Protective Role of Adequate Keratinized Mucosa Around Implant to Maintain Peri-Implant Health Tissue and Brushing Discomfort: A Pilot Study

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Abstract

The important role of adequate keratinized mucosa width (KMW) around implants has been studied, and although it is still a matter of debate due to inconsistent research results, recent systematic reviews have linked it to improved soft tissue health, esthetic patient satisfaction and biologic complications.

To evaluate protective role of keratinized mucosa width around implant with brushing discomfort and peri-implant health tissue.

This cross-sectional study evaluates 31 dental implants in 17 patients at Periodontic clinic, Dental Hospital Indonesia University. Patient were recruited during maintenance follow up from January to March 2021. The sample group were divided into two groups: adequate (KMW > 2mm) and inadequate group (KMW < 2mm). Peri-implant health parameters measured (Plaque Index (PI), Debris Index (DI) and Gingival Index (GI)), brushing discomfort (VAS) and periapical radiographic were evaluated.

There was statistically different between the two groups accordingly to PI (P=0.00), DI (P=0.04) and GI (P=0.05), however brushing discomfort (P=0.15) and bone loss were not significantly correlated (P=0.23).

There is a significant influence of keratinized mucosa width around implant on the health of the peri-implant tissues. Inadequate keratinized mucosa around implants associated with higher plaque index, debris index and gingival index. However there was no significant difference for brushing discomfort and bone level between the adequate and inadequate group.

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Introduction

Periodontitis is known as the most prevalent among non-communicable diseases, which affected 75% of adults. It is also mentioned that the pathogenesis identified similar with peri-implant disease.[1,2] In line with gaining popularity of dental implant for treatment modality of missing teeth, the incidence of peri-implant disease has also greatly increased.[2] These are seen as biological complications, and categorized into peri-implant mucositis and peri-implantitis.[3] The prevalence of peri-implant disease has wide range due to lack of standardization of the scientific methodology, case definition and diagnostic criteria.[4] However Pedro Diaz et al, estimate on their systematic review the prevalence of peri-implantitis was 19,53% at the patient level and 12,53% at implant level.

The etiology of peri-implant disease is the result of the dysbiotic oral biofilm between bacterial and host defence, and it is largely discussed that it has a similarity with periodontitis.[5,6] Peri-implant disease include peri-implant mucositis, defined as an inflammatory response of the peri-implant mucosa while peri-implantitis is more extensive into bone loss around implant. Risk factors including history of periodontitis; systemic disease such as diabetes, genetic, smoking, alcohol consumption; local

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factors such as poor oral hygiene, absence of keratinized mucosa and implant surface.[7]

Differ from periodontal tissue that surrounding the teeth, peri-implant soft tissue around implant is attached to the implant surface through hemidesmosome and the direction of the collagen fibers is parallel to the implant surface, thus make implant more susceptible to mechanical stress and bacterial penetration.[8] However, peri-implant soft tissue playing an importance role to maintain the long-term osseointegrated status of implants and bone tissues.[9] The role is to be a functional barrier between oral environment and implant, somehow after tooth extraction the surrounding bone and keratinized gingiva are resorb and making the hard and soft tissue remaining deficience.[10] Lang and Loe[11] mentioned in their study that there is a minimum amount of the keratinized mucosa width (KMW) to adequately maintain the teeth healthy, which 2 mm and 1 mm must be attached. The result of their study was 80% of sites with adequate KMW remained healthy, while sites with inadequate KMW showed signs of clinical inflammation. This result were a remarks of their conclusion that a requirement of KMW to maintain stability of periodontal health is 2 mm. Although the anatomy is different, it is also can be applied the need of adequate peri-implant soft-tissue around implant.[12]

