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Improvementof Periodontal Healthby Free Gingival Graft Around Teethand Dental Implants: Is It Still Relevant?

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Abstract

Periodontal health around natural teeth and dental implants requires sufficient width and thickness of keratinized tissue. There is a large debate about the need of keratinized gingiva around natural teeth and dental implants, which leads to a controversy. Periodontal health around natural teeth and dental implants requires sufficient width and thickness of keratinized tissue.

Furthermore, deficit in attached gingiva is more prone to attachment loss. However, among several surgical techniques, the free gingival graft finds its place to obtain gingival augmentation at sites without or with a minimal amount of keratinized tissue. Also, the goal of this surgical procedure would be to augment the thickness of gingival tissue, the vestibulum depth, to have root coverage or to stop the progression of gingival recession.

After the advent of several mucogingival surgical techniques, the aim of this review is to respond to the principal question "Is free gingival graft still relevant around teeth and implants?". Through a set of clinical cases and literature review, we intend to demonstrate first the need and the contribution of gingival augmentation in periodontal health, then to outline the potency of FGG in different clinical situation.

Keyword: Periodontal Health; Gingival Thickness;Keratinized tissue; Gingival Recession; Free Gingival graft;Peri-implant gingival tissue.

Introduction

Periodontal health around natural teeth and dental implants requires sufficient width and thickness of keratinized tissue. Indeed, deficit in KT less than 2 mm, is more prone to attachment loss, higher soft tissue inflammation, recession and plaque accumulation [1–3]. However, there is a large polemic debate about this topic. Despite this controversy, there are certain clinical conditions where it is necessary to recreate a band of KT in order to preserve gingival health.

Several surgical techniques are available for gingival augmentation, among them, the free gingival graft (FGG).

First described by Bjorn in 1963 [3], the FGG allowed gingival augmentation at sites without or with a minimal amount of KT. Several years later, FGG found other indications like gingival augmentation, vestibulum depth augmentation [4,5], root coverage or recession stabilisation [1–3].

Sixty years later, authors developed a large number of mucogingival techniques for the same indications. The aim of this article is to demonstrate, through a set of clinical cases, that FGG still have importance in maintaining periodontal and peri-implant health.

Keratinized Tissue and Periodontal Health

Attached gingiva seems to be necessary, in quantity and quality, and has an impact on periodontal health.

In 1972, Lang and Loe [6] have clearly demonstrated, an intimate relation between the width and the health of gingiva; Areas with less than 2mm of KT (corresponding to 1mm of attached gingiva) often presented a persistent inflammation. It's due to the increased mobility of marginal gingiva, which facilitate the penetration of micro-organisms. This leads to create a thin bacterial plaque, difficult to detect and to remove by conventional tooth-brushing [6,7]. On the other hand, a sufficient band of keratinized gingiva serves as a barrier to physical trauma. It constitutes a protection from recession's progression [1,6].

In opposition,Miyasato and al. in 1977 [7], did not found any relation between clinical inflammation and the amount of gingiva. This conclusion confirms the observational study of Bowers in 1963, who reported a healthy periodontium with less than 1 mm

of attached gingiva[8].

Wennström and Lindhe[9,10] demonstrated that gingival inflammation doesn't have any relation neither with the presence or absence of attached gingiva nor with the height of supporting attachment apparatus.

More recently, in 2015, Scheyer and al [11], in the consensus report of the AAP regeneration workshop, concluded that to prevent attachment loss in presence of plaque, a minimum of 2 mm of KT is required. However, when the plaque control is optimal, a minimum amount of KT is not needed to prevent attachment loss.

Facing the divergence of literature, a consensus has been found: height and width of attached gingiva are not crucial for maintaining gingival health, in the presence of good oral hygiene [12,13]. However, it's necessary to distinguish some particular clinical situations that modulate the need of gingival augmentation [11,12,14–17]:

- Prosthetic reconstructions with subgingival margins
- Pre-orthodontic and orthodontic therapy considering the direction of the tooth movement and the bucco-lingual thickness of the gingiva
- Anatomic situations,
- Patient's oral hygiene ability

Dental implants show a similar controversy around gingival quality. The world workshop in 2017 stated that the evidence is ambiguous regarding the effect of keratinized mucosa on the long-term health of the peri-implant tissue. However, the keratinized mucosa has advantages regarding patient comfort and ease of plaque removal [18]. Several studies have been performed around this topic.

