Restoring and Maintaining Healthy Gumlines: A Novel Approach

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INTRODUCTION

Periodontal (gum) disease, such as gingivitis and periodontitis, is a notable medical problem in the globe. By statistics, severe periodontitis affects approximately 1.1 billion people worldwide in 2019, with an increasing rate of 8.44% from 1990 to 2019[1]. It is noted that gum disease is also considered prevalent in Hong Kong. According to a cross-sectional study interviewing 1265 Hong Kong Chinese aged between 25 – 60, 62.2% of the individuals reported experiencing gum bleeding in the past 12 months[2]. Healthy gum acts as a natural protective barrier, and poor gum health not only lead to localized inflammation and infection, but also associates with systemic conditions like cardiovascular disease and diabetes[3].

Although gum health is so important, the public in Hong Kong still have many misunderstandings on the maintenance of gum health. For instance, dental scaling is sometimes avoided by certain local individuals due to misconceptions that it would "make the teeth thinner" or "widen the gum space"[4]. Besides, pharmacists' role in delivering oral healthcare services in Hong Kong is often underappreciated, and global practices on this matter will be further discussed in this article to examine how Hong Kong can learn from the experiences of other countries. This article aims to raise awareness about the importance of oral care with an emphasis on gum health conditions, and to reinforce local pharmacists' role in the primary oral healthcare field.

IMPORTANCE OF GUM HEALTH CONDITIONS

The most common types of gum diseases are gingivitis and periodontitis. Gingivitis is relatively mild, reversible inflammation of the gum, which is characterized by red, swollen and easily bled gums[5]. On the other hand, periodontitis is a chronic, irreversible inflammation state, which can potentially result in various degrees of destruction of supporting tissue adjacent to the teeth and is often characterized by bone loss surrounding the affected teeth[5]. Given that the difference in severity and reversibility between gingivitis and periodontitis, it is important to identify gum condition from the stage of gingivitis and offer appropriate and on-time treatment to prevent its progression into irreversible periodontitis. Although not many studies were done on the clinical transition from gingivitis to periodontitis, the pathophysiological changes that take place during the inflammation progression has been explored over time. For instance, "chronic periodontitis" was recognized as a significant dental health issue as early as in 1960s[6]. At that time, a critical observation was also made to identify gingivitis as the initial lesion for periodontitis, and oral plaque is also recognized as the primary etiologic cause of gingivitis[6]. Hence, attention should be paid to maintaining gum health starting from the early stage by preventing plaque buildup.

Oral inflammation may seem easy to tackle, but it can lead to more severe consequences such as bone loss and loss of teeth[7]. Apart from the perspective of oral health alone, poor gum health is also linked with systemic manifestations. It should be noted that there is a bidirectional relationship between oral health and systemic disease, given that 100 systemic diseases have oral implications[7]. Examples of systemic conditions reported to be linked with poor oral health include coronary heart disease, adverse pregnancy outcomes, stroke, hyperlipidemia, pulmonary infection, and more[8]. Although more studies still need to be done to investigate the actual causal relationship between oral health and systemic condition, the association between these two factors should never be overlooked. Besides, there is notable evidence that these comorbidities are more commonly seen in elderly, and good oral care of nursing home residents can lead to reduced adverse effects and healthcare expenditure[7]. Given the above potential consequences of poor oral or gum health, there is an urgent need for the public to learn the ways to maintain healthy gums.

The Concept of "Free Gingivae" for Healthy Gums

The gingiva, also commonly known as the gum, is the oral mucous membrane surrounding the teeth, and it can be further differentiated into marginal, attached and interdental regions (refer to ***Figure 1***)[9]. The free (or marginal) gingiva is the "terminal edge or border of the gingiva surrounding the teeth in a collar like fashion" and it composes the soft tissue wall of the gingival sulcus[9].

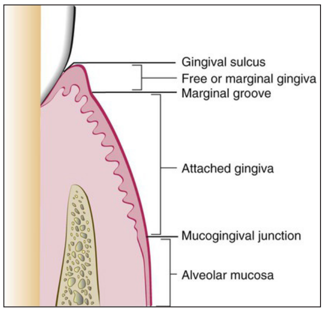

Figure 1: *Diagram showing the anatomy of gingiva*[9]

The role of healthy free gingivae may seem minor to many people, but its importance becomes notable when it is absent, as in the condition of gingival recession. Gingival recession is a clinically significant phenomenon in the field of dental care as the exposed root surfaces become vulnerable to decay and wear[10]. It can occur in both inflamed (gingivitis) and healthy gum tissues and becomes more common as people age, use inappropriate tooth brushing techniques and have tooth malposition[10]. Some of the factors contributing to gingival recession are summarized in ***Table 1*** below:

