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Attached Giniva- A Reliable Factor to Cling-To: Review Article

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Review Article

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ABSTRACT

Attached gingiva plays an important role in periodontal health. It is a topic of interest among dental professionals and dentists. All the specialties in dentistry deal with attached gingiva in their daily treatment procedures.

The attached gingiva is the part of the gingiva which is tightly attached to the underlying periosteum of the alveolar bone. Attached gingiva extending from the free margin of the gingiva to the mucogingival line minus the pocket or sulcus depth measured with a thin probe in the absence of inflammation. The significance of attached gingiva can be viewed from various specialties of dentistry like orthodontics, pedodontics, prosthodontics, etc. Adequate width of attached gingiva is necessary to prevent plaque accumulation and gingival recession. 2 mm of attached gingiva is necessary for periodontal health. It is a part of keratinized gingiva and helps to increase resistance to external injury and contribute to the stabilization of the gingival margin against frictional force. The firmness characteristic of attached gingiva is because of the connective tissue collagenous nature and due to its mucoperiosteum adherence. In order for the dentist to understand the attached gingiva various studies were conducted with appreciable findings. This article reviews the attached gingiva's significance in dentistry.

Keywords: Attached Gingiva, Inflammation, Mucogingival, Recession.

Introduction

The periodontium comprises cementum, alveolar bone, periodontal ligament, and gingiva. Gingiva is the part of oral mucosa that covers the alveolar process of the jaw and surrounds the neck of teeth. Gingiva extends from the gingival margin to the mucogingival junction except on the palatal surface of maxillary molars where it merges with palatal mucosa. Oral mucosa comprises masticatory lining and specialized mucosa. Gingiva belongs to the masticatory mucosa. Anatomically gingiva is divided into marginal, attached, and interdental gingiva. The attached gingiva is firm, and resilient bound tightly to the periosteum of underlying alveolar bone and is continuous with the marginal gingiva.

The attached gingiva plays an important role in providing support against physiologic forces exerted by muscle fibers of alveolar mucosa on gingival tissue. The width of the attached gingiva is different in different areas of the mouth; it is wider in the incisor region and narrower in the posterior teeth. The width of the

attached gingiva is the distance between the mucogingival junction and projection on an external surface of the bottom of the gingival sulcus or periodontal pocket. Various methods are used to determine the width of the attached gingiva such as the visual method, functional method, histochemical staining method, and so on. Hall WB suggested that the width of the attached gingiva can be measured by subtracting the sulcus or pocket depth from the total width of the gingiva. If the mucogingival junction is indistinct, it can be determined by stretching the lips or cheeks to demarcate the mucogingival junction while the pocket is being probed. Previously, attached gingiva was considered vital for the maintenance of marginal tissue health. But later it was proved that the attached gingiva and its width do not contribute much to maintaining periodontal health. Successive studies proved that the volume of the attached gingiva is the one that matters and not the width.

Anatomy of Attached Gingiva

The attached Gingiva is a part of the gingiva extending from the base of the gingival crevice to the mucogingival junction. Gingiva is composed of overlying stratified squamous epithelium and an underlying central core of connective tissue. The epithelium is predominantly cellular in nature. Connective tissue is less cellular and composed primarily of collagen fibers and ground substance. The epithelium of attached gingiva is keratinized and has thin, prominent epithelial ridges. The attached gingiva is lined by 4 layers: Stratum basale, Stratum spinosum, Stratum granulosum, and Stratum corneum.[1] Connective tissue is also known as lamina propria and it consists of the papillary layer and reticular layer. The papillary layer is seen adjacent to the epithelium. Consist of papillary projection between epithelial rete ridges. Elongated papillae provide good mechanical attachment and also prevent the epithelium from being striped by shear forces. The reticular layer is continuous with the periosteum of the alveolar bone. The principal cell type is keratinocytes; other cells found are Langerhans cells, Merkel cells, and melanocytes.[2]

The attached gingiva is firm, and resilient and is bound tightly to the underlying periosteum of the alveolar bone. The attached gingiva presents a texture similar to orange peel which is referred to as stippled. Attached gingiva varies among different individuals and different areas of the mouth. The attached gingiva appears coral pink colored and is determined by factors such as epithelial thickness, vascular supply, degree of keratinization, and presence of pigmentation.[1] It is absent in infancy and appears around 5 of age. It is a form of adaptive specialization. It is produced by the elevation of depression in the surface of gingival tissue.