Roccuzo and al [19] conducted a 10-year prospective comparative study to evaluate the clinical condition of implants, depending on the presence or not of keratinized mucosa. They concluded that the lack of KT around implants leads to plaque accumulation and soft tissue recession, even in the presence of sufficient oral hygiene and adequate supporting periodontal therapy.

Perussolo and al in 2018 [20], in a 4-year follow-up study, indicated that keratinized mucosa ≥ 2 mm around implants appears to have a protective effect on peri-implant tissues: less marginal bone loss, less plaque accumulation, less tissue inflammation and less brushing discomfort. Gobbato and al [21]concluded the same, the presence of inflammation around implants was associated with a limited amount of keratinized mucosa of < 2 mm. Cortellini et al. in 2018 [22], reported a significant improvement of the peri-implant immunological parameters in patients treated with FGG [22].

Cairo reported the benefits of keratinized mucosa around implant in « The Opinion Consensus Conference » in 2020 [23]. Chackartchi, Romanos and Sculean in 2019 [24] reported it too.

Moreover, in the Osteology Foundation Consensus, Giannobile and al. in 2018[25], reported that peri-implant soft tissue thickness can also affect marginal bone loss. Previously, Linkevicius et al [26], in a prospective clinical trial, concluded that vertical mucosal tissue thickness is an important factor in the aetiology of the early crestal bone loss. They added that crestal bone loss around implants was most evident when thin soft tissues were present during implant placement.

In the same field, Hammerle and Tarnow in 2018[27] reported that thin soft tissues lead to increased marginal bone loss compared to thick soft tissues, around dental implants [26–29]. Based on, possessing an adequate width and thickness of KT seems to be crucial both for natural teeth and dental implants in many situations.

Thus, Authors judged that gingival augmentation might result in a more secure periodontium and peri-implant tissues. The dense and highly stable gingiva seems to be more resistant than mucosa to mechanical, bacteria, and enzymatic attack [17].

For that, various surgical technics have been described. But, the FGG still the most effective procedure, the most widely used surgical technique and the gold standard to obtain gingival augmentation (width and thickness) at sites with a minimal amount of KT [4,5,17].

Despite all this, studies about the long-term association between periodontal health and the presence of a band of keratinized mucosa around implant sites are inconclusive [27].

Gingival Augmentation Procedures

Around implants

According to the report of the Osteology Foundation Consensus (Giannobile et al. 2018) [25], the FGG should be indicated when increasing the zone of KT around implant is required (Figure.1). In his preclinical study, Thoma DS et al. (2020) [16] confirmed this result, and explained that the amount of KT obtained is due to a small connective tissue layer in the FGG. This connective layer contains the genetic information for epithelial differentiation [16].

Kim et al in 2015[17] reported that both FGG and connective tissue graft were able to provide equivalent amounts of KT[17].

In a recent randomized controlled study comparing the effect of FGG, apically positioned flap and collagen matrix on increasing the keratinized mucosa width, authors found that FGG was the most effective technique to augment the amount of KT in sites of implant placement 30. The keratinized mucosa width gain was 4.85 ± 1.11 mm for FGG group, 3.03 ± 0.58 mm, and 1.93 ± 0.85 mm respectively for collagen matrix group, and apically positioned flap group. However, authors reported that