Table 1. Predisposing and precipitating factors of gingival recession
Predisposing factors: (1) Bone defects (e.g. lack of alveolar bone), (2) Thin and fragile gingival tissue, (3) Abnormal frenal attachment*
Precipitating factors: (1) Toothbrush trauma (improper toothbrushing techniques), (2) Oral piercings, (3) subgingival restoration, (4) Deep traumatic overbite, (5) Self-inflicted injuries, (6) Orthodontic therapy, (7) Plaque-induced periodontal inflammation, (8) Herpes simplex virus infection, (9) Smoking
* Frenal attachment is the mucous membrane with muscle fibers that connects the lips to the alveolar mucosa and periosteum underneath.

To preserve the health and proper functioning of the free gingival margins, measures should be taken to prevent practices that may potentially prove detrimental to the gums and teeth. Recommendations for maintaining gingival and oral health will be further elaborated upon in subsequent sections of the article.

Proper ways of removing Dental Plaque (or oral plaque)

Dental plaque (biofilm) is the complex community of microorganisms, consisting of both gram-positive and gram-negative bacteria, that adheres to the tooth surface and encased in a matrix made up of bacterial and salivary components[11]. Calcified form of plaque is also referred to as calculus or tartar[13]. Dental plaque has been acknowledged as the primary causative factor in gingival inflammatory diseases and it is proposed that the effective removal of plaque can lead to the control and lead to better management of the diseases[6]. More importantly. greater gingival inflammation in response to plaque accumulation is seen in the case of aggressive periodontitis, when compared to periodontally healthy individuals. Hence, it is preferable to clear the plaque efficiently before the condition deteriorates further.

Toothbrushing is often the first action that comes to mind when considering proper dental care. Yet, the way of toothbrushing varies among individuals and may result in varying efficacy in plaque removal. A meta-analysis[13] concludes (modified) Bass technique as most efficient in plaque and gingivitis reduction, when compared to other techniques. The American Dental Association (ADA)[14]suggests toothbrushing should be done twice a day using a soft-bristled brush, which should be replaced at least every 3 - 4 months. The optimal timing for tooth brushing remains unclear, given that individual factors such as the presence of dental caries and the risk of erosive tooth wear has to be considered[15]. The toothbrushing method recommended by ADA, which is similar to Bass technique, is attached as **Figure 2**[16]:

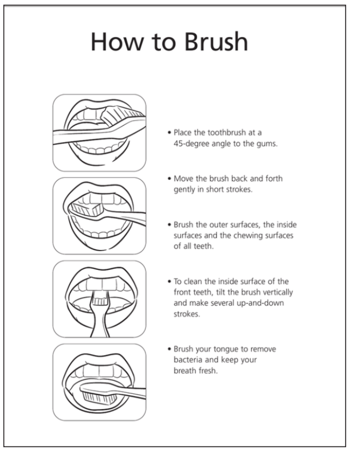

Figure 2: *ADA instruction on toothbrushing*[16]

Apart from tooth brushing techniques, the choice of toothpaste is also important. The regular use of fluoride toothpaste is suggested by the Centre of Disease Control and Prevention (CDC), given that fluoride help repairing and preventing damage to teeth caused by oral bacteria, as well as replacing minerals lost from acid breakdown. Also, the use of fluoride toothpaste increases the fluoride content in saliva, which protects enamel from demineralization and enhance its recovery[19,18]. In general, the role of fluoride toothpaste in controlling dental caries (tooth decay) and strengthening the teeth are well-recognized. Other fluoride oral products, such as fluoride mouthwash, can also achieve a similar effect[19]. However, fluoride-containing products should be used in caution in younger children due to potential risk of dental fluorosis, which may affect the appearance of children's growing teeth. Although it is mainly a cosmetic issue, the condition can range from mild, characterized by white flecks or streaks on the teeth, to severe, which can cause brown spots and enamel pitting[20]. According to ADA recommendation, a toothpaste smear with the size of a grain of rice should be used from the emergence of the first tooth until the age of 3, while from ages 3 to 6, a pea-sized amount of toothpaste should be employed[22]. These limits on toothpaste amount aim to reduce fluorosis caused by accidental consumption of toothpaste by children.

