

# Correlation of Width of Attached Gingiva on Oral Hygiene Maintenance and Gingival Health

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## ABSTRACT

**Introduction:** Attached gingiva aids in increased resistance to external injury and contribute in stabilisation of gingival margin against frictional forces as well as dissipates physiological forces exerted by the muscular fibers of the alveolar mucosa on gingival tissues.

**Objective:** To assess width of attached gingiva in adults and correlate with oral hygiene maintenance and gingival inflammation.

**Methods:** A cross-sectional study was conducted in patients aged 20-40 years visiting dental OPD with healthy periodontium. Plaque index (PI) and Gingival index (GI) were recorded. Mucogingival junction was determined by visual and functional method. Keratinised gingiva width (KGW) and probing pocket depth (PPD) was recorded and attached gingiva width (AGW) was calculated as (KGW-PPD).

**Results:** Total 85 patients (43 males and 42 females) enrolled in this study. Among total, 48.23% had AGW<1 mm. AGW <1 mm most commonly was found in mandibular first premolar, highest mean AGW was found in maxillary incisors. The mean GI and PI values for AGW<1 mm were found to be higher than those for AGW≥ 1 mm. However, result did not show any significant relation between AGW and severity of gingival inflammation (P value 0.608) and plaque control (P value 0.297).

**Conclusion:** The correlation between attached gingiva width and severity of gingival inflammation and plaque index was not significant statistically. However, the mean gingival index and plaque index score were higher for the attached gingiva width less than 1 mm.

**Keywords:** Attached gingiva width; gingivitis; keratinized gingiva; mucogingival junction; oral hygiene.

## INTRODUCTION

Gingiva is part of oral mucosa that covers alveolar processes of jaws and surrounds necks of teeth which is anatomically divided into free gingiva, attached gingiva and interdental gingiva.<sup>1</sup>

Attached gingiva is portion of gingiva bound to alveolar bone, extending from free gingival groove to mucogingival junction (MGJ). It aids in increased resistance to external injury and contribute in stabilisation against frictional forces.<sup>2</sup>

According to Hall, width of attached gingiva is determined by subtracting sulcus or pocket depth from total width of keratinised gingiva.<sup>3</sup> Traditionally, three methods are

commonly used to determine the MGJ - visual, functional and histochemical staining methods. Clinically, amount of keratinised gingiva can be evaluated by stretching lips or cheeks to demarcate MGJ and is considered to be insufficient when such stretching induces movement of marginal gingiva.<sup>4</sup>

For many years, presence of an adequate attached gingiva was considered critical for maintenance of marginal tissue health and prevention of continuous loss of connective tissue attachment.<sup>5</sup> Recent study reported contradictory results on influence of inadequate attached gingiva on prevalence of recession and oral hygiene maintenance.<sup>6</sup> So, aim of this study was to assess width of attached gingiva in adults and correlate with oral hygiene maintenance and gingival inflammation.

## METHODS

A cross-sectional study was conducted in patients attending Department of Dental Surgery, Bir Hospital, Kathmandu, Nepal. Ethical approval (IRB NAMS 1075/076/077) was obtained from Institutional Review Board of National Academy of Medical Sciences, Bir Hospital, Kathmandu, Nepal from October 2019 to March 2020. Informed consents were obtained from patients.

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For sample size calculation, pilot study was first performed on 10 individuals visiting dental OPD and selected as per inclusion and exclusion criteria mentioned below. As per the pilot study, correlation was found between attached gingiva width and gingival inflammation with correlation coefficient for individual teeth ranging from 0.20 to 0.46. So, by taking the mid value for correlation coefficient ( $r$ ) = 0.3, sample size was calculated. Total sample size after calculation was 85 and was collected on convenience basis.

Inclusion criteria were all patients of age 20-40 years visiting dental OPD; patients with probing pocket depth  $\leq 3$  mm. Exclusion criteria were subjects with high frenum, prosthetic restorations, and subjects undergoing orthodontic treatment; pregnant ladies; patients with systemic diseases such as Diabetes, Hypertension, Renal disorders, Cardiovascular disorders, immune compromised patients, or under medications affecting periodontium.