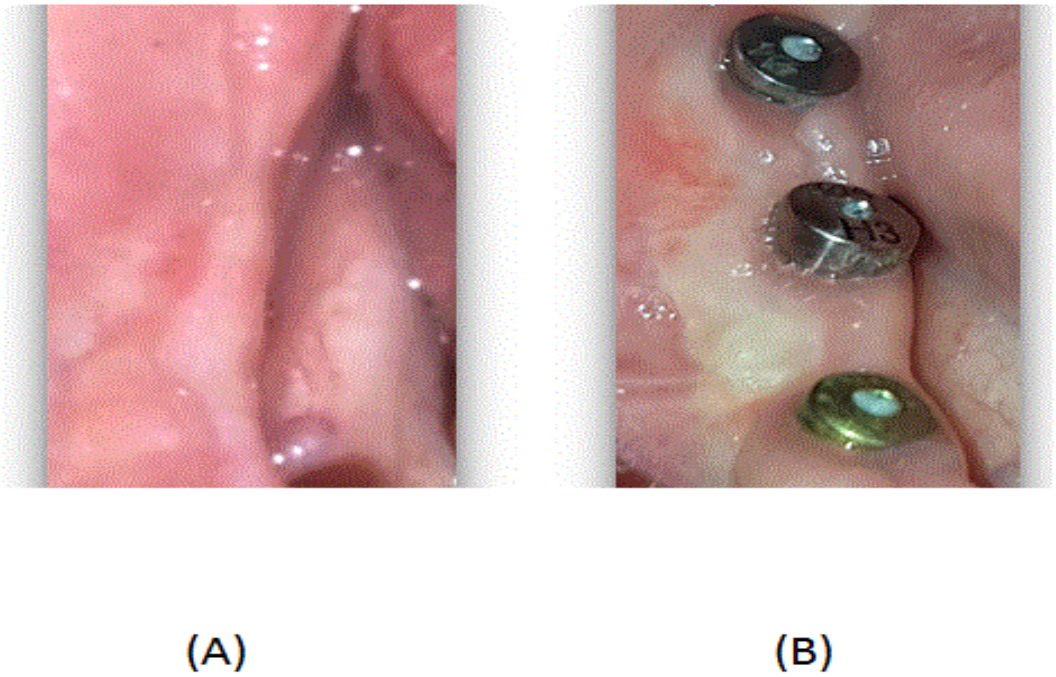

Figure 1: Gingival augmentation around implants :
In this case, 3 implants are osseo-integrated (A). However, it is clear that gingiva covering the arch is insufficient to allow implant stability. The FGG done in the second surgical stage (B) provided a height and thickness of KT around these implants.

postoperative pain was significantly higher in the FGG group. The use of a collagen matrix could be an alternative to diminish the intervention's impact on patient's postoperative quality of life.

when using apically positioned flap/vestibuloplasty, Thoma and al [31] reported that the addition of an autogenous FGG allows a better gain on KT than an apically positioned flap/vestibuloplasty alone [31].

Around teeth

In 2019, Cevallos et al. conducted a 15 years longitudinal study to evaluate clinical outcomes of acellular dermal matrix (ADM) allograft compared to autogenous FGG, for gingival augmentation. FGG group showed a significant increase in width and thickness of keratinised mucosa. They observed a creeping attachment in long term with FGG, in opposition to the ADM group where they observed significantly more gingival recessions, shrinkage. However, the ADM group showed better aesthetic results [32]. Wei and al (2000) [33] and Agudio et al. (2017) [34] reported the same results. De Resende and al [35] confirmed these outcomes too, and added that the ADM presented a delayed healing and maturation with can be explained by the absence of cellularity and the inductive capacity in the matrix. This one is considered as a scaffold for cell migration from adjacent tissues, justifying then the delayed healing and a better fusion with the adjacent tissues [35].

In the presence of less than 1mm of attached gingiva, inflammation, attachment loss and recession may occur11. Authors explained that this minimal band would maintain periodontal health by prohibiting the introduction of micro-organisms [6,7] and would serve as a barrier to physical trauma and future progression of recession [1,6]. Based on this, FGG would be recommended for gingival augmentation to increase the height and thickness of KT and maintain a healthy periodontium (Figure. 2).

There are other circumstances, classified as traumatic situation, where FGG is indicated: restorative subgingival margins and some orthodontic movements. Restorative subgingival margin is often associated with greater plaque accumulation, inflammation, bacterial change to harmful Gram-negative anaerobic microbiota and gingival recession[17,36]; Augmenting the density and the stability of the gingiva by a FGG, makes it more resistant to mechanical, bacteria, and enzymatic attack than mucosa.

