An Evaluation of Keratinized Gingival Width in Egyptian Females: A Cross-sectional Study

Lubna Ahmad Amro[1*], Mahetab Mohammed Abdal Wahab[2], Nada Zazou[3], Ahmed Elsayed Hamed Amr[4]

[1] Department of Oral Medicine, Periodontology and Oral Diagnosis, Faculty of Dentistry, October University for Modern Sciences and Arts, Giza, Egypt
E-mail: lamro@msa.edu.eg
ORCID: https://orcid.org/0000-0002-1125-4255
[2] Department of Oral Medicine, Periodontology and Oral Diagnosis, Faculty of Dentistry, Ain Shams University, Cairo, Egypt.
E-mail: mahetabmohamed@dent.asu.edu.eg
ORCID: https://orcid.org/0000-0003-4934-8668
[3] Department of Oral Medicine, Periodontology and Oral Diagnosis, Faculty of Dentistry, October University for Modern Sciences and Arts, Giza, Egypt
E-mail: drzazou@hotmail.com
ORCID: https://orcid.org/0000-0002-0896-9313
[4] Department of Oral Medicine, Periodontology and Oral Diagnosis, Faculty of Dentistry, Ain Shams University, Cairo, Egypt.
E-mail: hmedmr@dent.asu.edu.eg
ORCID: https://orcid.org/0000-0002-3630-1126
*** Corresponding author: Lubna Ahmad Ali Ahmad Amro**
E-mail: lamro@msa.edu.eg

Abstract

Aim: To identify mean keratinized gingival width in anterior maxilla and examine its relationship with tooth shape in a sample of Egyptian females.
Material & Methods: This cross-sectional study was conducted on a total number of 85 adult female patients between ages 18 and 40 attending the outpatient clinic of Oral Medicine, Periodontology and Oral Diagnosis Department, Faculty of Dentistry, Ain Shams University from December 2022 till January 2023. Keratinized gingival width related to upper central incisors, and dimensions of upper central incisors were measured using University of California periodontal probe.
Results: Mean age of the sample was (27.19 ± 6.22) years. Mean Keratinized gingival height was (5.16 ± 1.39) mm. Mean crown length was (8.56 ± 1.05) mm. Mean crown width was (8.09 ± 0.70) mm. There was a weak positive correlation between Keratinized gingiva and square teeth.
Conclusion: There is a weak positive relationship between keratinized gingival width and age, and a weak positive relationship between keratinized gingival width and square teeth in Egyptian females.
Key Words: keratinized gingival height, square teeth, crown length, crown width

Introduction

Healthy gingiva which consists of the keratinized mucosa that covers the teeth and the alveolar bone, should have a pale or salmon pink color, and it is separated from dark red, non-keratinized alveolar mucosa by a small groove known as the mucogingival junction[1].

The gingiva is divided further into free marginal, and attached gingiva; free gingiva constitutes the movable, most coronal portion of the tissue while attached gingiva is the immovable portion that extends to the mucogingival junction. In some cases, a shallow groove named the gingival groove is located 1–2 mm apical and parallel to the gingival margin, separating the free from the attached gingiva[2,3].

The term "periodontal biotype" was first introduced in 1989, and described as two different categories, the thin- scalloped and thick biotypes[4]. Many scientists have studied periodontal biotypes and proposed various classifications over the years, in 1993 the term "periodontal morphotype" was introduced and studies showed that more recession is likely to occur in thin periodontal biotype[5]. Thick gums were described as dense and fibrous in appearance while thin ones were described as more brittle and almost transparent[6]. It was noted that in spite of the many researches done, the two categories of periodontal biotype were still quite extreme and most patients showed an intermediate clinical appearance, making diagnosis quite challenging[7].

Finally, the World Workshop of Periodontology 2017, changed the term "Periodontal biotype" to "periodontal phenotype" and defined it as the genetically determined type of gingiva based on its shape, consistency, position, gingival thickness (GT), width of keratinized tissue and the alveolar process [8].