Width of Attached Gingiva and Factors affecting it

It is the distance between mucogingival function and projection on the external surface of the bottom of the sulcus.[3] A study was conducted using 73 patients and it was found that width is greater in the incisor region: 3.77 mm in the maxillary central incisor and 2.516 mm in the mandible anterior. It is narrower in the posterior tooth region – 3.04mm in maxilla premolar -2.75 mm in mandible premolar and 2.58 in maxillary molars and 2.48 in mandibular molars.[3] All individuals have an increased width of attached gingiva in the maxilla than in the mandible. The width of attached gingiva is minimal in newly erupted permanent teeth and increases with permanent teeth eruption. One of the factors affecting the width of the attached gingiva is High frenum attachment. The narrow width of the attached gingiva is usually seen in association with high frenum and muscle attachment. Width is known to increase with age and supra-erupted teeth; the mucogingival junction remains stationary while teeth move in an occlusal direction throughout adult life. Width of the attached gingiva increases as age advances due to the absence of concurrent gingival margin retraction. Recurrent inflammation also affects the width of the attached gingiva.[4] Dehiscence and fenestrations, recession, and malposition of the tooth affect width of the attached gingiva. When compared to normally erupted teeth, tooth in labio or buccoversion have a narrow zone of attached gingiva, and teeth in

linguoversion have a wider zone. Transitions from deciduous dentition to permanent dentition also affect the width of the attached gingiva.

Measurement of Width of Attached Gingiva

The width of attached gingiva is determined by subtracting the sulcus or depth from the total width of the gingiva. Various methods are used to measure the width of attached gingiva such as the Visual method, Functional method, and Visual methods after histochemistry staining. In the visual method, the mucogingival junction can be assessed as a scalloped line separating the attached gingiva from the alveolar mucosa. In the roll test or functional method, the mucogingival junction can be assessed as a borderline between movable and immovable tissue. Tissue mobility can be assessed by running a horizontally positioned probe from the vestibule towards the gingival margin in an apicocoronal direction. In the visual method after histochemistry staining, the mucogingival junction can be assessed visually after staining the mucogingival junction with potassium iodine solution. The attached gingiva is iodine negative since it is keratinized and there is glycogen in the superficial layer.

Clinical Significance

The attached gingiva has a significant role in the prevention of subgingival plaque formation and the maintenance of good oral hygiene. Due to improper closing of the periodontal pocket as a result of inadequate width of attached gingiva subgingival plaque formation occurs. It can occur due to various conditions such as some individuals does not have adequate width of attached gingiva by birth, which will result in the recession of the gingiva and bone loss due to the pull-down of the gingiva by muscles in the alveolar mucosa. The Movability of marginal tissue also occurs due to the stretching of tissue by orthodontic therapy. The abnormal frenal attachment also increases the pull on the gingival margin. The attached gingiva prevents the spread of gingival inflammation. The attached gingiva maintains patient comfort and resistance to mechanical trauma during oral hygiene procedures, thus enables the patient to maintain good oral hygiene. Peri-implant health can be maintained if oral hygiene is good. The attached gingiva plays a significant role in the case of implants. It provides a tight collar around implants. The attached gingiva is necessary to prevent the movement of mucosa around an exposed cover screw. Prevention of inflammation spread around the implants is made possible by this tight band of tissue around the implant. The gingival margin fits better around the teeth and implant when there is an adequate amount of attached gingival.[5] The absence of keratinized attached gingiva increases the chance of occurrence of peri-implant lesions and plaque-induced destruction. An increase in accumulation of plaque, inflammation of the gingiva, bleeding on probing, and mucosal recession is seen in association with the absence of a sufficient amount of keratinized mucosa around implants. It may be due to several reasons such as abnormal free attachment, and deep pockets that reach the level of mucogingival junction. Lang and Loe made a study on the relationship between gingival width and inflammation.[6] It was found that teeth with greater than 2 mm of keratinized tissue are clinically healthy since there are no exudates and inflammation. But teeth with less than 2 mm of keratinized tissue were found unhealthy since there is the presence of inflammation and exudate. So they concluded that 2 mm or more of keratinized gingiva (corresponds to 1 mm or more of attached gingiva) is necessary to maintain good gingival health.[6]

Change in width of Attached Gingiva in Children

A study was conducted and it is observed that the degree of tooth eruption and position of teeth in the dental arch affect the width of the attached gingival.[7] Rose and App found that the width of the attached gingiva is more in permanent dentition when compared to deciduous dentition and increases with age due to tooth eruption as a result of a gradual reduction in the depth of the sulcus. In deciduous teeth, it is not correlated with the reduction of sulcus depth. When permanent teeth erupt in the oral cavity their sulcus is deeper than

that of corresponding deciduous teeth and gradually sulcus becomes shallower. These differences may be due to initial weak periodontal attachment, false pocket, and temporary inflammation during teeth eruption.