Regarding the relation between orthodontic treatment and the position of soft tissue margin and gingival dimensions, Wennström[37] reported that the important factors to consider are the direction of the tooth movement and the bucco-lingual thickness of the gingiva. Facial tooth movement would reduce height and bucco-lingual tissue thickness and moving the tooth out of the alveolar bone housing would augment the risk of recession.

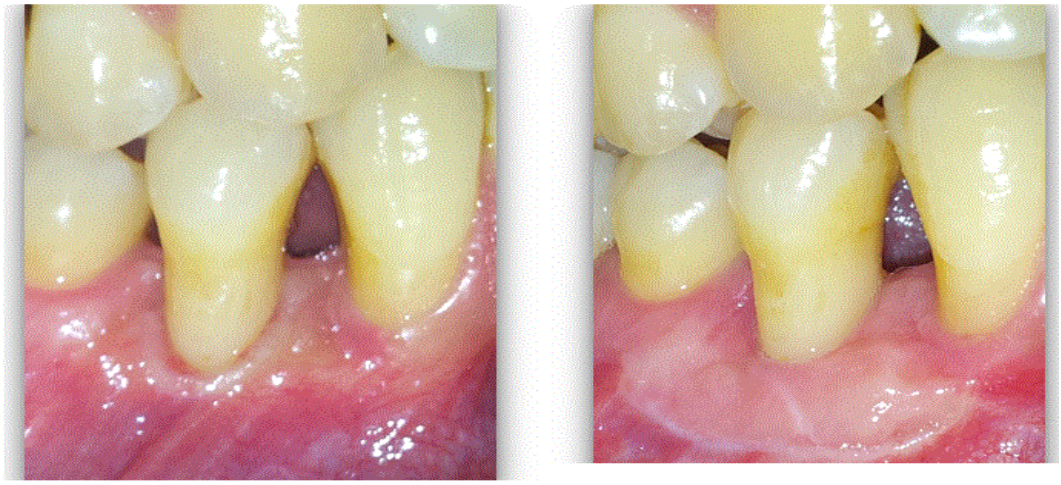

Figure 2: Gingival augmentation around teeth :
(A) Buccal Miller type 3 recession at first mandibular premolar. There is an insufficient KT around the teeth, in addition to the anatomical traction of the frenum.
(B) The FGG allowed having a thick and high band of keratinized tissue to protect the sulcus and to eliminate the frenum traction. These outcomes allowed a better hygiene, more stability of the free gingival band and more stability of the attachment level (Healing at 1-year post surgery).

Thus, before initiation of orthodontic therapy, we should evaluate the expected movements and the bucco-lingual thickness of the soft tissue on the pressure side [11,17,37]. Areas with less than 2 mm of KT should undergo gingival augmentation, especially if the expected movements would move the tooth out of the bony envelope [11,17,37](Figure.3).

