



# An Interrelation between the Width of Attached Gingiva, Vestibular Depth and its Impact on Dental Hygiene Care

Sai S. Sreeja<sup>1</sup> Rahul Bhandary<sup>1</sup> Amitha Ramesh Bhat<sup>1</sup> Geethu Venugopalan<sup>1</sup> Meghana Sri Sai Ivaturi<sup>1</sup>

<sup>1</sup>Department of Periodontology, AB Shetty Memorial Institute of Dental Sciences, Nitte (Deemed to be University), Mangalore, Karnataka, India

Address for correspondence Sai S. Sreeja, post graduate student, Department of Periodontology, AB Shetty Memorial Institute of Dental Sciences, Nitte (Deemed to be University), Mangalore-575018, Karnataka, India (e-mail: sreejareddysai@gmail.com).

J Health Allied Sci<sup>NU</sup> 2023;13:404–409.

## Abstract

**Introduction** The portion of the keratinized gingiva that is firmly attached to the bone is a significant determinant influencing oral hygiene and aids in the removal of deposits from the gingival crest, upgrades esthetics, and minimizes erythema in the area of the restituted dentition.

**Aim** To assess an interrelation among the thickness of attached gingiva, erythema, and dental hygiene. An interrelation of vestibular height, thickness of attached gingiva, and dental hygiene.

**Materials and Methods** A transverse study has been conducted. A total of 150 individuals were polled for information. The thickness of attached gingiva and vestibular height were assessed in six front dentitions by means of functional method. Clinical metrics comprising Oral hygiene index and modified gingival index has been documented.

**Results** There was a positive correlation association among attached gingival width and oral health care ( $p < 0.01$ ). The vestibular depth, in contrast did not demonstrate any correlation ( $p < 0.01$ ).

**Conclusion** An adequate amount of attached gingiva is essential to maintain the gingival health and overall oral hygiene, whereas the depth of vestibule did not show any association with oral hygiene maintenance.

## Keywords

- ▶ width of attached gingiva
- ▶ vestibular depth
- ▶ oral hygiene

## Introduction

The gingiva that comprises both unattached (marginal gingiva) and attached gingiva is the keratinized portion that advances from the gingival crest to MGJ.<sup>1</sup> Attached gingiva is described as the “distance between the MGJ and the projection on the external surface of the bottom of the gingival sulcus or the periodontal pocket.” The flexible and established component of the gingiva that is firmly connected to

the supporting bone underneath is referred to as the attached gingiva. It is the keratinized portion of gingiva that helps the supporting structures of the dentition to withstand trauma or damage originating from external sources and assists to anchor the free gingival margin opposed by forces acting against each other. This ability of the attached gingiva is contributed by its histologic properties, which permit it to be stiff, rigid, and withstand friction. The strain or pressure is mainly sustained due to its dense mesh of tightly bound

article published online  
November 23, 2022

DOI <https://doi.org/10.1055/s-0042-1757735>.  
ISSN 2582-4287.

© 2022. The Author(s).

This is an open access article published by Thieme under the terms of the Creative Commons Attribution License, permitting unrestricted use, distribution, and reproduction so long as the original work is properly cited. (<https://creativecommons.org/licenses/by/4.0/>)

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

fibrous tissue. It acts as a base in opposition to physical stresses produced onto the supporting tissues, i.e., gingival tissue by that of the bundle bone fibers.<sup>2</sup> It also aids in the removal of deposits from the gingival crest, upgrades esthetics, and minimizes erythema in the area of the restituted dentition. If there is a presence of an adequate amount of attached gingiva the margin of the gingiva adheres well over the dentition and also around the prosthesis.<sup>3,4</sup>

Historically, there are mainly three techniques to determine the MGJ such as functional method (VM), visual method (FM), histochemical staining followed by visual method (HM).<sup>5</sup> The mucogingival junction can be determined using the functional method by demarcating the boundary between the fixed and mobile tissue. The tissue mobility can be assessed by applying a gentle load on the margin of the gingiva by using a periodontal probe oriented parallelly from the vestibule. It can also be visually examined by staining the complexity of mucogingival junction using an aqueous iodine solution. A mechanism behind which aqueous iodine solution works depends on the disparity of the amount of glycogen present. The amount of glycogen content, amount of non-specific esterase, and acid phosphatase composition of the alveolar membrane vary histochemically from that of the gingiva that is keratinized. Also, an iodine-positive response is attributed to the higher levels of elastic fibers in the oral epithelium.<sup>6,7</sup> In contrast, the gingival tissue, firmly adhered to the underneath supporting osseous tissue structure has no glycogen present in its outer most layer, which results in negative reaction after staining with iodine. As a result, the iodine solution selectively dyes only the alveolar mucosa, accentuating the MGJ.