Radiographs were used by Sarrio et al[8,9] to measure the width of the gingiva in both dentitions. In both dentitions, width is found to be increased with the eruption of teeth; this is due to the pull of adjacent tissue when the tooth erupts in the oral cavity.[8,9]

Ochsenbein and Maynard[10] and Hall[11] found that when the eruption process is completed, the width of the attached gingiva does not change. It was noted that the absence or limited attached gingiva in the vestibular side does not always cause gingival recession. The position of the tooth is more critical than the width of the attached gingiva in developing a recession of the gingiva. Crowding, protrusion, tilting, and rotation of teeth are considered as aetiology of recession. It was found that recession of the gingiva can be corrected without surgery due to normal positioning of teeth after the eruption of teeth or due to adjunctive orthodontic therapy.

Techniques for Increasing Width of Attached Gingiva

The width of attached gingiva should be increased in conditions such as patient's plaque control is comprised, for teeth with abnormal frenal attachment, little or no attached gingiva in teeth that requires prosthetic restoration or orthodontic therapy, pocket depths that extends beyond the alveolar mucosa. In earlier days apically repositioned flap technique was used by surgeons to increase the width. In this technique surgeons increase or preserve existing attached gingiva by moving tissue in an apical direction.

A modification of an apically repositioned flap was introduced. When compared to the original technique, this technique preserves the marginal gingiva and thus avoids the risk of recession. In this method, a periodontal probe or anaesthetic needle is used to detect the presence of bone dehiscence, and then alveolar mucosa is stained using an iodine solution to outline the width of the attached and keratinized gingiva. A horizontal incision is made in the attached portion of keratinized gingiva slightly located apical to the alveolar crest. The size of the teeth and contour of the gingiva determine the mesial and distal extension of the horizontal incision. Two vertical incisions were made on the mesial and distal ends connecting the horizontal incision. Then the flap is elevated, moved apically, and positioned at the desired level.

Free gingival graft[12] is another surgical method to increase the attached gingiva. In this technique, a piece of gingiva is removed from the donor site and placed in the recipient site. Before re-establishment of vascularization, cut blood vessels provide nutrition to free gingival graft. By the next day, vascularization is re-established through the anastomosis.

Sub-epithelial connective tissue graft(13) is another technique used to increase the attached gingiva. Indicated in single or multiple root exposed teeth. Free grafts of connective tissue without epithelium are transplanted and then the grafts are covered with epithelium and thus they exhibit characteristics similar to normal epithelium. The success rate of connective tissue graft is high due to the dual blood supply from the connective tissue base and from the recipient flap. When compared with free gingival graft, sub-epithelial connective tissue graft offers minimum palatal denudation and avoids the formation of keloid.

Attached Gingiva in Orthodontic Therapy

The relationship between orthodontics and periodontics often resembles symbiosis. Periodontal health is enhanced by the movement of mal-aligned teeth, while the motion of orthodontic teeth is often facilitated by

periodontal treatment. For orthodontic treatment, the attached gingiva should be healthy and gingival recession should not be present.[14] Attachment loss of healthy attached gingiva and gingival recession affects orthodontic treatment severely. Animal studies show that areas where there is an absence of attached gingiva have more inflammation than areas where there is a wider zone of attached gingival.[15,16] To prevent unpredictable attachment loss and recession, gingiva augmentation is indicated prior to orthodontic treatment to enhance soft tissue around the tooth.[14] This is done in case the tissue is of thin biotype, but if the tissue is thick a revaluation is done for the need for augmentation after completion of orthodontic treatment.[17] So before orthodontic treatment is done the orthodontist should evaluate whether a minimum zone of attached gingiva is present around the teeth of interest.[14]

According to Dannan (2008), alignment and levelling of orthodontic teeth do not result in significant changes in the width of keratinized gingiva when proper plaque control is ensured which was observed in a study conducted in 10 patients with front tooth crowding under orthodontics treatment.[18] Studies conducted in monkeys have shown that recession and attachment loss during orthodontic tooth movement is due to plaque-induced inflammation and volume of marginal soft tissue rather than the width of keratinized and attached gingival.[19] Another experimental study that as long as the tooth is displaced inside the envelope of the alveolar process the risk of adverse side effects in peripheral soft tissues is minimal. Fine and delicate tissues are much more prone to recession during orthodontics than in normal or thick tissues.[20]

Attached Gingiva and Dental Implants

The clinical significance of attached gingiva around the implant is that it prevents the spread of inflammation, and the recession of marginal tissue provides a tight collar around the implant and enables the patient to maintain oral hygiene.