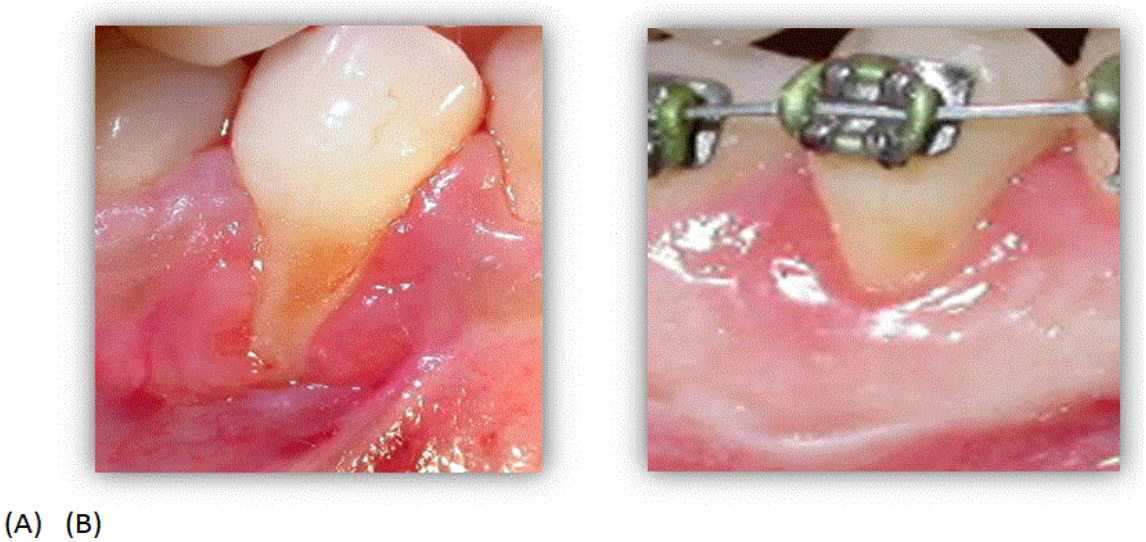

Figure 3: Pre-orthodontic gingival augmentation
A. Buccal Miller type II recession at mandibular premolar, associated to a non-carious cervical lesions. Due to the facial expected orthodontic movement and in order to improve periodontal conditions around tooth 45, a FGG is indicated. Besides, it may prevent the progression of the non-carious cervical lesion (Agudio et al. 2019).
B. Optimal root coverage at 1-year post surgery with creation of sufficient amount of KT.

Treatmentof Recession

We can resort to the FGG for root coverage in isolated and multiple recession defect (Figure.4). we can expect a primary root coverage immediately after grafting and a secondary root coverage "creeping attachment", during a period of time ranging 10 to 27 years [34,38].

Agudio and al [34] realized a 25-year follow-up observation of patients treated with FGG in sites showing absence or reduced amount of attached gingiva associated with gingival recession. They observed that 37.4% of the total number of treated teeth showed complete root coverage due to creeping attachment of the gingival margin, in a period between 6 months and 25 years after surgery. The coronal migration was ranging from 1 to 4mm. However, FGG showed a great outcomes variability and low degree of predictability of favourable results regarding recession coverage [5]. Literature reported percentages of root coverage ranging from 11% to 100%. This huge variance may be due to differences in the gingival lesion, surgical techniques and probably because of luck of blood supply when the FGG is placed over an exposed root surface [4,5]. Otherwise, SCTG seems to give more predictable root coverage comparing to

