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MINI REVIEW

Attached gingiva: A review through the history

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ABSTRACT

The attached gingiva acts as a protective barrier and stabilizes the gingival margin. Its role in periodontal health has been debated for decades. With the rise of esthetic dentistry, the importance of attached gingiva in preventing gingival recession and aiding patient comfort in oral hygiene became clear. Techniques to augment attached gingiva have evolved over the years. Initial methods like the apically repositioned flap gave way to advanced procedures such as free gingival grafts and connective tissue grafts, offering better esthetic outcomes. Recent advancements focus on minimally invasive techniques and using allograft and xenograft materials to reduce morbidity. This review explores the historical and contemporary significance of attached gingiva in periodontal and peri-implant health.

KEYWORDS

Attached gingiva; Gingival augmentation; Gingiva; Oral hygiene; Peri-implant health

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Introduction

Oral mucosa comprises three distinct zones: the gingiva and hard palate, known as the masticatory mucosa; the dorsum of the tongue, referred to as specialized mucosa; and the oral mucous membrane, or lining mucosa. Macroscopically, the gingiva is divided into marginal, attached, and interdental areas [1]. The attached gingiva, a vital part of the periodontal apparatus, acts as a protective barrier and stabilizes the gingival margin. This portion of the gingiva is tightly bound to the underlying periosteum of the alveolar bone, extending from the mucogingival junction to the external surface projection at the bottom of the sulcus or periodontal pocket. It plays a crucial role in shielding the periodontium from mechanical trauma, microbial invasion, and inflammatory processes [1].

The width of the keratinised gingiva is measured as the distance from the gingival margin to the mucogingival junction, while sulcus depth is measured from the gingival margin to the base of the sulcus. The width of the attached gingiva is then calculated by subtracting the sulcus depth from the width of the keratinised tissue [2].

Historical Aspect

Over the years, the width of the attached gingiva and its importance in maintaining a healthy periodontium has been extensively discussed. Lang & Löe (1972) advocated for maintaining at least 2mm of attached gingiva, positing that the absence of this gingival band could lead to inflammation [3]. Early studies by Corn et al. (1962) and Carranza et al. (1970) suggested that this band of gingiva plays a critical role in dispersing muscular forces and enduring damage from chewing and brushing [4,5]. This led to the development of gingival augmentation techniques to overcome its inadequacy.

However, several authors historically claimed that the width of the attached gingiva does not significantly impact periodontal health if oral hygiene is adequately maintained. There was insufficient evidence to suggest that a narrower band of attached gingiva is more susceptible to inflammation as compared to a wider band. Wennström and Lindhe (1983) assessed the role of attached gingiva through a study on beagle dogs, finding that meticulous plaque control led to the preservation of gingival health without gingival recession or attachment loss, regardless of the width of the attached gingiva [6-8].

Wennström, in 1987, conducted a 5-year longitudinal study that aimed to monitor changes in the position of the soft-tissue margin at 26 buccal sites that were surgically deprived of all the gingival tissue. Six-months post-treatment, baseline examinations revealed that these sites had minimal or no regenerated attached gingiva (<1mm). For comparison, 12 control sites with adequate width of attached gingiva (>1mm) were also examined. Assessments included oral hygiene status, gingival conditions, probing pocket depths, probing attachment levels, the position of the soft tissue margin, and gingival width at baseline and after 5 years. Results indicated a slight increase in the width of the gingiva at the test sites over the observation period. Specifically, 7 out of 26 test sites showed coronal regrowth of the soft tissue margin, whereas 2 sites exhibited further apical displacement. In contrast, 3 control sites developed recession and a reduction in gingival width. The study concluded that in patients maintaining proper plaque control, the absence of an adequate zone of attached gingiva does not lead to an increased incidence of gingival recession [9].

Baker et al. (1976) proposed that localized inflammation in thin gingival biotypes can lead to connective tissue breakdown, emphasizing careful handling during restorative or orthodontic procedures in esthetically sensitive areas [10]. Maynard et al. (1979) suggested that 5mm of keratinized tissue is preferable to mitigate recession risk, especially in areas requiring subgingival restorations [11].

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Present Consensus - The Importance of Attached Gingiva

Despite earlier conflicting views, contemporary consensus underscores the significance of having an adequate band of attached gingiva around teeth. The clinical relevance of attached gingiva became more pronounced with the advent of esthetic dentistry and restorative procedures. The sufficient width of the attached gingiva reduces the likelihood of gingival recession due to the preparation of subgingivally placed esthetic margins and enhances patient comfort in maintaining oral hygiene [12]. Currently, a consensus advocates for at least ≥ 2mm of keratinized tissue and ≥ 1mm of attached gingiva surrounding teeth to maintain periodontal health and stability [13].

Tarnow, in 2021, put forth a revised definition of attached gingiva for both healthy and diseased teeth and implants having two components. Part A applies when the biologic width is supracrestal, involving epithelial attachment and gingival fibres, and is attached to a healthy tooth or tissue-level implant. Here, the zone of the attached gingiva is measured from the gingival sulcus base to the mucogingival junction. Part B, on the other hand, applies when the biologic width is subcrestal, as seen with infrabony defects on periodontally compromised teeth, periodontally involved tissue-level implants, and bone level-implants placed at or below the bone crest. In this case, the zone of the attached gingiva is measured from the bone crest to the mucogingival junction, rather than from the base of the sulcus [14].