The thickness of keratinized gingival portion can be assessed by measuring the distance between the marginal gingiva and the MGJ. The sulcular depth can be evaluated as an interval extending from the gingival margin to the base of crevice of the gingiva. The thickness of the attached gingiva can then be determined with the help of these measurements as the discrepancy among the depth of the sulcus and thickness of the keratinized gingival tissue.<sup>2</sup> Keratinized gingival portion can be clinically evaluated by pulling the lips to delineate mucogingival junction and if the marginal gingiva is mobile then the amount of determined keratinized gingiva is considered to be inadequate.

The width of attached gingiva (WAG) usually differs in the buccal sites of every tooth. The thickness is highly pronounced in upper and lower anterior regions, especially the incisor area which is around 3.5 to 4.5 mm (maxilla) and 3.3 to 3.9 (mandible), whereas the thickness is less pronounced in the maxillary and mandibular posterior region, which is around 1.9 mm in the maxillary arch and 1.8 mm in the mandibular premolars.<sup>8</sup> Bhatia et al in 2015 have performed a study to evaluate the WAG in various age limits and reported a gradual rise in the thickness of the gingiva along with the age.<sup>9</sup> Furthermore, a previous study conducted by Ainamo et al has also concluded increased gingival width in over erupted teeth.<sup>10</sup>

Lang et al have reported areas that are free from plaque and with an inadequate amount of keratinized gingiva

(<2 mm) presented with an inflammation, regardless of maintaining good overall dental hygiene, hence implying a minimum of 2 mm keratinized gingival width is critical for clinically healthy gingival tissues.<sup>11</sup> Following that, several authors questioned the premise. According to Miyasato et al, even if the thickness of the attached gingiva is < 1 mm, the gingival tissue would still persist to be healthy.<sup>12</sup> Lindhe et al performed a research to evaluate the response of various dentogingival units that had a different thicknesses of attached gingiva in beagle dogs and concluded that the dentogingival units that lacked an adequate amount of attached portion of gingiva might not be more vulnerable to inflammation than those compared with those having a broader area of attached gingival portion.<sup>13</sup> Stetler et al conducted a study on periodontal health of dentition with subgingival restorations and its correlation with the thickness of attached gingiva and concluded that subgingivally restored teeth with an insufficient amount of attached gingiva presented with a higher incidence of apical migration of gingiva than those compared with an adequate amount of attached gingiva.<sup>14</sup> Freedman et al concluded that there will be migration of the marginal gingiva and inadequate closure of the periodontal pocket which in turn might enable the deposition of plaque subgingivally if the thickness of the attached gingiva is insufficient.<sup>15</sup>

Vestibular depth is described as the length between the coronal portion/edge of the gingiva that is apical to the gingival sulcus (attached gingiva) and the deepest depression of the fold formed by the oral mucosa, i.e., mucobuccal fold. In other words, it is the area that is provided for speech, mimicry and absorption of the food betwixt the jawbones and cheeks. This area also allows the insertion of tooth cleaning aids such as brushes as well as interproximal hygiene tools. A vestibular depth that supports the maintenance/preservation of one's mouth clean and free of disease is typically regarded as a sufficient vestibular depth.<sup>16</sup> It was thought that a narrow vestibular depth or insufficient depth of vestibule along with the inadequate portion of keratinized tissue would promote the lodgement of food granules in the process of chewing, as well as interfere with the maintenance of oral cavity hygiene.<sup>17</sup>

Vestibular depth can be assessed by positioning the cheek expander and with the dentition of the opposing jaws held in contact, from the coronal edge of the gingiva that is apical to gingival sulcus to the deepest depression of mucobuccal fold. This assessment can be performed by using UNC graduated periodontal probe.<sup>16</sup> In this study this method was taken into consideration. Another method to assess the vestibular depth is by radiographic technique by Ward et al. Using probe, the sulcular depth of the gingiva is noted, after which a radiopaque lead foil sheet (5 mm in length) will be placed in the region of the tooth that demarcates the deepest depression of the mucobuccal fold. This lead foil is usually placed in the gingival sulcus. Then, using the probe, the portion of the lead foil above the gingiva (supragingival) and the portion beneath the gingiva (subgingival) are calculated. Orahesive is placed onto the lead foil that helps it to attach firmly to the surface of tooth. The mucosa will be coated with the contrast

dye to render the lip crest and mucobuccal fold radiopaque. Hence, this will render the upper and lower bounds of the vestibule radiopaque using a contrast dye and lead foil as a marker, allowing for their determination on a skull scan.<sup>18</sup> In a recent study, Padmini et al failed to establish a relation between the attached gingival thickness, mandibular vestibule depth, and maintenance of dental hygiene.<sup>2</sup>

The goals of the current study are to examine the relationship between the WAG and dental hygiene maintenance as well as the relationship between vestibular depth and maintenance of dental hygiene.