Longitudinal clinical studies did not identify significant differences in the growth of the implant recession with or without keratinized mucosa.[21] However, it has been noted that the absence of a suitable area of attached gingiva has been associated with a high build-up of plaque and gingival inflammation. Keratinized and non-mobilized gingiva is important around the implant. Mobile mucosa may disrupt the epithelial attachment zone of implants and increase the risk of plaque-induced inflammation.[22] Keratinized gingiva has the orientation of collagen fibers perpendicular to the implant surface.[23] It prevents the spread of inflammation from plaque.[24] Hygiene aid are more comfortable within keratinized non-mobile tissue. It also provides a tight collar around the implant. Meffert et al prefer to obtain keratinized tissue before implant placement.[25] Mehdi adibradstated that there is an important influence of the width of the keratinized mucosa on the health of the peri-implant tissues.[26]

Attached mucosa is necessary to prevent movement of mucosa around an exposed cover screw from inflecting trauma upon to marginal soft tissue.[27] It is preferable to locate the implants in masticatory mucosa. Hence if there is inadequate gingiva present it is better to augment the gingiva before placement of fixture.

Lindhe et al placed a ligature wire around the dental implants to induce peri-implantitis and reported extensive bone loss around the implants area.[28] Warrer et al found that when there is an absence of attached gingiva the implant site is more prone to inflammation and bone loss.[29] Chung et al reported that more plaque and gingival indices are related to the absence of attached gingiva, particularly on implants placed in posterior sextants.[30]

Bouri conducted a cross-sectional study to determine an association between the width of the keratinized mucosa and the health of the implant[31] The narrow area of keratinized tissue in the implant-supporting tissue was found to have more plaque and signs of inflammation with more alveolar bone loss than in wider zone of keratinized tissue. The progression of peri-implant mucositis to per-implantitis is massively restricted by the tissue barrier concept of attached gingival.

Attached Gingiva Studies

Various studies were conducted to find the relationship between attached gingiva and periodontal health with a variety of controversial results. They are:

Lang and Löe (1972): 32 dental students underwent 6 weeks of supervised oral hygiene, and the width of keratinized gingiva, gingival index, and gingival exudates were scored around plaque-free sites. The outcome was that sites with<2 mm keratinized gingiva had a higher percentage of sites with clinical inflammation and gingival educates. The conclusion was that for periodontal health 2 mm gingiva is necessary.[32]

Miyasato et al (1977):- Gingival status of 16 dental personnel with adequate attached gingiva and minimal attached gingiva were compared. The gingival index was compared in 6 subjects having contralateral sites with inadequate and adequate attached gingiva following a period of 25 days of no oral hygiene at sites. The outcome was that no marked difference in gingiva index in subjects with minimal attached gingiva or adequate attached gingiva. Following a period of no oral hygiene, there was no significant difference between gingival index and plaque scores in areas with narrow or wide attached gingiva. The conclusion was that it is possible to achieve gingival health even in absence of adequate attached gingiva.[33]

Wennström and Lindhe animal studies (1983) 7 beagle dogs, 4 different dentogingival units with varying widths of attached gingiva created followed by 40 days of plaque accumulation. The outcome was that clinical and histological investigations did not reveal any differences in the extent of inflammation. The conclusion was that gingival units with the absence of attached gingiva are more susceptible to inflammation than those with a wide zone of attached gingival.[34]

Wennstrom (1987)5 Years of monitoring of 26 sites deprived of attached gingiva compared with 12 control sites with adequate Attached gingiva. The outcome was that 7/26 test sites showed a slight increase in attached gingiva, 2 sites showed reduced attached gingiva, and 3 control sites showed reduced attached gingiva. The conclusion was that with good plaque control attached gingiva didn't result in gingival recession.

Conclusion

The adequate width of attached gingiva covers essential components, prevents the spread of inflammation, and helps in maintaining a healthy periodontium. Thus it is important for the dentist to understand the biology of attached gingiva and its significance. An adequate amount of attached gingiva provides a stable base for maintaining good oral hygiene.

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