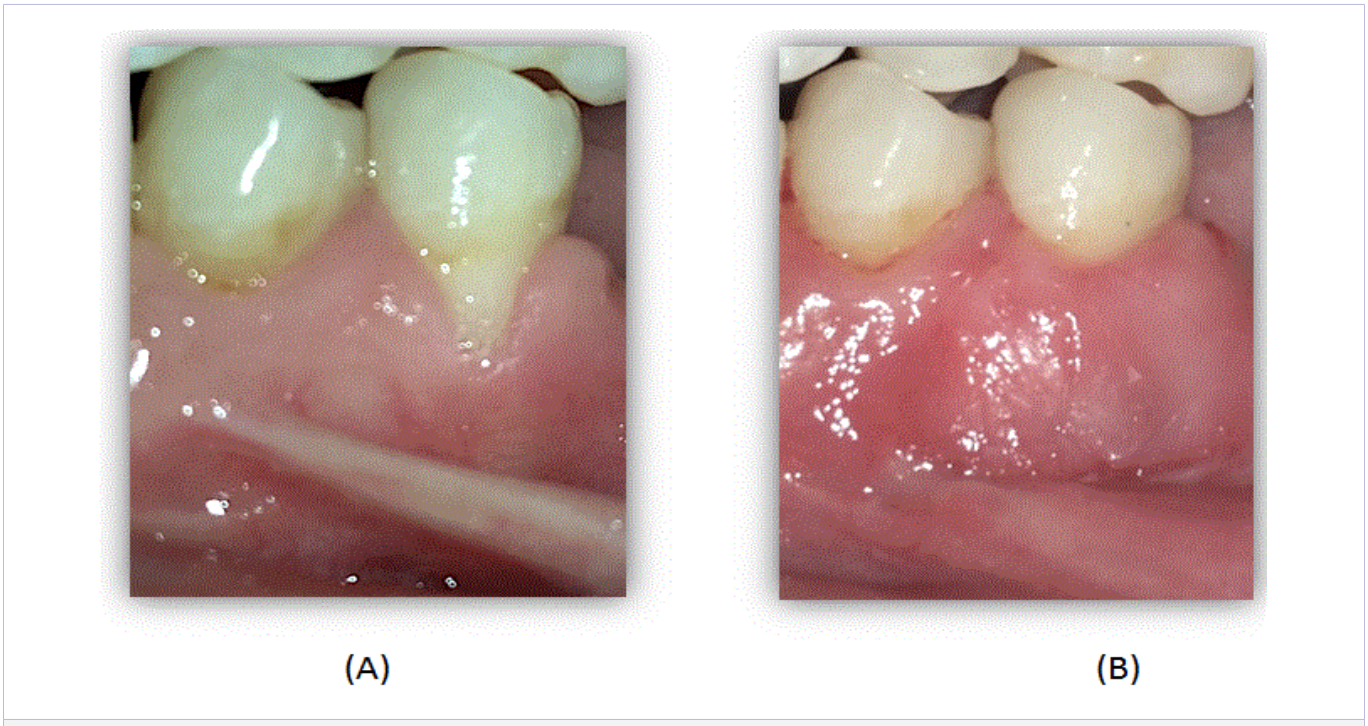

Figure 4: Root coverage :
A. Buccal Miller type II recession at mandibular premolar (45). FGG is indicated to cover the recession, to improve height of KT and to create and adequateenvironementfo support removableprothesis.
B. At 6 month post surgery: Complete root coverage with sufficient amount of KT is observed.

other techniques[39–41]. However, these conclusion is generally weighted toward maxillary canines and premolars mainly to achieve aesthetic outcomes, and not at the anterior mandibular sites[34,41,43]. In this anatomic region (Fig.5), gingival recession is generally associated to an unfavourable mucogingival environment, characterized by an inadequate width of attached gingiva, a minimal amount of baseline KT and a shallow vestibular depth [4,34,38,42]. Therefore, FGG is considered the best treatment option for root coverage at mandibular incisors[4,38]; in addition, this mandibular region doesn't present any aesthetic needs [41,44].

From a histological point of view, FGG leads to changes of the original, pre-established genetical conditions of the recipient site: it augments the epithelial thickness of KT and leads to a higher intensity and density in collagen bundles [45]. Clinically, FGG promotes KT band; stable gain in height and thickness. Then, periodontal biotype change is due to those modifications promoted by FGG on the native soft tissue [44,45]. However, the aesthetic is the mean disadvantage of the FGG. It's reported with a poor texture, colour and tissue integration as well as the lack of apical alignment of the alveolar mucosa [1,4,42,44]. Consequently, when the aspect is not satisfying, a second surgical step, gingivoplasty or gingivectomy may be necessary in order to improve aesthetic outcomes [42].

To improve the aesthetic satisfaction and avoid a second intervention, a modification of the conventional approach of the FGG was introduced by Cortellini et al. [43]: the partially epithelialized FGG. The aim was to improve root coverage

potential and mucogingival junction alignment in the lower anterior area. Recessions were completely covered in high percentage with excellent alignment of the mucogingival junction and appreciable aesthetic outcomes 42,43. The mean percentage of recession coverage was at 96%, with 87,5% of total root coverage in multiple recession.

Previously, Bernimoulin and al. [46] introduced the two stages technic with the ultimo aim to cover the exposed root. FGG can be used as the first stage procedure to augment the amount of gingiva apically to the recession. The second stage consists on coronally advanced flap or laterally coronally advanced flap surgery, 3 months later, in order to cover the exposed root [4,5,47]. The mean percentage of root coverage cited was 72.30% at 4 years [48].

Conclusion

Despite the unpredictability of an aesthetic result for FGG, the technique has an advantage in term of simplicity, KT height and width gain and some situations of recession coverage; it is limited to the aesthetically irrelevant dental and implant sites [5,13,49]. It remains, in several situations, the only solution for gingival augmentation associated or not to root coverage.

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