Apart from fluoride, the details of other major ingredients commonly used in toothpaste are also listed in the table below as reference:

Table 2: Summary of ingredients commonly used in toothpaste apart from fluoride
(Note: The list is not exhaustive and only serves to provide examples on toothpaste ingredients, and some ingredients may have more than one functions)

Categories	Ingredients	Details
Abrasives (for stain removal/ whitening)	Silica/ hydrated silica	• Compatible with majority of active ingredients (e.g. not reacting with fluoride to form insoluble salt) • Concentration or amount of hydrated silica added is not proportional to abrasiveness
	Calcium phosphate	• Can be subclassified into anhydride and dihydrate forms, in which the former is harder in nature • The dihydrate form has mild abrasive effects and is compatible with other ingredients. However, it loses the water for crystallization and turns back to anhydride form after prolonged use, causing it to become harder in texture.
	Calcium carbonate	• Higher abrasiveness than calcium phosphate, but lower abrasiveness than hydrated silica in general
	Sodium bicarbonate (baking soda)	• Compatible with majority of active ingredients • Graded as a low abrasivity agent • Possess biological compatibility, acid-buffering effect and antibacterial activity in high concentrations • One analysis states the variability in the concentration of sodium bicarbonate in toothpaste (ranging from 35% to 67%). Also, its concentration is mentioned to be positively related with plaque removal efficiency, but such an association is not statistically significant
Anticaries agents	Xylitol	• Sweet in taste and offers a cooling sensation • Decreases both acid synthesis from glucose and Streptococcus mutans present in saliva and plaque by inhibiting glycolysis
	Calcium/phosphate	• Enhance remineralization and facilitate fluoride uptake
	Sodium bicarbonate	• Disfavor the growth of aciduric bacteria by increasing saliva pH, and hence preventing tooth decay • Prevent caries by enhancing enamel remineralization and lowering enamel solubility
Anti-plaque/ anti-gingivitis agents	Sodium lauryl sulphate (SLS)	• Act as enzymes inhibitor of glucosyltransferase and fructosyltransferase. By preventing these enzymes from synthesizing glucan in situ from sucrose, SLS can significantly slow the plaque regrowth and hinder Streptococcus mutans colonization.
	Triclosan	• Possess anti-inflammatory, anti-microbial and anti-metabolism properties • Triclosan alone does not effectively inhibit plaque unless combined with other antibacterial chemicals. For example, efficacy of triclosan is increased by incorporating with copolymers or addition of other antibacterial material, such as zinc citrate

Anti-plaque/ anti-gingivitis agents	Stannous ions (Tin (II) ions)	• Added in toothpastes in the form of stannous chloride/ fluoride/ pyrophosphate • May inhibit bacterial glycolysis • Stannous fluoride causes enamel surface to become hydrophobic, which disfavors bacterial colonization
	Zinc ions	• Added in toothpaste in the form of zinc chloride/citrate • Inhibits glucose uptake of several bacteria by phosphotransferase pathway and inhibits protease activity of other bacteria
Anticalculus agents	Pyrophosphate	• Added in toothpastes in the form of tetrasodium/tetrapotassium/disodium pyrophosphate. • Reduces protein binding ability of hydroxyapatite surfaces of the teeth • Prone to enzymatic hydrolysis, which leads to reduced duration in mouth cavity
	Zinc ions	• Apart from anti-plaque properties, zinc ions also inhibit crystal growth, contributing to anti-calculus effect
Desensitizing agents	Potassium salts	• It is proposed that potassium ion can depolarize the nerve and inhibit nerve response upon stimuli
	Strontium salts	• As a bioactive material to seal dentinal tubules, given that root sensitivity of teeth can be partly attributed to open dentinal tubules • Replaces calcium in hydroxyapatite and favors tissue remineralization • Strontium can also depolarize dental nerves
	Stannous salts	• Desensitizing effect due to disposition of insoluble stannous salts • Stannous fluoride may stain teeth, but staining effect can be reduced by addition of zinc phosphate
	Calcium Sodium phosphosilicate	• A bioactive glass that reacts with aqueous solvent to synthesize hydroxy-carbonate-apatite, which has similar structures to mineral in dentin and enamel • A 6-week clinical trial shows greater sensitivity reduction than potassium nitrate
	Note: A meta-analysis in 2015 supports the use of potassium-, stannous fluoride- and calcium sodium phosphosilicate-containing toothpaste for the indication of dentin hypersensitivity, but not strontium-containing desensitizing toothpaste[27].	

On the other hand, although recommended by many dental professionals, current studies have found no significant extra benefits of using dental floss in addition to toothbrushing for preventing dental caries and gingivitis[21]. Besides, regular cleanings and scaling procedures are another common approach to clear plaques and maintain dental health. A 2017 Korean clinical study (n=352) found that the patient group receiving regular professional dental scaling demonstrated higher scores on an oral health index and exhibited more favorable oral health behaviors, compared to the group receiving irregular dental scaling[22], proving the effectiveness of regular dental scaling procedure in reinforcing oral health.