Patients visiting dental OPD of 20-40 years with healthy periodontium were examined clinically after taking written informed consent. Oral hygiene maintenance was evaluated using Plaque index by Silness and Loe (1964) and modified by Loe in (1967).<sup>7</sup> The gingival inflammation was assessed using gingival index (mGI) by Loe and Silness (1963).<sup>7</sup> Four areas per tooth were examined - Distal facial papillae, Facial margin, Mesial facial papillae and Entire lingual gingival margin.

Mucogingival junction was determined by visual and functional method. Visually mucogingival junction appears as a scalloped line separating gingiva from alveolar mucosa. Functionally, mucogingival junction was assessed as borderline between movable (alveolar mucosa) and immovable (attached gingiva) tissue. This was done by stretching the lip or cheek to demarcate the mucogingival line while the pocket is being probed. If the mucogingival junction was indistinct, tissue mobility was determined by running horizontally positioned periodontal probe from vestibule towards gingival margin using light pressure.

After determining mucogingival junction, the keratinised gingiva width (KGW) was measured by using UNC-15 periodontal probe as the distance from the crest of marginal gingiva to mucogingival junction in the mid buccal region. The probing pocket depth (PPD) was recorded using UNC-15 probe and the attached gingiva width (AGW) was calculated as difference of (KGW- PPD). Attached gingiva width of  $<1$  mm was taken as inadequate and  $\geq 1$  mm was taken as adequate in reference to the study by Wennstrom et al.<sup>8</sup> Keratinised gingiva width of  $<2$  mm was taken as inadequate and  $\geq 2$  mm was taken as adequate in reference to the study by Stetler et al.<sup>9</sup> The third molars were excluded.

The collected data were analysed using SPSS Statistics for Windows, version 16 software. The correlation between width of attached gingiva and gingival inflammation and oral hygiene maintenance was assessed by Pearson's correlation coefficient. A P value of  $<0.05$  was taken as significant.

## RESULTS

Total 85 patients were enrolled in this study. Forty-three were male and 42 were female patients with a mean age of  $28.99 \pm 6.33$  years. Table 1 shows the mean values of age, KGW, AGW, PI and GI in male and female and in total sample. 48.23% of total sample had  $AGW < 1$  (M = 23, F = 18). No statistically significant difference was present between mean AGW values in males and females (P value 0.11).

$AGW < 1$  mm most commonly was found in mandibular first premolars followed by maxillary second molars, maxillary first premolar and mandibular incisors while it was least common in maxillary incisors. Mean AGW in maxillary anterior regions were higher compared to the mandibular anterior regions. Mean attached gingiva width in upper and lower arches in males and females are shown in Table 2. Table 3 shows GI and PI in relation to adequate and inadequate attached gingiva. The mean GI and PI values for  $AGW < 1$  mm was found to be higher than those for  $\geq 1$  mm. Results showed no correlation between AGW and severity of gingival inflammation (P value 0.608) and plaque control (P value 0.297) as shown in Table 4.

**Table 1: Demographic data with overall mean values.**

Gender	No. of Samples	Mean Age $\pm$ SD	Mean KGW $\pm$ SD	Mean AGW $\pm$ SD	Mean PI $\pm$ SD	Mean GI $\pm$ SD
Male	43	28.51 $\pm$ 6.04	4.03 $\pm$ 0.59	2.62 $\pm$ 0.53	1.31 $\pm$ 0.43	1.71 $\pm$ 0.30
Female	42	29.47 $\pm$ 6.58	4.19 $\pm$ 0.60	2.81 $\pm$ 0.57	1.09 $\pm$ 0.34	1.72 $\pm$ 0.20
Total	85	28.99 $\pm$ 6.33	4.12 $\pm$ 1.14	2.72 $\pm$ 1.18	1.21 $\pm$ 0.62	1.72 $\pm$ 0.40