The keratinized gingiva width is defined as the distance between the mucogingival junction and the gingival margin[9]. Although other authors stated that the width of the keratinized gingiva should be at least 2 mm to ensure periodontal health[10], other authors have argued that adequate oral hygiene measures applied by the patient even if there is a lack of keratinized tissue, maintain periodontal health[11].

The dimensions of gingiva and different parts of the masticatory mucosa demonstrate considerable site and subject variability. They have become the subject of considerable interest in restorative and periodontics from both an epidemiologic, as well as a therapeutic point of view[12]. Many authors have concluded that gingival width and thickness differ not only among different individuals, but also at different intraoral sites in the same individual[13] with the most keratinized gingival width being present in upper anterior area particularly gingiva around the upper central incisor[14].

Careful measurement and consideration of keratinized gingival height is integral to treatment planning and prediction of possible treatment outcomes for all patients[15].Therefore evaluating the prevalence of keratinized gingival in different populations and its possible correlation with other clinical parameters is of utmost importance. Several studies have been done over the years to evaluate the keratinized gingival width in other

populations and its correlation with other parameters such as gender and shape of teeth[14,15,16,17,18,19,20] ; However, to the best of our knowledge no previous observational study evaluated the keratinized gingival width in the Egyptian population. The aim of this study was to identify mean keratinized gingival width in anterior maxilla and examine its relationship with age and crown ratio in a sample of Egyptian females.

Materials and Methods

Study design

This study was conducted on a total number of 85 medically free adult female patients between ages 18 and 40 attending the outpatient clinic of Oral Medicine, Periodontology and Oral Diagnosis Department, Faculty of Dentistry, Ain Shams University from December 2022 till January 2023 who had intact anterior dentition and had not undergone previous orthodontic treatment.

This cross-sectional study followed guidelines of strengthening the reporting of observational studies in epidemiology (STROBE**).** The study was reviewed and approved by the Research Ethical Committee of the Faculty of Dentistry at Ain Shams University (approval Number: FDASU-Rec IM122107, approval Date: 22/12/21). A written informed consent form was read, understood, and signed by all the participants. No selection bias was identified, and the sample was representative of the reference population.

Intraoral Examination

The keratinized gingival width related to upper central incisors was measured mid-facially from the gingival of the sulcus to the mucogingival junction (MGJ) by University of California (UNC-15) periodontal probe (Figure 1)

Figure (1): Measurement of keratinized gingiva using UNC periodontal probe.

Tooth width & tooth height of maxillary central incisors were measured, average of both readings was taken (Figure 2a & Figure 2b). Ratio of Width/Height of maxillary central incisor was calculated[21]. The optimum Width/Height proportion of upper central incisors should be approximately 80 %; increasing the W/H ratio will lead to squarer

looking teeth, whereas decreasing it will give a longer tooth appear

Figure 2a upper central incisor length measurement using UNC-15 periodontal probe

Figure 2b upper central incisor width measurement using UNC-15 periodontal probe

Statistical Analysis

The mean and standard deviation values were calculated for quantitative data while frequencies were calculated for qualitative data. Fisher exact and Chi-square tests were used to determine the relationship between frequencies. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows. Spearman test was used to determine correlation.

Results

Among the 85 patients, the mean value of age was (27.19 ± 6.22) years. The mean value of crown length was (8.56 ± 1.05) mm. The mean value of crown width was (8.09 ± 0.70) mm. The mean value of Keratinized gingiva was (5.16 ± 1.39) mm. The mean value of W: L crown ratio was (95.65 ± 12.51).

Table (1): The mean and SD of Age, Crown length, Crown width, Crown ratio and keratinized gingival width.

Variables				
	Min	Max	Mean	SD
Age	18 years	39 years	27.19 years	6.22
Crown length	7 mm	11 mm	8.56 mm	1.05
Crown width	6 mm	10 mm	8.09 mm	0.70
Keratinized gingival width	3 mm	10 mm	5.16 mm	1.39
W: L crown ratio	70 %	128 %	95.65 %	12.51

. *; significant ($p<0.05$) ns; non-significant ($p>0.05$)

Correlation between Keratinized gingiva and Age:

There was a very poor positive correlation between Keratinized gingiva and Age with correlation coefficient 0.082, Sig.(2-tailed) 0.456, where increase in Age is accompanied by increase in keratinized gingiva (Figure 3).