Through many controversy, adequate KMW around implant may offer an essential role as mechanical barrier and soft tissue seal to bacterial penetration and the force of mastication, achieve to more predictable long-term implant survival rate and also gaining more aesthetic outcome. This is also rationalized a recommendation to do surgical procedures to gain the adequate KMW in deficient areas. Improvement of KMW around implant can be achieved by different techniques such as the free gingival graft, apically displaced flap or the subepithelial connective tissue graft which could be done prior or after implant placement. Inadequate keratinized mucosa not always cause peri-implant disease, by maintaining the oral hygiene in zone with KMW less than 2 mm can preventing the implant more susceptible to inflammatory.[13] This study is aim to evaluate association of keratinized mucosa width around implant with brushing discomfort, oral hygiene and peri-implant soft tissue health. The assessment of the peri-implant soft tissue were using clinical parameter which plaque index (PI), debris index (DI) and gingival bleeding index (GI)

Materials and methods

Study design and sample selection

The design of this study is a cross-sectional study. Subjects were taken from the existing patient population who have dental implant treatment at Dental Hospital Faculty of Dentistry Indonesia University during their maintenance follow up from January to March 2021. The inclusion criteria was patient had at least 1 dental implant restored with a fixed prosthesis that was in function for more than 6 months. All Patients were informed that their data would be used for statistical analysis and gave their informed consent to the treatment. between a lack of keratinized mucosa and peri-implant tissue health. The protocol for this study was approved by the Ethical Committee, Faculty of Dentistry, Universitas Indonesia, Indonesia (NO. 33/Ethical Approval/FKGUI/IX/2020).

Peri-implant clinical and radiographic examination

Peri-implant clinical evaluations were performed at the buccal aspects. Assessments were performed one by one of the two previously calibrated examination (DA and D). Inter-examiner reliability was determined by kappa correlation coefficient test, which was 0.95. The examination was manually performed with plastic periodontal probe (12-UNC COLORVUE®; Hu-Friedy, Chicago, IL, USA). Data collection of peri-implant parameters which evaluated are:

Width of keratinized mucosa.

The distance between the gingival margin to the mucogingival junction at the mid-buccal aspect of the implant measured in millimeters. The sample group were divided into two groups: adequate (KMW >2mm; Fig 1) and inadequate group (KMW <2mm; Fig 1).

2.4 Plaque index (PI).

The following criteria were used to score this index: 0 = no plaque in gingival area; 1 = no plaque visible by the unaided eye, but plaque is visible on the point of the probe after it has been moved across surface at entrance of gingival crevice; 2 = gingival area is covered with a thin to moderately thick layer of plaque; deposit is visible to the naked eye; 3 = heavy accumulation of soft matter, the thickness of which fills out niche produced by gingival margin and tooth

surface: interdental area filled with soft debris.[14]

Figure 1. Adequate (KMW >2mm; left) and inadequate group (KMW <2mm; right).

Figure 2. The VAS is represented by a line ranging from 0 to 100 mm.

Debris Index.

To determinations representing the amount of debris according to the criteria for classifying debris as follow: 0= No debris or stain present, 1= Soft debris covering not more than one third of the tooth surface, or presence of extrinsic stains without other debris regardless of surface area covered, 3= Soft debris covering more than one third, but not more than two thirds, of the exposed tooth surface, 4= Soft debris covering more than two thirds of the exposed tooth surface

Gingival index.

The following criteria were used to score the gingival index: 0 = normal gingiva; 1 = mild inflammation: slight change in color, slight edema, no bleeding on probing; 2 = moderate inflammation: redness, edema and glazing, bleeding on probing; 3 = severe inflammation: marked redness and edema, ulcerAtions; tendency toward spontaneous bleeding.[14]

Brushing discomfort.

Method of brushing

After the clinical assessments, all patients received a standardized toothbrush, an interproximal brush, and dental floss. Subsequently, oral hygiene instructions were provided once with the aid of a dental model. The brushing technique adopted included the vibrating motion of the toothbrush with gentle pressure at an angulation of 45°. Subsequently, patients were asked to clean each of the peri-implant area for not more than 30 s, applying the oral hygiene instructions and the cleaning devices provided.[15]

Visual analog scale.

