香港家庭醫學學院學刊
The Hong Kong Practitioner
The Journal of The Hong Kong College of Family Physicians

The Hong Kong Practitioner
is indexed in EMBASE/Excerpta Medica
ISSN 1027-3948 (Printing)
ISSN 2410-5015 (Online)

Published by
The Hong Kong College of Family Physicians
Room 803-4, 8th Floor,
HKAM Jockey Club Building,
99 Wong Chuk Hang Road, Hong Kong.
Tel : 2871 8899
Fax : 2866 0616
Website: http://www.hkcfp.org.hk

Dental considerations in older adults attending the primary care clinic

Katherine CM Leung 梁超敏

HK Pract 2023;45:105-111

Summary

Oral health is part of our general health. Older adults attending the primary care medical clinic often require dental care as well. Many of them present with dental caries, periodontal diseases and tooth-loss due to worsened physical health and other cumulative damage brought by previous dental diseases. The elderly patients may also be suffering from systemic diseases and/or conditions which may have direct impact on their dental conditions. This article draws the attention of physicians, who are treating their older patients, to major dental diseases as well as the interactions between systemic diseases and/or other medical conditions with their dental conditions. Therefore, dental and medical professionals should work closely together to provide collaborative patient care.
Keywords: *Older adults, dental diseases, primary care*

摘要

口腔健康是整體健康的一部分。尋求基層醫療的老年人通 常也需要牙科護理。由於身體健康變差和牙齒受先前的牙 患累積的破壞，他們大都患有齲齒(蛀牙) 、牙周病和缺 牙。他們也可能患上一些可直接影響口腔健康的疾病。本 文提請治療老年人的醫生注意主要的牙齒疾病及其與身體 疾病的相互作用。牙醫和醫生應攜手合作給予病人全面的 照顧。
關鍵詞：老年人，牙齒疾病，基層醫療

Introduction

Oral health is part of our general health. Older people receiving medical care often require dental care as well. With increased dental awareness and better access to dental care, the elderlies tend to retain more teeth into their later years of life. However, the dental condition of the older patients is often far from satisfactory, due to their worsening physical conditions and cumulative damage caused by dental diseases in their past. Furthermore, degenerative changes, chronic diseases and their treatments received can negatively affect their oral health.

Two major dental diseases that cause eventual tooth loss if left untreated are dental caries and periodontal disease. Both diseases are to a large extent induced by dental plaque accumulation.

Dental plaque

Dental plaque is a collection of microorganisms found on a tooth surface as a biofilm, embedded in a matrix of polymers of host and bacterial origin.[1] It accumulates preferentially at stagnant areas such as proximal surfaces between teeth, underneath fixed dental prostheses and on the fitting surface of removable dentures, as these sites are normally less affected by the flushing effect of saliva and tongue movement. Dental calculus is formed when the minerals from saliva calcify the dental plaque. The surface of dental calculus is rough and further attracts plaque deposition.

Dental diseases

(a) Dental caries

Dental caries is a transmissible bacterial disease process caused by acids from bacterial metabolism diffusing into enamel and dentine and dissolving the mineral.[2] It is a major non-communicable disease affecting the vast majority of older adults. The estimated annual increments of coronal[3] and root[4] caries are 0.86 and 0.5 surfaces respectively. A recent systematic review highlighted that the trend of dental caries had shifted from children to adults with the third peak of caries emerging at around the age of 70, due to the appearance of root caries.[5] People who are older, of lower socioeconomic status, tobacco users and those with more severe gingival recession and poorer oral hygiene have a higher risk of root caries.[6]

Demineralisation of tooth substances occurs when bacteria metabolise sugar in the mouth to produce acid that demineralises the tooth substances. This happens when food containing carbohydrate is being consumed. This process can be reversed by remineralisation of the affected tissues naturally by salivary minerals or therapeutically by fluoride. However, if remineralisation does not happen due to persistently low pH of the oral cavity e.g. frequent meals, or unavailability of fluoride, the enamel breaks down and cavities appear, and the infection can spread to the underlying dentine. This causes sensitivity, or sharp and mild to moderate degree of pain when the patient consumes cold and sweet food and beverage. The carious sites appear brown or black with visible pits or cavities. Restoration of the carious lesions is necessary to remove the infected tooth substance, and to prevent plaque accumulation and food stagnation to facilitate proper toothbrushing.

