

Normal anatomy and clinical significance of attached gingiva: A review

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Abstract

Attached gingiva is a part of keratinized gingiva which aids in periodontium to increase resistance to external injury and contribute in stabilization of gingival margin against frictional forces and also aids in dissipating physiological forces which are exerted by the muscular fibers of the alveolar mucosa on the gingival tissues. The firmness characteristics of attached gingiva is determined by the collagenase nature of connective tissue and its adherence to the underlying muco-periosteum. Elongated

papilla gives good mechanical attachment and prevents epithelium being striped under shear forces. Thick network of closely packed collagen fibers resist the loading. So the attached gingiva can easily bear the compressive and shear forces.

Keywords: Width of attached gingiva, keratinized gingiva, Mucogingival junction, Tissue barrier concept.

Introduction

Oral mucosa consists of three zones namely the gingiva and hard palate, termed the masticatory mucosa; the

dorsum of the tongue (specialized mucosa) and the oral mucous membrane (lining mucosa). Macroscopically, the gingiva is divided into marginal, attached and interdental areas. **Orban** first described the term attached gingiva as that part of the gingiva that is firmly attached to the underlying tooth and bone and is stippled on the surface.¹

According to **Orban** and **Sicher** oral cavity is lined by three different kinds of mucosa. Masticatory mucosa which includes covering of hard palate and gingiva of alveolar process, lining mucosa which includes covering of lips, cheeks and vestibular fornix and specialized mucosa covering the dorsum of tongue. Each of this oral mucosa has its own clinical significances. Anatomically gingiva is divided into three distinct parts namely free, attached and interdental gingiva. Attached gingiva is a part of keratinized gingiva which aids in periodontium to increase resistance to external injury and contribute in stabilization of gingival margin against frictional forces and also aids in dissipating physiological forces which are exerted by the muscular fibers of the alveolar mucosa on the gingival tissues. In the early 1980s, **Wennstrom et al.** reported a series of well-designed experiments to prove that the width of attached gingiva have little role in maintaining periodontal health.²

It is demarcated by the space between the mucogingival junction and the projection on the external surface of the bottom of the gingival sulcus or the periodontal pocket.

According to glossary of periodontal term (1972) Attached gingiva is that portion of gingiva that extends from the base of gingival crevice to mucogingival junction. **Orban(1948)** appear to be the first to describe attached gingiva, he divided gingiva into free and attached gingiva demarcated by free gingival groove (FGG) according to him, FGG is at appropriate level of the bottom of gingival sulcus. **Ainamo and loe (1966)** conducted a study to show that FGG was present only in

one-third of cases examined so it was unreasonable to assume that FGG represent the demarcation line between free gingiva and attached gingiva.³

According to glossary of periodontal term Attached gingiva is firm, resilient and tightly bound to underlying periosteum, tooth of alveolar bone through connective tissue. Facial aspects of attached gingiva extend to relatively loose and movable alveolar mucosa is demarcated by mucogingival junction.

The epithelium of attached gingival is keratinized in nature and has prominent epithelial ridges. There is no elastic fibers present in connective tissue. These characteristics are exactly the opposite of the histology of alveolar mucosa.

It is lined by four layers.

- Stratum Basale
- Stratum spinosum
- Stratum granulosum
- Stratum corneum

Coral pink color of attached gingiva is governed by factor like thickness of epithelium, vascular supply and degree of keratinization and presence of pigmentation.

The firmness characteristics of attached gingival is determined by the collagenase nature of connective tissue and its adherence to the underlying muco-periosteum. Elongated papilla gives good mechanical attachment and prevents epithelium being striped under shear forces. Thick network of closely packed collagen fibers resist the loading.⁴ So the attached gingiva can easily bear the compressive and shear forces.