The level of brushing discomfort experienced by the patients during oral hygiene was evaluated with the use of the visual analog scale (VAS; adapted from Jensen et al. 1986). The VAS is represented by a line ranging from 0 to 100 mm (Fig. 2). Immediately after tooth brushing, patients were invited to mark a point in the line that represented the level of discomfort they felt during the cleaning procedure varying from 0 (no discomfort) in one extreme to 100 (extreme discomfort) in the other. The VAS values obtained were categorized into one of the following classes of brushing discomfort: no discomfort (0 < VAS < 30) and brushing discomfort (30 – 100 VAS) [15]

Method of analysis

Brushing discomfort was evaluated per quadrant. Thus, in each subject, the quadrants that harbored implant-supported prostheses were divided into two groups: quadrants with all implants with ≥2 mm of KM (Wide Group) or at least one implant with <2mm of KM (Narrow Group). The patient was considered the experimental unit; hence, in those patients presenting more than one quadrant included in the same experimental group, one of the quadrants was randomly selected to represent the patient.[15]

Radiographic evaluation

The marginal bone level (MBL) measured by periapical radiographic, from fixed reference point on the implant to the mesial and distal crestal bone level. The most severe bone level site was selected to represent the bone level of each implant[16] (Fig 2).

Results

Thirty one implants in seventeen patients were examined in this study and the demographic parameters were presented on the table 1. The mean width of keratinized mucosa was 1.29 mm. The mean values of clinical parameters were: PI= 0.88; DI= 0.76; GI= 0,67 and MBL= 0.16mm. (Table 2). The deepest MBL were viewed when the width of keratinized mucosa was inadequate.

	Individu		Implant	
	n	%	n	%
Gender				
Male	9	53	-	-
Female	8	47	-	-
total	17	100		
KMW				
Adequate	7	41	12	39
Inadequate	10	59	19	61
Total	17	100	31	100
Implant System				
Strauman®	-	-	14	45
Dentium®	-	-	17	55
Total			31	100

Table 1. Demographic of the population.

	Mean (SD)
KMW	1.29 (0.18)
PI	0.88 (0.15)
DI	0.76 (0.14)
GI	0.67 (0.14)
MBL	0.15 (0.07)

Table 2. The mean values of the clinical parameters.

The Visual Analogue Scale value distribution according to group is presented in Table 4. Thus, 23.53% of patients in the inadequate Group complain the discomfort, whereas 17.64% in the adequate Group. No discomfort was observed in 35.30% of patients in the inadequate Group and 23.53% of patients in the adequate Group.

The association between KMW around implant and peri-implant and radiographic parameters are presented in Table 3. There was statistically different between the two groups accordingly to PI, DI and GI (Table 4).

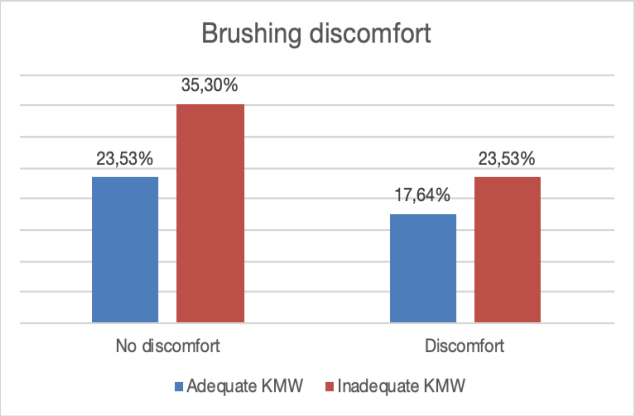

Table 3. Frequency distribution of VAS value of brushing discomfort in both adequate and inadequate category.

	Adequate group Mean (SD)	Inadequate group Mean (SD)	p-value
Brushing discomfort	0.65 (0.14)	0.31 (0.12)	0.15
PI	0.41 (0.12)	1.38 (0.22)	0.00*
DI	0.47 (0.15)	1.06 (0.21)	0.04*
GI	0.41 (0.17)	0.94 (0.19)	0.05*
MBL	0.00 (0.00)	0.31 (0.14)	0.23

Table 4. Comparison between keratinized mucosa width around implant with peri-implant health and radiographic.
Statistic analyze using independent t-test.
*statistically significant.