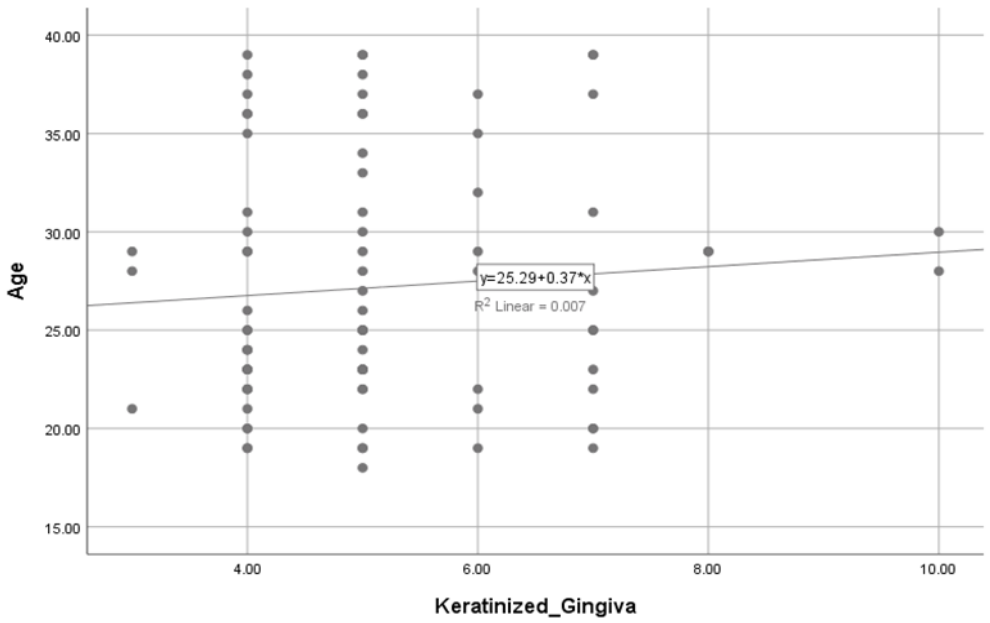

Figure (3): Scatter plot representing correlation between Keratinized gingiva and Age

Correlation between Keratinized gingiva and W: L crown ratio:

There was a weak positive correlation between Keratinized gingiva and W: L crown ratio with correlation coefficient 0.183, Sig. (2 tailed) 0.093, where increase in W: L crown ratio is accompanied by increase in keratinized gingiva (Figure 4).