Width of Attached Gingiva

It is the distance between mucogingival junction and projection on external surface of bottom of sulcus. Width of facial gingival varies in different areas of oral cavity; it is generally greatest in the incisor region. 3.5-4.5 mm in maxilla anteriors, 3.3-3.9 mm in mandibular anteriors. It is

narrower in posterior tooth region: 1.9mm in maxillary premolars and 1.8 mm in mandibular premolars. Width of attached gingiva is less in newly erupted permanent teeth and it gradually increases with permanent teeth eruption. Bower measured the width of facial attached gingiva in both primary and permanent dentition.⁵ The width of gingiva varies from 1-9 mm, being greatest at the incisor region especially in the lateral incisor and smallest in the canine and first premolar region. Voigt et.al measured the width of attached gingiva in clinically normal subjects.⁶ He demonstrated that the greatest width (4.7mm) of attached gingiva present at first and second molar sites and decrease at premolar and third molar sites. The incisor and canine demonstrated the smallest width (1.9mm). The width of lingual attached gingiva is decreased with the increase of age from primary to permanent dentition. **Ainamo et.al** stated that, mucogingival junction remains stationary throughout life and changes in width of attached gingiva are caused by modification in position of coronal gingiva.⁷ With progression of age width of attached gingiva increases.^{8,9} **Maze land et.al** said that, width depends on height of alveolar process and vertical dimension of lower face. Andin- sobocki and bodin in a series of studies over 2 year used longitudinal observational to confirm the pattern of Facial keratinized tissue in children.¹⁰ Over a 2 year period both primary and permanent teeth demonstrated an increase in both facial attached and keratinized tissue. Zone of attached gingiva was narrower on facially positioned teeth then on well-aligned or lingually positioned teeth.

Functions of Attached Gingiva¹¹

Gives support to marginal gingival. Help to withstand the functional stresses of mastication & tooth brushing. It also provides attachment or a solid base for the movable alveolar mucosa for the action of the cheeks, lips, and tongue.

Factors Effecting Width of Attached Gingiva¹²

- High frenum attachment
- Recurrent inflammation
- Recession
- Malpositioned teeth
- Osseous dehiscence

Assessment of Width of Attached Gingiva

- Functionally by passive movement of lips and cheeks (**Ochsenbein et al.1974, Cohen 1964**)¹
- Measure the amount of attached gingiva using probe (subtraction method)¹
- Staining method
- OPG assessment (**Talari and Ainamo 1977**)²
- Anaesthesia method

Measurement of Width of Attached Gingiva

HALL suggested that the width of attached gingiva is determined by subtracting the sulcus or pocket depth from total width of gingiva.¹³



Fig.1: Visual method of demarcating the mucogingival junction

Methods to Determine Mucogingival Junction

- Visual method.(Fig.1)
- Functional method.
- Visual methods after histochemistry staining.

I. Mucogingival junction is determined by a scalloped line which is separated the attached gingiva from the alveolar mucosa.

II. Assessed as a borderline between movable and immovable tissue. Tissue mobility was measured by

running a horizontally positioned probe from the vestibule toward the gingival margin using light force.

III. Assessed visually after staining the mucogingival junction with iodine solution.

In case of distinct mucogingival junction which is done by stretching the lip or cheek to demarcate Mucogingival junction while pocket is being probed.

In case of indistinct Mucogingival junction its position can be gauged by placing a probe horizontally flat against the mucosal surface and sliding it coronally.

Clinical Significance

Friedman stated that “inadequate” zone of gingiva would facilitate Subgingival plaque Formation because of improper pocket closure resulting from the movability of the Marginal tissue. It may be due to:

Some people are born without sufficient attached gingiva, resulting in the muscles in alveolar mucosa to pull the gingiva down. It causes gingival recession as well as bone loss. Abnormal free attachment, which exaggerates the pull on gingival margin. Vigorous brushing in people with naturally thin tissue or when the tissues have been stretched during orthodontic treatment.

- Deep pockets that reaches the level of mucogingival junction. Attached gingiva prevents spread of inflammation, recession of marginal tissue, provides tight collar around implants, enable patients to maintain good oral hygiene.

Lang and loe

Reported a study on the relationship between the gingival width and inflammation, in an effort to determine the adequate amount.¹⁴

In 100% of teeth with less than 2mm of keratinized tissue, inflammation and exudates were present. 76% of cases with greater than 2mm of keratinized tissue there was absence of exudates and was considered as clinically healthy.