## Materials and Methods

### Study Design and Participants

A cross-sectional was performed from September to December 2021, with a sample of 150 patients in AB Shetty Memorial Institute of Dental Sciences. The participants included 79 males and 71 females. The protocol was explained to the participants in a written script as well as orally before the start of the study, followed by which the consent was obtained from the patient. The inclusion criteria for the patients were with an age limit of 20 to 40 years. The exclusion criteria were patients below 20 years of age, high frenal attachment, periodontal disease, orthodontic treatment, and non-compliant patients. Identification numbers were randomly assigned to each patient. Written consent was obtained from each patient before conducting the survey. Ethical clearance was obtained before the start of the study.

### Data Collection

The parameters recorded in the study were oral hygiene status, inflammation status of the gingiva, vestibular depth as well as the width of the attached gingival portion. Simplified oral hygiene index was used to assess the oral hygiene condition and modified gingival index was used to assess the inflammation of the gingiva. The vestibular depth was recorded from the margin of the gingiva to the greatest concavity of the mucobuccal fold (→ Fig. 1). If the dentition that is being measured has gingival recession, then the neighboring tooth is to be considered. Functional method was used in this study to determine the location of the MGJ, after which the keratinized tissue width was measured and sulcus depth was subtracted from the measured keratinized gingiva (→ Fig. 2). This was done on all the buccal sites of the upper and lower anterior teeth.

### Simplified Oral Hygiene Index Values and Interpretation

Simplified oral hygiene index (OHIS) was proposed by John C Greene and Jack R Vermillion in 1964 in which facial surfaces of 16, 11, 26, 31 and the lingual surfaces of 36, 46 that are completely erupted permanent teeth without any crown restorations or the teeth with reduced height due to caries were examined for debris and calculus.

The simplified oral hygiene index is interpreted as follows:

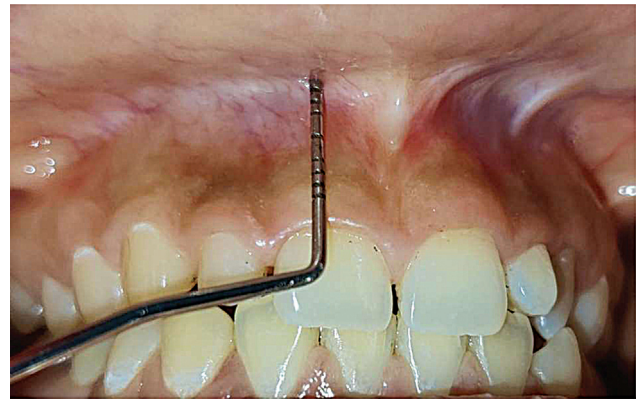


Fig. 1 Assessment of the depth of the vestibule.



Fig. 2 Assessment of the width of the attached gingiva by demarcating the mucogingival junction.

The addition of simplified debris scores and simplified calculus scores will result in the total OHIS scores.

1. It is interpreted as “good” if the OHIS values are between 0.0 to 1.2
2. It is interpreted as “fair” if the OHIS values are between 1.3 to 3.0
3. It is interpreted as “poor” if the OHIS values are between 3.1 to 6.0

## Statistical Analysis

These statistical analyses were performed using statistical software (SPSS v.21.0) and a  $p$ -value was  $< 0.05$  was considered statistically significant. Student's  $t$ -test was used to compare variables such as depth of vestibule, width of attached gingiva, OHIS, Gingival Index. Pearson's correlation coefficient was used to assess the correlation between width of attached gingiva and depth of the vestibule with oral hygiene status and Gingival index.

## Results

A total of 150 patients have taken part in the study at AB Shetty Memorial Institute of Dental Sciences, Mangalore. The majority of the respondents ( $n = 150$ ) were between the ages of 20 and 40 years. Out of 150 participants, the study included 79 males and 71 females (→ Table 1).