Boynuegri, in 2013, noted that a narrow band of keratinised tissue (less than 2mm) at the dental implant site has been linked to increased plaque accumulation and mucosal inflammation, along with elevated levels of pro-inflammatory mediators [15]. Ramanauskaite conducted a systematic review and meta-analysis assessing the influence of the width of keratinised tissue on the prevalence of peri-implant diseases. In essence, the data from the included studies indicate that having less than 2mm of keratinised tissue is associated with poorer peri-implant tissue health compared to implant sites with at least 2mm of keratinised tissue [16].

Surgical Techniques

Despite the controversy, several techniques have been developed to increase the attached gingiva width. These techniques include repositioning the attached gingiva by Nabers (1954), the pushback technique by Goldman (1956), Bohannan's complete denudation and periosteal separation (1962), apically repositioned flap by Friedman (1962), free gingival graft introduced by Bjorn (1963) and modified by Sullivan and Atkins in 1968, and connective tissue graft by Langer [17-24]. Among these, the apically repositioned flap and free gingival grafts are the most commonly used [25].

Repositioned flap technique

Apically repositioned flap (ARF)

This procedure is based on Naber's principle of repositioning the attached gingiva [17]. The attached gingiva is repositioned apically following meticulous debridement of the root surfaces. This is achieved by making vertical incisions and suturing the flap accurately to position the free gingival margin at the level of the alveolar crest [21]. However, the apically repositioned flap technique has notable drawbacks, such as leaving 3-5 mm of denuded bone in the coronal portion, which risks bone resorption [25].

Autogenous soft-tissue grafting techniques

Free gingival grafts (FGG)

FGG involves the elevation of a split-thickness flap, preparing the recipient bed for the donor graft. The graft, typically 1.25-2mm thick, is placed coronal to the cementoenamel junction to counteract tissue shrinkage during healing. This method increases the width of keratinized tissue and is adapted to the crown anatomy to prevent graft destabilization. However, this technique has drawbacks including post-operative discomfort, poor color match, and morbidity at the donor site [22,23,26,27].

Connective Tissue Grafts (CTG)

CTG, known for superior esthetic outcomes, involves elevating a partial-thickness flap to ensure adequate blood supply at the recipient site. The flap can be reflected via an envelope method or by creating a tunnel. The graft is placed coronal to the raised flap's border, with its epithelial border intact, and secured with sutures to prevent destabilization post-surgery [24,26,28].

Advanced techniques

Modified apically repositioned flap (MARF)

Introduced by Carnio and Miller in 1999 for single-tooth cases and expanded by Carnio and Camargo in 2006 for multiple teeth, MARF involves a horizontal beveled incision in the attached gingiva, followed by split-thickness flap elevation and apical suturing. Healing occurs through the migration of keratinized epithelial cells over the exposed periosteum, resulting in the formation of attached gingiva. MARF is favored for its simplicity, consistent color matching, reduced surgical time, and elimination of a separate donor site [29-31].

Use of allografts and xenografts

Recent advancements focus on using allograft and xenograft materials to minimize the morbidity associated with autogenous grafts. These materials offer alternatives for gingival augmentation, reducing the need for dual surgical sites and associated complications [32,33].

Preferred Choice of Treatment

Thoma et al. systematically evaluated the literature on soft tissue grafting techniques to determine the most effective methods for augmenting and stabilising the gingival tissue. The study focused on increasing the width of the attached gingiva and gaining soft tissue volume. The apically repositioned flap/vestibuloplasty (ARF/V) procedure was found to significantly increase the width of the attached gingiva compared to untreated controls. Combining ARF/V with autogenous tissue resulted in significantly more attached gingiva than with untreated controls and showed borderline statistical significance compared to ARF/V with allogeneic tissue. The ARF/V with allogenic graft experienced more shrinkage compared to autogenous tissue [34]. Extensive research conducted over several decades in the field of

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mucogingival surgery has established the coronally advanced flap combined with CTG as the gold standard for root-coverage procedures. In contrast, the use of FGG is primarily reserved for situations wherein the primary goal is to increase the width of the attached gingiva [35].

Montero et al., in their systematic review, aimed to assess the effectiveness of soft tissue substitutes versus autogenous gingival grafts in surgical procedures designed to increase the width of keratinised tissue around dental implants. The findings indicated that FGG is more effective than soft tissue substitutes for augmenting keratinised tissue at the implant site. However, xenogeneic substitutes may serve as a viable alternative to autogenous tissues as they reduce surgical time and post-surgical pain [36].

Conclusions

The significance of having an adequate zone of attached gingiva in maintaining periodontal health remains a topic of debate, although its value in aesthetics and specific clinical contexts has been acknowledged. The attached gingiva plays a crucial role in maintaining periodontal health by providing stability, reducing the risk of gingival recession, and enhancing patient comfort in oral hygiene maintenance. Historical and recent advancements in surgical techniques have significantly improved the management of insufficient attached gingiva. Continued research and innovation in this field are essential to further refine these techniques and improve clinical outcomes.

Disclosure Statement

No potential conflict of interest was reported by the author.

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