**Table 2: Mean attached gingiva width in upper and lower arches.**

Gender	Mean AGW $\pm$ SD (Upper Arch)	Mean AGW $\pm$ SD (Lower Arch)
Male	2.89 $\pm$ 0.67	2.35 $\pm$ 0.55
Female	3.32 $\pm$ 0.70	2.31 $\pm$ 0.67
Total	3.10 $\pm$ 1.16	2.33 $\pm$ 1.08

**Table 3: Gingival and Plaque index in relation to adequate and inadequate attached gingiva.**

Width of attached gingiva (AGW)	Corresponding mean PI $\pm$ SD	Corresponding mean GI $\pm$ SD
< 1 mm	1.45 $\pm$ 0.63	1.92 $\pm$ 0.17
$\geq$ 1 mm	1.19 $\pm$ 0.61	1.71 $\pm$ 0.40

**Table 4: Correlation between the parameters.**

Correlation	Pearson's Coefficient	P value
AGW and GI	0.056	0.608
AGW and PI	-0.114	0.297

## DISCUSSION

In the present study, inclusion of age group of 20-40 years is because the width of attached gingiva is reported to change with increasing age. Kolte et al.<sup>10</sup> in 2014 measured width of attached gingiva dividing the study population into three age groups (16-24 years, 25-40 years and >40 years) and found that width of attached gingiva increased with increasing age groups. Thus, the selection of young adults would avoid age related differences.<sup>11,12</sup> This would also avoid the confounding effect of possible chronic diseases.

Patients undergoing orthodontic treatment or with aberrant frenal attachment were excluded from the study as the position of the tooth, particularly its degree of displacement facially in the arch, was found to affect the attached gingiva width.<sup>13</sup> Bowers et al. also reported the association of aberrant frenum and muscle attachments with narrow attached gingiva width.<sup>13</sup>

The mucogingival junction serves as an important anatomical landmark for the assessment of width of attached gingiva, and can be demarcated by various methods. Fasske et al.<sup>14</sup> suggested Lugol's iodine to be the most accurate method for determining the MGJ with minimal intra and inter examiner variability. However, Bhatia et al.<sup>15</sup> found that width of attached gingiva in different areas of the jaw were not affected by the method (visual, functional or histochemical) used in assessing the attached gingiva width. Hence, the method used in the present study for the assessment of attached gingiva width may not have affected the findings. Single examiner carried out all the measurements so as to eliminate inter examiner variability. The mid-buccal region was chosen as it is easily accessible, convenient and is the area where the attached gingiva could be least in its width.

In present study, the mean width of attached gingiva was found to be greater in females (3.32  $\pm$  0.70) than males (2.89  $\pm$  0.67) in the maxillary arch. However, no significant difference was seen between males and females with respect to the width of attached gingiva of lower arch. Various studies<sup>16,17</sup> have reported that the female patients had a greater width

than males, which is in accordance with our findings. Besides, Bowers et al.<sup>13</sup> reported no significant differences between the mean of widths of attached gingiva in male and female while other studies<sup>10,18</sup> found that females had a narrow zone of attached gingiva which contradicted our data. These variations might be attributed to racial differences in study sample in various studies.

The mean value of attached gingiva is reported to vary in different areas of the mouth with greatest width in maxillary central incisors and least in mandibular molars.<sup>16</sup> The present study showed mean value of KGW and AGW in total sample were 4.12 $\pm$ 1.14 mm and 2.72 $\pm$ 1.18 mm, respectively with wide variations among different individuals and different teeth. AGW was higher in upper arch (3.10 $\pm$ 1.16 mm) than in lower arch (2.33 $\pm$ 1.08 mm) which is similar to several other studies<sup>13,19</sup> and in contrast to the study done by Bhatia et al.<sup>15</sup> The mean width of the attached gingiva for maxillary and mandibular arches were much similar to the findings of Kolte et al. [3.06 ( $\pm$ 0.69) mm and 2.35 ( $\pm$ 0.74) mm, respectively], who carried out the study in Indian population having much similar tissue phenotype as Nepalese population.<sup>10</sup>