**Table 1** Demographic details

Gender	Age group	No.
Males	20-40	79
Females	20-40	71
Total		150

The average WAG was 3.00 mm and 2.01 mm in the maxillary arch and mandible, respectively. The average vestibular depth in maxilla was 9.8 mm and in mandible was 7.8 mm (► **Table 2**). ► **Fig. 3** shows the graphic representation of mean values of all the parameters based on gender.

A significant difference was seen between width of the attached gingiva with oral hygiene index and gingival index (► **Table 3**).

There is no significant difference between depth of the vestibule with oral hygiene and gingival indices (► **Table 4**).

**Table 3** Association of width of attached gingiva and to OHIS ( $p < 0.01$ )

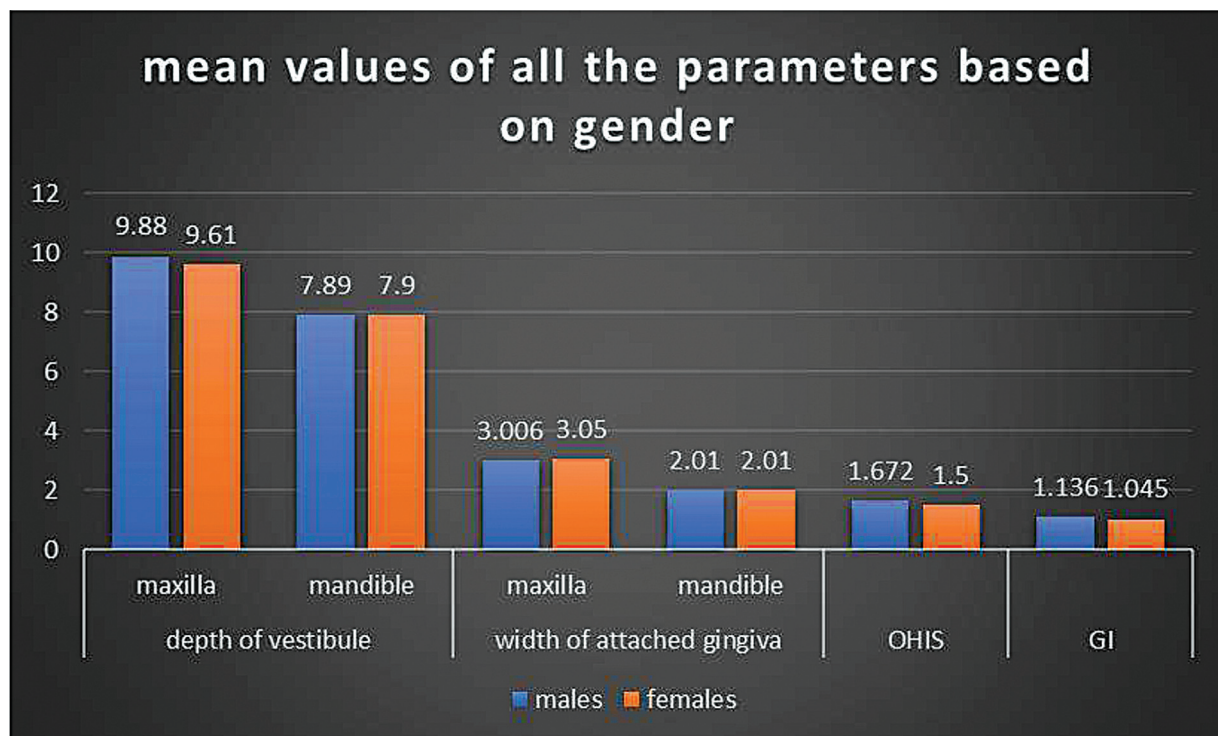
WAG	Pearson correlation	Sig.(two-tailed)
Maxilla	-0.372	0.000**
Mandible	-0.358	0.000**

**Table 4** Association of width of attached gingiva and to Gingival Index ( $p < 0.01$ )

Width of attached gingiva	Pearson correlation	Sig.(two-tailed)
Maxilla	-0.281	0.000**
Mandible	-0.344	0.000**

**Table 2** Mean of all the parameters in maxilla and mandible

Variables	N	Depth of vestibule		Width of attached gingiva		OHIS	GI
		Maxilla	Mandible	Maxilla	Mandible		
Male	79	9.88 ± 1.37	7.89 ± 1.20	3.006 ± 0.82	2.01 ± 0.77	1.672 ± 0.84	1.136 ± 0.54
Female	71	9.61 ± 1.47	7.90 ± 1.41	3.05 ± 0.90	2.01 ± 0.78	1.500 ± 0.56	1.0456 ± 0.56
t-Value		1.173	0.012	0.353	0.011	1.239	0.99
p-Value		0.243	0.990	0.725	0.991	0.217	0.319