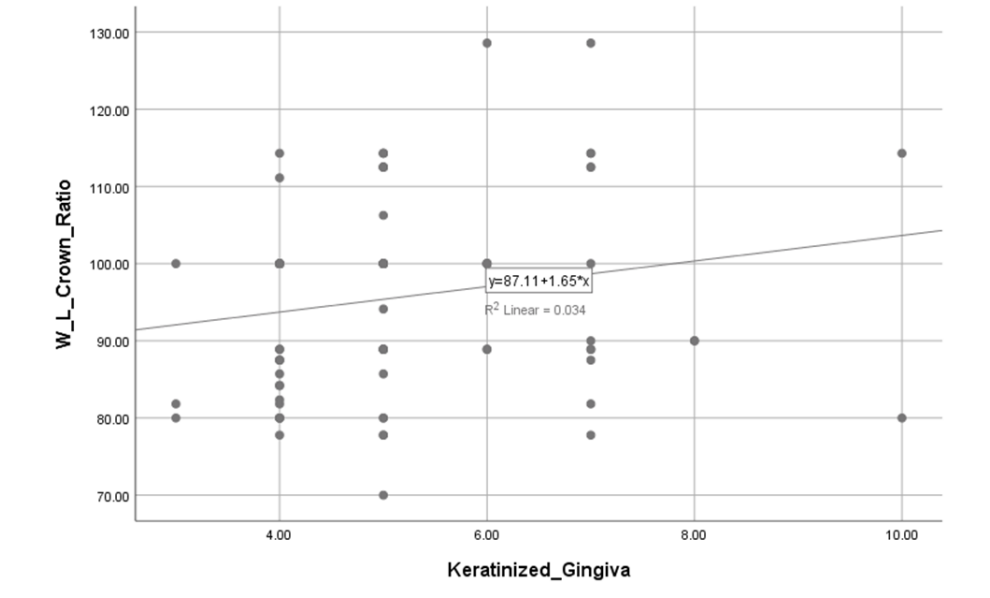

Figure (4): Scatter plot representing correlation between Keratinized gingiva and W: L crown ratio

Discussion

The North Carolina periodontal probe is considered one of the most accurate periodontal probes[22] in this study, measurements were all taken by the same calibrated trained periodontal examiner to ensure validity and reproducibility of the results. Clinical crown length and width of upper maxillary right and left central incisors were measured, in case of different dimensions in the same patient average of both readings was taken. The normal range for width: height ratio of the maxillary centrals is 75% to 85% according to the Recurring Esthetic Dental proportion[21].

In this current study, the mean value of Keratinized gingiva in the anterior region was (5.16 ± 1.39) mm. A study conducted on the Yemeni population found mean keratinized gingival width measurement (5.0 ± 1.50) mm, which is quite similar to the findings of this current study[19].A more recent study performed on the Turkish population found mean keratinized gingival width 4.80±0.13 mm[20] **.**In a study conducted on the Indian population, female patients had a greater width than males and the 20- to 30-year-old group had the greatest width of attached gingiva; mean was 3.771±1.761[16]**.**While another study conducted on the Indian population found no significant difference in keratinized gingival width between females and males[18]. Another study found mean keratinized gingival width in central incisor area was 4.38 ± 1.18 mm in a sample of the Indian population[15] which is relatively close to the values found in this study. In a more recent study conducted on a Caucasian sample found mean keratinized gingival width in upper incisor area was 3.9 ± 1.32 mm, and no significant difference between males and females[14]. While only one study found keratinized gingival height was more in males than[17]**.**

In this current study the mean value of crown length, was 8.56 ± 1.05 mm, and the mean value of crown width was 8.09 ± 0.70mm. Racial and gender differences in the average dimensions of the maxillary anterior teeth have been reported in the literature[23,24] .A study that were conducted on the Jordanian population found mean crown length 10.47 ± 2.34 in Jordanian population; however , age of the participants ranged between 18 and 67, with a mean of 34.47±10.76 years[25]; another study found the mean of crown length and width in Jordanian females 9.27±0.93 mm and 7.92±0.72 mm respectively with the age of the participants range between 23 and 52, with a mean of 33.47±9.07 years[26]. The values recorded by these two studies were slightly different than ours perhaps because both studies were done in the Jordanian population, which may yield different values than the Egyptian population and the mean age in their studies

was more than the mean age of this current study which was, 27.19 ± 6.22; and it is widely known that tooth length increases with age[27].

This study found a very poor positive correlation between Keratinized gingiva and Age, with correlation coefficient 0.082. Similar to our study, some studies conducted on different populations have found that keratinized gingival width increases with age[28,29,30]. However, A study conducted on the Yemeni population found that age had no significant difference in keratinized gingival width measurement[19].

This study found a weak positive correlation between Keratinized gingiva and crown ratio with correlation coefficient 0.183 in Egyptians. Similarly, a 1993 study reported more keratinized tissue width with more square shaped teeth[5]. Another study found wide-short shape of maxillary front dentition more often with wide keratinized gingiva in Caucasian subjects[12], similar findings were found in 2008 study conducted on Taiwanese[31]. A study conducted on the Yemeni population found wide keratinized zone of gingiva was more associated with square teeth but with no significant difference[19].

