects above the age of 18 years) with clinically healthy gingiva on an intact periodontium from Eastern India. The collected data was sent to statistician for analysis.

In the present study UNC-15 periodontal probe was used by a single examiner for all the recordings. The UNC-15 probe was chosen because it was rigid, calibrated (with options to measure upto 15 mm) and blunt. The bluntness of the point would not permit it to be forced easily beyond the base of the gingival sulcus, thereby providing a false reading for the depth. A single examiner took all the measurements in order to maintain the uniformity of standard and all the measurements were verified by a faculty member to reduce the possibility of discrepancies and errors.

The present study measured the width of attached gingiva with the help of UNC-15 Periodontal probe similar to a study performed by Shaju Jacob[7] and coworkers while Talari,[8] Ainamo[8] and Saario[8] used Schiller's iodine solution and orthopantomograms to measure the same. It has been reported by Bhatia et. al in 2015 that various methods of assessing attached gingival width, like visual, functional or histochemical do not result in any variations.[9]

One of the earliest studies on the width of attached gingiva was done by Bowers[10] in 1963 in the Ohio State University College of Dentistry, on a North American population. Bowers reported that facial attached gingiva varied in different areas of the mouth, which has been corroborated by multiple studies done around the world since then and also by the present study.

The present study was unable to find any relationship of the width of attached gingiva with age, which is in agreement with a study done in an adult population attending a dental college in Chhattisgarh by Shaju Jacob and coworkers, and also with a study done by Adesola[5] and coworkers on an adult Nigerian population. It is to be noted that all the above three studies have been conducted exclusively on adult populations within the age groups of 18-50 years.

Studies which have been conducted on populations having deciduous, mixed and permanent dentitions and have considered subjects up to and above 65 years of age have come to the conclusion that the width of attached gingiva increases with increase in age. This includes studies by Bowers (done on subjects between 3 and 35+ years), Bhatia et al.[9,10] (done on subjects between 1 and 45+ years age groups), Vandana et al.[11] (done on subjects between 4 and 25 years age groups), Khairat et al.1[2] (done on subjects of 1-60 years age groups) and Chacko et al.[12] (done on subjects of <14 to 45+ years age group).

The lingual/palatal zone of attached gingiva was not considered in this study because there is no clear dividing line between the attached gingiva and alveolar mucosa of the palate, the attached gingiva blends imperceptibly with the alveolar mucosa of the palate. Similarly, a definite demarcation between attached gingiva and lingual alveolar mucosa of the mandible could not be recorded for most subjects.

The findings of the present study should be interpreted with some caution considering the relatively small population of subjects considered. Thus further studies are required on larger sample sizes of periodontally healthy individuals in different populations in India to get a reference value for the width of attached gingiva and depth of gingival sulcus for each reigon, for making better treatment options and determination of treatment prognosis.

The mean gingival sulcus depth recorded in the present study was 1.04±0.13 mm. This was not significantly associated with age or gender. This value is slightly lower than the values recorded in the nigerian population by Adesola et al.[5] but is below the so called probing depth of a clinically normal gingival sulcus in humans, which has been proposed to be between 2-3 mm by Joseph P. Fiorellini, David M. Kim, and N. Guzin Uzel.[1]

6. Conclusion

The current study has come up with some baseline values for the width of attached gingiva and depth of gingival sulcus for the Eastern Indian population. From the above values it can be concluded that:

1. The attached gingival width varies in different areas of the mouth, being greater in the maxillary than in the mandibular reigon, with the maxillary central incisors having the greatest width and the mandibular first premolars having the least.
2. No significant relationship of attached gingival width was observed with age and gender.
3. The mean gingival sulcus depth was found to be 1.04±0.13 mm.
4. The lowest depth of gingival sulcus was found in canines of maxillary arch and first premolars of mandibular arch, whereas the highest depths were encountered in the first molars of maxillary arch and lateral incisors of mandibular arch.

7. Source of Funding

None.

8. Conflict of Interest

None.

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