The width of the attached gingiva on the facial aspect differs in different areas of the mouth. Incisor region has generally greatest width (3.5- 4.5 mm in maxilla; 3.3-3.9 mm in mandible) and narrower in the posterior teeth (1.9 mm in maxillary and 1.8 mm in mandibular first pre-molars).<sup>1</sup> In the present study, AGW <1 mm was most commonly found in the posterior teeth, mainly in mandibular first premolars and mean AGW were highest in maxillary anterior re-gions.

Attached gingiva <1 mm was taken as inadequate in this study which is according to study by Wennstrom et al.<sup>8</sup> Lang and Loe<sup>20</sup> who reported that inflammation and exudates was present in 100% of teeth with less than 2 mm of keratinised tissue while no exudates were present in 76% of cases with greater than 2 mm of keratinised tissue. In our study, mean plaque index and gingival index in the areas with AGW<1 mm was found to be higher than in areas with AGW $\geq$ 1 mm which is in agreement with the study by Lang and Loe.<sup>20</sup> However, the difference in mean plaque and gingival indices in areas with AGW<1 mm

and AGW $\geq$ 1 mm was not statistically significant. This could have been statistically significant if probe of accuracy up to 0.1 mm was used.

The comparison of attached gingiva width with severity of gingival inflammation and plaque index in the current study did not show significant co-relations (P value 0.608 and 0.297, re-spectively). Similar findings were reported by Miyasato et al. in 1977 who found that gingiva with appreciable width (greater than or equal to 2.0 mm) as well as gingiva with minimal width (less than or equal to 1.0 mm) of keratinised tissue exhibited only minute amounts of gingival exudate. There were generally no clinical signs of inflammation for both types of tissue which supports the present study.<sup>21</sup>

The findings of this study also supports the findings by Padmini et al. who conducted cross-sectional clinical study in 165 young Malaysian adults, and found that neither width of at-tached gingiva nor depth of the vestibule showed any significant association with gingival inflammation or oral hygiene maintenance.<sup>22</sup> A five years longitudinal study, reported that in patients maintaining a proper plaque control, the lack of an “adequate” zone of attached gingiva does not result in an increased incidence of soft tissue recessions.<sup>8</sup> It is not the width but the volume of attached gingiva that is critical around restored or orthodontically moved teeth.<sup>23</sup> However, volume was not assessed in the present study.

In contrast to the findings of our study, Friedman had focused on the protective role of adequate attached gingiva and stated that “inadequate” zone of attached gingiva would facilitate subgingival plaque formation (as observed by scanning electron microscopic study) because of improper pocket closure resulting from the movability of the marginal tissue.<sup>5</sup>

Paturu et al. in 2016 reported significant association between inadequate width of attached gingiva and the prevalence of recession.<sup>6</sup>

This study also supports the findings by Tenenbaum et al.<sup>24</sup> and Kennedy et al.<sup>25</sup> (WHO reported that it is possible to maintain periodontal health and attachment through the control of gingival inflammation despite the absence of attached gingiva.

One of the limitations of our study is the use of UNC-15 probe which is calibrated in every one millimeter. Thus, for a particular value of AGW (for example 1 mm), variable scores of GI and PI would be obtained at different sites which doesn't give the exact relation. This could have been improved with use of automated probe that can measure differences of 0.1 mm which would have given the precise relation.

## CONCLUSION

Finding of this study suggests the correlation between attached gingiva width and severity of gingival inflammation and plaque index was not statistically significant. However, the mean gingival index and plaque index score were higher for the attached gingiva width less than 1 mm. This variation in clinical and statistical significance could be due to the use of conventional probing. Hence, we would recommend future researches to be done using probe that can measure up to 0.1 mm.

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**Conflict of Interest:** None.

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