**Fig. 3** Representation of the parameters in the form of graph



## Discussion

In the current study, 150 participants were examined to assess whether if there was any relation between WAG and vestibular depth with maintenance of dental hygiene. It has been shown that the vestibular depth did not have a clinical significance on oral hygiene maintenance but there was a significant correlation between WAG and oral hygiene maintenance. To determine the prevalence of periodontal disease, the WAG must be measured. The mucogingival junction acts as an essential reference point in determining the WAG, which is delineated using a variety of approaches. As proposed by Goldman, the mucogingival junction can be located by functional method, i.e., by demarcating the boundary among the mobile and fixed tissue. The movement of the tissue can be assessed by applying a gentle load on the margin of the gingiva using a periodontal probe oriented parallelly from the vestibule.<sup>19</sup> This technique was chosen because of its convenience, economical, and patient compliance. A study recently conducted by Bhatia et al compared the differences between both functional and histochemical staining method for determining the mucogingival junction and then measuring the WAG and reported no significant variances.<sup>9</sup> Because of the ease of accessibility, the mid-buccal region of the tooth was chosen.<sup>15</sup> All evaluations were performed by a single investigator to avoid probing variations.

In our study, the average width of attached gingiva did not show any significant difference in males and females. Bowers et al found no statistically significant variations between male- and female-attached gingiva widths<sup>20</sup> which was in line of accordance with our findings. Other investigations have reported a reduced WAG in females when compared with males.<sup>21,22</sup> which is opposite to our results. The WAG varies in different regions of the oral cavity, which is the maximum in the central incisors of the maxilla and minimum in the lower molars.<sup>8</sup> In this study, the average attached gingival width was 2.01 mm. It was more in the maxillary arch (3.00 mm) when compared with the mandible (2.01 mm), which is in line with other studies.<sup>20,23</sup>

In 1979, the concept of "Tissue barrier" was established by Goldman and Cohen. They hypothesized that a firm or thick layer of connective tissue (CT) consisting of collagen fibers would resist or slow the extension of inflammation effectively when compared with the loosely arranged fibers of alveolar mucosa. If the width of attached gingiva was less than 1 mm, then it was considered to be insufficient in this study which was in accordance in research of Wennstrom et al.<sup>24</sup> Lang and Loe conducted a study concluded that areas that are free from plaque and with an inadequate amount of keratinized gingiva (<2 mm) presented with an inflammation regardless of maintaining good overall dental hygiene.<sup>11</sup> In this study areas with less than 1 mm of attached gingiva, the mean simplified oral hygiene and modified gingival indices scores were higher when compared with the areas with greater than 1 mm of keratinized tissue width and these findings were in line with the findings of Lang et al.<sup>11</sup> The possible explanation for the positive correlation between attached gingiva and its impact on the dental hygiene care is

that irrespective of the presence or absence of frenal attachments, inflammation of the gingiva was still present, implying that the gingival inflammatory reaction is not solely the result of stimulation caused from these structures. It is more likely that a mobile marginal gingiva would make it easier for the bacteria to enter into the crevicular portion of the gingiva, leading to the formation of fine film of the biofilm and plaque beneath the gingiva, i.e., subgingivally, which is usually challenging to visualize as well as to get rid of with the use of toothbrush.<sup>25</sup>

## Conclusion

In this study, the association between the attached gingival width and its impact on dental hygiene care was found to be statistically significant. The areas with < 1 mm of attached gingiva the OHIS and the modified gingival indices scores were higher when compared with areas with > 1 mm of attached gingiva. However, the correlation between the vestibular depth and its impact on dental hygiene care was not statistically significant.

### Conflict of Interest

None declared.