They concluded that to maintain gingival health 2mm of keratinized gingiva, with less than 1mm of attached gingiva is adequate. **Hall** mentioned few critical factors to be considered for determination of adequate attached gingiva.¹⁵

- Patients age
- Level of oral hygiene practice
- Teeth involved any
- Potential or existing esthetic problem
- Existing recession with esthetics or sensitivity problem
- Patients’ dental needs
- An adequate band of attached gingiva could be defined as that amount which is sufficient to prevent recession in opinion of individual practioners.¹⁶

Indication to Increase Width of Attached Gingiva

- Patient experiencing discomfort during tooth brushing and chewing.
- In cases where orthodontic treatment planned and final position is expected to result in recession.
- To improve aesthetics-the coverage of denuded root surface for aesthetics which increase the attached gingiva.
- For teeth that serve as an abutment for fixed or removable partial dentures, as well area in relation to denture.

Keratinized Attached Gingiva Around Implants

Absence of keratinized mucosa increases the susceptibility of peri-implant lesions and plaque induced destruction. Keratinized gingiva around implant has more hemidesmosomes and orientation of collagen fiber in the connective tissue zone of an implant often appear perpendicular to implant surface, but in mobile non keratinized tissue these fibres run parallel to surface of the implant.¹⁷ **Schrodter et al.** reported that implant epithelial attachment zone is disrupt by the mobile mucosa

and contribute to an increased risk of inflammation from plaque.¹⁸ Hygiene aids are more comfortable to use within the keratinized tissue as it's more resistant to abrasion. **Mehdi Adibrad et al** said that there is a significant influence of width of keratinized mucosa on health of the peri-implant tissues.¹⁹ Higher plaque accumulation, gingival inflammation, bleeding on probing, and mucosal recession are associated with the absence of adequate keratinized mucosa around implants supporting over dentures. **Listgartan** and **Schroeder** stated that 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.¹⁷

Methods of Measuring Thickness of Attached Gingiva

Gosalind et al said that average thickness of attached gingiva is 1.25mm.²⁰ Earlier method of measuring the thickness of attached gingiva includes traumatic technique like probing and injection needles. "KRUPP SDM" is a new device that atraumatically measures the thickness of attached gingiva. This device uses pulse echo principle with aids of pulse generator and at a measurement frequency of 5MHz, a piezoelectric crystal is allowed to oscillate. Ultrasonic pulses are transmitted through the sound permeable gingiva. on reaching bone or teeth surface, it is reflected. A transducer probe of 4mm diameter moistened with saliva is applied to measure site with slight pressure to produce acoustic coupling. By timing received echo with respect to transmission of pulse, thickness is digitally displayed.

Eager divided attached gingiva based on periodontal type:

- Shallow thin gingiva with slender crown formation.
- Wide thick gingiva with quadrant crown formation.
- Unknown combination

Method of increasing the width of attached gingiva (gingival augmentation). The earliest of these techniques are the vestibular extension operations:

- Denudation techniques. (**Ochsenbein 1960, Corn 1962, Wilderman 1964**)²¹
- Periosteal retention procedure or Split flap procedure (**Staffileno et al. 1962, 1966, Wilderman 1963, Pfeifer 1965**)
- Free grafts have been used for gingival augmentation (**Haggerty 1966**²², **Nabers 1966, Sullivan & Atkins 1968, Hawley & Staffileno 1970, Edel 1974**).

The most common surgical procedures which are used for augmenting the zone of attached gingiva effectively and predictably are the apically positioned flap, free gingival graft, and Sub epithelial connective tissue graft.

Tissue Barrier Concept

Goldman and Cohen outlined a "tissue barrier" concept for mucogingival surgery.²³ They postulated that a dense Collagenous band of connective tissue retard or obstruct the spread of inflammation better than does the loose fiber arrangement of the alveolar mucosa. They suggested that an adequate tissue barrier can be achieved by increasing the zone of keratinized tissue.

Conclusion

It is important that dentist who plan to perform periodontal plastic surgery understand the biology of attached gingiva. The need for gingival augmentation has to be tailored according to particular clinical situation and patient oral hygiene competence. Adequate keratinized gingiva provides a firm and stable Base for maintaining good oral hygiene, restorative and esthetic procedure. Restoring dentist should be aware of the biology of keratinized Gingiva and methods for increasing the attached gingiva for a successful treatment Outcome.

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