Discussion

The reduction in KMW around implant is associated with the reduced potential of the soft-tissue seal making the protective role against bacterial penetration is impaired.[8,16–18] In contrast to the results of the studies previously mentioned, there are several studies[19,20] that showed in patients who have a compliance to do the oral hygiene home care and in-office supportive therapy, implants with a keratinized mucosa <2 mm not always shows any clinical parameters of inflammatory on soft tissue. The reduced protective potential is also associated with increasing plaque accumulation around the implant. Several studies mentioned that there is a relationship between the inadequate KMW with an increase in plaque accumulation. This can be explained by several recent studies,[15,21] which stated that patients complaint of pain and discomfort during brushing in the area around the implant with inadequate KMW. The keratinized mucosa is consist of thick keratinized epithelium, rich in collagen fibers and unattached to the

underlying bone, this could be a reason why an adequate KMW can offer more comfortable feeling because it is less mobile during brushing the teeth.[15] The inadequate KMW is not an absolute etiology of this biological complication, but it can offer tissue immobilization to facilitate patient during cleaning procedures, protect the implant from the oral environment so the osseointegration between implants and bone is safe and also can be a barrier from bacterial infiltration results in peri-implant tissue health. Healthy peri-implant tissue not only can be achieved but also provide more aesthetically for patient satisfaction.

In this study we found that implants with inadequate keratinized mucosa width more likely to have higher plaque index, debris index and gingival index scores, and it is in line with previous clinical studies.[8,15,17,22] A result from systematic reviews by Gobbato[23] shows that inadequate KMW have an association with higher plaque index around implant. Peri-implant soft tissue is consist of scars tissue that formed during implant placement so the collagen fibers are orientated parallel into the implant surface, different from the collagen fibers attached to the teeth, which are oriented perpendicular and strongly attached to the cementum. The reduction of the peri-implant soft tissue resistance are the results from the absence of these collagen fibers that horizontally oriented. This could be leading to soft tissue breakdown and cause a gingival inflammatory.[24] Numerous surgeries are recommended increase the width of KMW around implant to offer better ability of the peri-implant tissue seal. The effect of gingival graft surgery to increase the width of peri-implant KMW was studied by randomized clinical trial.[25] They stated their study results based on peri-implant clinical and immunological parameters. In a group of patient with gingival graft procedure to gain adequate KMW showed an improvement on the clinical and immunological parameters when compared to group of patients with inadequate KMW that did not undergo the procedure.

We did not find any correlation between inadequate keratinized mucosa width and brushing discomfort. The possible cause may be associate to individual pain threshold, an adaptation to the discomfort overtime, number of implant sites exhibiting <2 mm of KM in the quadrant, brushing strength, and vestibulum depth.[15] It is contrast to some literatures[15,21] that mentioned patient with inadequate KMW around are more susceptible to brushing discomfort. The reason is also make sense, because the keratinized soft tissue is consist of several layer of thick keratinized epithelium and attached into underlying bone provide more comfortable to patient during oral hygiene procedure.[26]

Investigation of the marginal bone level in this research within the limitation of the study were higher in implants with inadequate keratinized mucosa width, although the difference not significant. In accordance to our findings, other investigators reported no association between the width of keratinized mucosa and alveolar bone loss around dental implants.[9,15,16,21] Also, the requirement of the adequate KMW is not only the matter to the marginal bone level, it is include the patient's habit such as smoking; the implant procedure such as surgical procedure, implant design; and local factor such soft and hard tissues surrounding prior to implant placement, occlusal loading, and patient's compliance. Further studies with greater number of participants and adjustment of related cofounding variable are needed.

Conclusions

In this study we found that there is a significant influence of keratinized mucosa width around implant on the health of the peri-implant tissues. Inadequate keratinized mucosa around implants associated with higher plaque index, debris index, gingival index. However there was no significant difference for brushing discomfort and bone level between the adequate and inadequate group.

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Declaration of Interest

The authors report no conflict of interest.

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