Preventive & remedial measures on gum-related inflammation

To prevent the periodontal inflammation, it is important to adopt behavioral change by considering lifestyle risk factors, such as smoking, type 2 diabetes, mental stress and nutritional intake[23]. A comprehensive review article published in 2022 synthesized a multitude of global studies demonstrating the beneficial effects of smoking cessation on periodontitis and tooth loss and suggested that smoking cessation can be achieved from both pharmacological and non-pharmacological perspectives[24]. In terms of nutritional intake, it is evident that diet that is high in fiber, high in omega-6-to-omega-3 fatty acid ratio and low in sugar decreases the risk of periodontal diseases[25]. Besides, micro-nutrients such as vitamins A, B, C, zinc, calcium and polyphenols are shown to prevent periodontal diseases as well34. Moreover, plain water intake was found to have a negative relationship with periodontitis risk in a study of the population aged over 45[26], although the exact association between fluid intake and periodontitis risk is still unclear. One of the possible ways to explain such relationship would be the fact that better hydration status stimulates more saliva secretion, which can be beneficial as study points out that low saliva flow rate is associated with severe types of periodontal disease[27]. Hence, it is still recommended to stay hydrated to reduce chances of developing periodontal diseases.

Apart from preventative measures, some biomaterials appear to be useful in the treatment of pre-existing gum inflammation. One typical example is hyaluronic acid (HA) that normally present in gingiva periodontal ligament. Studies has proven HA's role in periodontal treatment, as indicated by reduced gingival bleeding after application of HA gel to gingivitis and periodontitis patients, as well as its advantages in periodontal regeneration[28].

Besides, the European Federation of Periodontology (EFP) has released a comprehensive clinical practice guideline for the treatment of stage I-III periodontitis[29]. The guideline summarizes evidenced-based stepwise recommendations to tackle the disease, including but not limited to risk factor management, subgingival periodontal instrumentation, professional mechanical plaque removal, choice of adjunctive antibiotic and surgical interventions[38].

PHARMACISTS' ROLE IN MAINTAINING ORAL HEALTH

Currently, oral health care system in Hong Kong is mainly supported through private sector, while dental care services offered by the government are very limited[30]. The prices of private dental services hugely vary among different dental clinics due to lack of regulation to govern the price[39]. According to a Hong Kong-based study done in 2007 (n=800), a clear difference is shown in dental neglect score between low- and higher-income groups, in which individuals with lower income shows higher oral dental neglect score[31]. This result implies that socioeconomic disparity is a notable factor that affects Hong Kong citizens' willingness in searching for oral healthcare services. Although it is hard to change the socioeconomic environment in Hong Kong, pharmacists can offer help in oral healthcare field from a primary healthcare approach. In 2009, the integration of dental care into primary healthcare services and the emphasis on collaborative work among healthcare providers was advocated by the WHO's 7th global conference[32]. Given that "prevention is better than cure", it would be a good move to enhance the oral health of local citizens from an early stage of disease prevention at community level.

Nevertheless, difficulties are present in incorporating pharmacists into oral care or primary healthcare in Hong Kong. A local study points out that over 30% of respondents disagreed or had not comments to consulting pharmacist prior to using OTC products, due to reasons including "uncertainty on pharmacist's role", "having low trust/acceptance level on pharmacists" and "not seeing the need of consulting a pharmacist"[33]. The study also mentioned that fewer than half of respondents (45%) believed pharmacists should serve a leading role in self-care. It is against these backdrops that pharmacists should be encouraged to take on a more active role in the provision of primary oral healthcare, by learning from pharmacy practices implemented in other countries. For example, common oral healthcare services offered by community pharmacists in Australia and Malaysia include provision of OTC treatment for oral health-related issues, referral to dentist/doctors (when needed), symptomatic identification of oral health problems and provision of counselling and guidance regarding oral health issues[34,35]. The common oral problems and their respective OTC treatment are summarized in **Table 3**[36].

Table 3: Summary of common oral problems and respective OTC treatment products[46]

Oral Problems	Treatment Products
Gum inflammation	Chlorhexidine mouthwash/gel
Mouth ulcer	Analgesic gel (e.g. NSAID, benzydamine hydrochloride, lignocaine)
Oral thrush	Nystatin mouthwash, miconazole oral gel, systemic antifungal (e.g. fluconazole – for more severe cases)
Xerostomia	Saliva stimulants or substitutes, sugar-free chewing gum
Denture cleaning	Denture cleanser

To be specific, drugs associated with adverse effects in the oral cavity require pharmacists to provide counseling to enable better management of these conditions43. Some of the oral adverse effects and respective management or prevention strategies associated with common drug classes are summarized in **Table 4**.