Conclusion

Keratinized gingival height has long been associated with periodontal health. Amount of keratinized gingiva around a tooth not only influences the selection of treatment modality, but also influences the treatment outcome. Differences exist between the normal gingival features between genders and races that need to be identified by observational studies and implemented in the formulation of treatment plans.

Within the limitations of this study we can conclude that there is a weak positive relationship between keratinized gingival width and age, and a weak positive relationship between keratinized gingival width and square teeth in Egyptian females. However further research needs to be done in this area in the form of larger scale cross-sectional studies on both genders.

Declarations

Ethics approval and consent to participate

This cross-sectional study was conducted as per guidelines of strengthening the reporting of observational studies in epidemiology (STROBE). The study was reviewed and approved by the Research Ethical Committee of the Faculty of Dentistry at Ain Shams University (approval Number: FDASU-Rec IM122107, approval Date: 22/12/21). A written informed consent form was read, understood, and signed by all the participants.

Consent for publication

Not applicable.

Data availability statement

The original data are available with corresponding author upon request.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors contributions

LA: conception and design of the study; data acquisition and analysis; interpretation of data; manuscript draft and revision; personal accountability, MA: contributed to data acquisition, analysis, interpretation, drafted and revised manuscript personal accountability. NZ: conception and design of the study; data acquisition and analysis; interpretation of data; manuscript draft and revision; personal accountability, AA: conception and design of the study; data acquisition and analysis; interpretation of data; manuscript draft and revision; personal accountability. All authors reviewed and approved the manuscript.

References

1. **J Ainamo, H Löe:** Anatomical characteristics of gingiva. A clinical and microscopic study of the free and attached gingiva. *J Periodontol. 1966 Jan-Feb; Volume 37(Issue 1): p 5-13.*

2. **A Ainamo:** The Influence of age on the location of the maxillary mucogingival junction, *J Periodontal Res May 1978, Volume 13, Issue 3: p189-193.*

3. A Ainamo, J Ainamo: The width of attached gingiva on super erupted teeth, *J Periodontal Res 1978 May; Volume 13, Issue 3: p194-198.*

4. **J Seibert; J Lindhe.** Esthetics and Periodontal Therapy. *In Textbook of Clinical Periodontology; Munksgaard: Copenhangen, Sweden,1989; Volume 2, pp. 477–514.*

5. Olsson M, Lindhe J, Marinello CP. On the relationship between crown form and clinical features of the gingiva in adolescents. J Clin Periodontol. 1993; 20:570–7. doi: 10.1111/j.1600-051x.1993.tb00773. x.

6. JYK Kan; T Morimoto; K Rungcharassaeng;P Roe; DH Smith. Gingival biotype assessment in the esthetic zone: Visual versus direct measurement. *Int. J. Periodontics Restorative Dent. 2010, 30, 237–243.*

7. **Y Shao; L Yin; J Gu; D Wang; W Lu; Y Sun**. Assessment of Periodontal Biotype in a Young Chinese Population using different Measurement Methods. *Sci. Rep. 2018, 8, 1–8.*

8. **P Cortellini, NF Bissada.** Mucogingival conditions in the natural dentition: Narrative review, case definitions, and diagnostic

considerations. *J. Clin. Periodontol. 2018, 45, S190–S198*

9. AW Gargiulo, FM Wentz, B Orban. Dimensions and relations of the dentogingival junction in humans. *J Periodontol. 1961; 32:12-35.*

10. **NP Lang, H Loe.** The relationship between the width of keratinized gingiva and gingival health. *J Periodontol 1972; 43:623-627*

11. **JYK Kan; K Rungcharassaeng; K Umezu; JC Kois.** Dimensions of peri-implant mucosa evaluation of maxillary anterior single implants in humans. *J. Periodontol. 2003, 74, 557–562.*

12. Müller HP, Heinecke A, Schaller N, Eger T. Masticatory mucosa in subjects with different periodontal phenotypes. J Clin Periodontol. 2000;27(9):621–6.