## References

- 1 Ainamo J, Löe H. Anatomical characteristics of gingiva. A clinical and microscopic study of the free and attached gingiva. *J Periodontol* 1966;37(01):5–13
- 2 Padmini H, Raja KK, Hoe ZY, Teh YJ, Ting CJ. Correlation of width of attached gingiva, depth of the vestibule on gingival health and oral hygiene maintenance in Malaysian young adults. *J Clin Diagn Res* 2018;12(11):
- 3 Tarnow D, Hochman M, Chu S, Fletcher P. A new definition of attached gingiva around teeth and implants in healthy and diseased sites. *Int J Periodont Restor Dent* 2021;41(01):43–49
- 4 Fiorellini JP, Kim DM, Ishikawa SO. The gingiva. In: Newman, Michael G, Takei HH, Klokkevold PR, and Carranza FA, eds. *Carranza's Clinical Periodontology*. St. Louis: Elsevier Saunders; 2015;12:9–39
- 5 Guglielmoni P, Promsudthi A, Tatakis DN, Trombelli L. Intra- and inter-examiner reproducibility in keratinized tissue width assessment with 3 methods for mucogingival junction determination. *J Periodontol* 2001;72(02):134–139
- 6 Weinmann JP, Meyer J, Mardfin D, Weiss M. Occurrence and role of glycogen in the epithelium of the alveolar mucosa and of the attached gingiva. *Am J Anat* 1959;104:381–402
- 7 Tencate AR. The distribution of acid phosphatase, non-specific esterase and lipid in oral epithelia in man and the macaque monkey. *Arch Oral Biol* 1963;8:747–753
- 8 Hall WB. Can attached gingiva be increased nonsurgically? *Quintessence Int Dent Dig* 1982;13(04):455–462
- 9 Bhatia G, Kumar A, Khatri M, Bansal M, Saxena S. Assessment of the width of attached gingiva using different methods in various age groups: a clinical study. *J Indian Soc Periodontol* 2015;19(02): 199–202
- 10 Ainamo A, Ainamo J. The width of attached gingiva on supra-erupted teeth. *J Periodontal Res* 1978;13(03):194–198
- 11 Lang NP, Löe H. The relationship between the width of keratinized gingiva and gingival health. *J Periodontol* 1972;43(10):623–627
- 12 Miyasato M, Crigger M, Egelberg J. Gingival condition in areas of minimal and appreciable width of keratinized gingiva. *J Clin Periodontol* 1977;4(03):200–209

- 13 Ericsson I, Lindhe J. Recession in sites with inadequate width of the keratinized gingiva. An experimental study in the dog. *J Clin Periodontol* 1984;11(02):95–103
- 14 Stetler KJ, Bissada NF. Significance of the width of keratinized gingiva on the periodontal status of teeth with submarginal restorations. *J Periodontol* 1987;58(10):696–700
- 15 Freedman AL, Green K, Salkin LM, Stein MD, Mellado JR. An 18-year longitudinal study of untreated mucogingival defects. *J Periodontol* 1999;70(10):1174–1176
- 16 Halperin-Sternfeld M, Zigdon-Giladi H, Machtei EE. The association between shallow vestibular depth and peri-implant parameters: a retrospective 6 years longitudinal study. *J Clin Periodontol* 2016;43(03):305–310
- 17 Wennstrom J, PiniPrato GP. Mucogingival therapy periodontal plastic surgery. In: Lindhe J, Karring T, Lang N, eds. *Clinical Periodontology and Implant Dentistry*. 4th ed. Copenhagen: Blackwell Munksgaard; 2003:576–650
- 18 Ward VJ. A technique of measurement of the depth of the vestibular fornix in the mandibular anterior region. *J Periodontol* 1976;47(09):525–530
- 19 Goldman HM. A review of current technics in periodontal therapy as practised in the United States. *Int Dent J* 1960;10:287–309
- 20 Bowers GM. A study of the width of attached gingiva. *J Periodontol* 1963;34(03):201–209
- 21 Kolte R, Kolte A, Mahajan A. Assessment of gingival thickness with regards to age, gender and arch location. *J Indian Soc Periodontol* 2014;18(04):478–481
- 22 De Rouck T, Eghbali R, Collys K, De Bruyn H, Cosyn J. The gingival biotype revisited: transparency of the periodontal probe through the gingival margin as a method to discriminate thin from thick gingiva. *J Clin Periodontol* 2009;36(05):428–433
- 23 Adesola UK, Okhiabigie AP, Adeola A, Omowunmi AP, Ayodeji TO. Evaluation of the attached gingiva width and sulcus depth in an adult Nigerian population - a pilot study. *J Int Acad Periodontol* 2018;20(03):78–85
- 24 Wennström JL. Lack of association between width of attached gingiva and development of soft tissue recession. A 5-year longitudinal study. *J Clin Periodontol* 1987;14(03):181–184
- 25 Lang NP, Löe H. The relationship between the width of keratinized gingiva and gingival health. *J Periodontol* 1972;43(10):623–627