Table 4: Summary of oral adverse effects of common drug classes/ drugs and their management/ prevention strategies		
Adverse Effects	Drug Classes/ Drugs	Management/Prevention Strategies
Gingival enlargement	Anticonvulsant, CCB, cyclosporine, erythromycin, oral contraceptives	Use lowest effective dose for shortest duration, maintain personal oral hygiene via proper toothbrushing and flossing, gum excision may be needed if situation is not reversed after 3-6 months
Hyperpigmentation	Amiodarone, antibiotics, anticancer drugs, antimalarials, antiretrovirals, chlorhexidine gluconate, clofazimine, heavy metals, hormone replacement therapy, ketoconazole, methyldopa, oral contraceptives, quinidine	Shorten duration of or discontinue medication use, Surgery may be needed is situation is not normalized
Angioedema	ACEi, NSAID, selective cyclooxygenase inhibitors	Symptom relief by antihistamine or corticosteroid, avoid the concerned causative agent in the future
Chemical burns	ARB, NSAID	Discontinue causative agent, apply topical benzocaine and/or corticosteroid & follow-up in 1-2 week
Osteonecrosis of the jaw	Antiangiogenic drugs, bisphosphonates, denosumab	Discontinue bisphosphonate, maintain good oral hygiene and visit dentist regularly, dental work is required before treatment initiation, hold bisphosphonate for 2-3 months after intrusive dental procedure
Xerostomia	Amphetamines, analgesics, anticholinergics, antidepressants, antiemetics, antihistamines, anxiolytics, bronchodilators, decongestants, diuretics, skeletal muscle relaxants	Promote the habit of drinking water, use saliva-stimulating substances (sialogogues) or oral lubricants, prevention of caries-forming habits (e.g. eat or drink sugar-rich content), use lowest effective dose for causative agents, prescribe cevimeline
Oral candidiasis	Antimicrobials, ICS	Rinse mouth thoroughly after drug use
(Note: ACEi = Angiotensin-converting enzyme inhibitors, ARB = Angiotensin-receptor blockers, CCB= calcium channel blocker, NSAID = nonsteroidal anti-inflammatory drugs, ICS = inhaled corticosteroid)		

Apart from the services offered to patients over the counter, pharmacists can also involve in a multidisciplinary antibiotic stewardship team in a dental setting, which is an important field today aimed at addressing the rise of antimicrobial resistance (AMR) in the treatment of oral infections[37]. Moreover, an inadequacy of dental and oral health care training is reported in a cross-national study including medical, nursing and pharmacy schools in universities across Asia, Australia, Canada, Europe and the United States. More interprofessional education courses related to the field should be launched in in universities, as they can enhance students' knowledge in areas like self-treatment of dental disorder and adverse oral health effects caused by medications, as reported in a pilot study[39,40].

CONCLUSION

Maintaining healthy gum conditions, particularly the free gingival margins, is essential for preserving overall oral function and systemic wellbeing. As outlined in this article, poor gum health can lead to oral disorders including gingival recession, gingivitis and periodontitis, and are linked to a host of adverse health outcomes. The "free gingivae" concept highlights the importance of protecting this delicate, vulnerable tissue through proper plaque removal and other preventative measures. Individuals are encouraged to prioritize gum health by adopting the strategies discussed, such as using the modified Bass toothbrushing technique, choosing fluoride-containing oral care products, and undergoing regular professional cleanings. These steps can help prevent the onset and progression of gum disease, preserving the integrity of the free gingival margins. Additionally, addressing lifestyle factors like smoking, poor diet, and stress can further maintain gum and overall health. Improved gum health brings a multitude of benefits, not only for the mouth but for the body as a whole. By maintaining healthy gumlines, individuals can avoid localized periodontal inflammation while reducing their risk of associated systemic conditions like heart disease and diabetes. More active pharmacist's involvement in primary oral healthcare in Hong Kong should be encouraged to facilitate better health outcomes in the community. Ongoing research and innovation will be crucial to further expand more effective, evidence-based strategies for restoring and preserving gum health. As the public and healthcare providers gain a deeper appreciation for the criticality of gum care, the prospects for better oral and overall wellbeing across populations is hoped to improve in near future.

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The views and opinions expressed in this article are solely those of the authors and do not reflect the official policy or position of Haleon, the company in which we work as either a pharmacy intern or a full-time employee while writing this article. We are writing this article in our personal capacity, and the content herein is not associated with or attributed to Haleon. Any information provided is our personal viewpoints only and should not be interpreted as a publication by Haleon.

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