13. WD Jing, L Xu, X Xu; JX Hou, XT Li. Association between Periodontal Biotype and Clinical Parameters: A Cross-sectional Study in Patients with Skeletal Class III Malocclusion. *Chin. J. Dent. Res. 2019, 22, 9–19.*

14. ME Jennes, C Sachse, T Flügge, S Preissner, M Heiland, S Nahles. Gender- and age-related differences in the width of attached gingiva and clinical crown length in anterior teeth. *BMC Oral Health. 2021 Jun 4;21(1):287.*

15. R Shah, NK Sowmya, DS Mehta. Prevalence of gingival biotype and its relationship to clinical parameters. *Contemp Clin Dent. 2015 Sep;6(Suppl 1): S167-71.*

16. Jacob P Shaju, RM Zade. Width of attached gingiva in an Indian population: A descriptive study. *Bangladesh Journal of Medical Science.2009; 8,3.*

17. 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(5):428–33.

18. **R Kolte, A Kolte, A Mahajan.** Assessment of gingival thickness with regards to age, gender and arch location. J Indian Soc Periodontol. *2014; 18:478–481*

19. Alhajj, W.A. Gingival phenotypes and their relation to age, gender and other risk factors. BMC Oral Health 20, 87 (2020).

20. Nalbantoğlu Ahmet Mert , Yanık Deniz ,Revisiting the measurement of keratinized gingiva: a cross-sectional study comparing an intraoral scanner with clinical parameters, J Periodontal Implant Sci. 2023 Jun 27;53(5):362–375.
doi: 10.5051/jpis.2204320216

21. S Wolfart, AC Quaas, S Freitag, P Kropp, WD Gerber, M Kern. Subjective and objective perception of upper incisors. J Oral Rehabil. *2006; 33:489–95.*

22. L Mayfield, G Bratthall, R AttStröm. Periodontal probe precision using 4 different periodontal probes. *J Clin Periodontol. 1996;23(2):76–82*

23. C Sanin, BS Savara: An analysis of permanent mesiodistal crown size. *Am J Ortho1971; 59:488-50034.*

24. **JD Sterrett, T Oliver, F Robinson et al.** Width/length ratios of normal clinical crowns of the maxillary anterior dentition in man.*J Clin Periodontol 1999;26:153-157*

25. R Al-Habahbeh, R Al-Shammout, O Al-Jabrah, F Al-Omari: The effect of gender on tooth and gingival display in the anterior region at rest and during smiling. *Eur J Esthet Dent 2009 Winter ;4(04): p382–395*

26. **O. Al-Jabrah, R. Al-Shammout, W. El-Naji, M. Al-Ajarmeh, PDJB, & A. Al-Quran,** Gender Differences in the Amount of Gingival Display During Smiling Using Two Intraoral Dental Biometric Measurements, *J Prosthodont, 2010 Jun;19(4): p286-93.*

27. **SE Bishara, JR Jakobsen, JE Treder, MJ Stasi.** Changes in the maxillary and mandibular tooth size-arch length relationship from early adolescence to early adulthood. A longitudinal study. *Am J Orthod Dentofacial Orthop. 1989 Jan;95(1):46-59.*

28. Jack W. Vincent, J. Bernard Machen, Marvin P. Levin,Assessment of Attached Gingiva Using the Tension Test and Clinical Measurements 01 July 1976 Journal of periodontology

29. J. Ainamo, A. Talari, The increase with age of the width of attached gingiva, Journal of periodontal research, August 1976

30. Bhatia, Gouri; Kumar, Ashish; Khatri, Manish; Bansal, Mansi; Saxena, Sameer. Assessment of the width of attached gingiva using different methods in various age groups: A clinical study. Journal of Indian Society of Periodontology 19(2): p 199-202, Mar–Apr 2015. | DOI: 10.4103/0972-124X.152106

31. Chou YH, Tsai CC, Wang JC, Ho YP, Ho KY, Tseng CC. New classification of crown forms and gingival characteristics in taiwanese. Open Dent J. 2008 Nov 28; 2:114-9. doi: 10.2174/1874210600802010114.PMID: 19444325; PMCID: PMC2681166.