When the infection spreads further to the vascularised and innervated dental pulp, it causes pulpal inflammation and necrosis. The severe and spontaneous dental pain can keep the patient awake. Dental abscesses may also develop. At this stage, root canal treatment will be needed. It is noteworthy that caries damages the tooth and the restorative procedures can further weaken it, risking its fracture upon receiving masticatory load.

Fluoride is an effective anti-caries agent which halts demineralisation and promotes remineralisation of enamel and dentine.[7] Dentists usually apply fluoride varnish, containing 22600 ppm fluoride, 2-4 times a year for caries prevention and arrest of early lesions. In the past decade or two, silver diamine fluoride (SDF) became the gold standard for root caries prevention and treatment.[8] It is also effective in the remineralisation of deep carious lesions on the occlusal surface and the treatment of hypersensitive dentine. Among the professionally applied topical fluorides, an annual application of 38% SDF solution combined with oral health education has been shown to be the most effective way of dental root caries prevention.[9]

(b) Periodontal disease

Plaque-related gingivitis occurs when dental plaque accumulates along the gingival margin over days or weeks without disruption or removal while non plaque-related gingival diseases can arise due to various causes[10-11] including genetic disorders such as hereditary gingival fibromatosis, specific infections, e.g. candidiasis, autoimmune diseases of the skin and mucous membrane, such as lichen planus, herpes simplex I & II, and leukaemia. The initial phase of plaque-related periodontal disease is gingivitis which involves host-immune response to dental plaque. Healthy gingiva appears pink and firm, and attaches closely to teeth, whilst it reddens, swells, sores and bleeds on probing in gingivitis **(Figure. 1)**.

Figure 1:

This patient suffers from periodontal disease. Heavy plaque deposition around the gingival margin, bleeding on probing and recession of the gingiva exposing the root surfaces can be seen.

Figure 2:

Dental caries attack the lingual surface of the lower anterior teeth of a Sjögren's syndrome sufferer. These sites are usually protected by a continuous flow of saliva.

Certain drugs and smoking habits can modify the host response to dental plaque. For example, patients taking calcium channel blockers, antiepileptics and immunosuppressants may show abnormal gingival enlargement.[12] Smokers usually exhibit less gingival bleeding, greater alveolar bone loss and clinical attachment loss. The treatment response is suboptimal and healing is impaired.[13] This implies that periodontal diseases are more difficult to detect and the treatments are less effective.

Plaque-related gingivitis can be resolved when dental plaque is removed. However, if it is allowed to accumulate for a long time, apical movement of the gingival margin will lead to gingival recession and hence root surface exposure. The root surface dentine is prone to caries. The tooth may become hypersensitive and present with pain or discomfort to cold and other stimuli such as sour food.

The advanced stage of periodontal disease, or periodontitis, is irreversible. The clinical signs include increased probing depth, clinical attachment loss, and tooth mobility and displacement. Periodontal abscess with pus draining may be present. In severe cases, the tooth may self-exfoliate. The patient often complains of halitosis, tooth mobility, poor masticatory efficiency, chewing discomfort, and food packing.

Oral hygiene practice

The key prognostic factor of periodontal disease is dental plaque accumulation. Therefore, good oral hygiene practice that includes toothbrushing twice daily and interdental cleaning are necessary. Non-surgical periodontal therapy including scaling and root planning aims to remove dental calculus and smoothen the root surfaces to enable the resolution of gingivitis. As an adjunct measure, 0.2% chlorhexidine digluconate mouthwash may be prescribed.[14] However, its long-term use is not recommended due to side effects like a change in taste, staining of the teeth, the gingiva and the dental appliances, irritation and superficial desquamation of the oral mucosa. Oral antibiotics may sometimes be necessary to eliminate causative bacteria. For periodontitis, surgical periodontal treatment involves flap surgery to expose root surfaces for scaling and root planing. For cases with severe gingival recession and bone resorption, grafting of soft tissues or bone and guided bone regeneration to cover exposed roots for aesthetics and to enhance bony support may also be performed.

Dental plaque is a causative factor in both dental caries and periodontal diseases. Proper oral hygiene measures cannot be overemphasised. Mechanical plaque removal by toothbrushing with regular fluoridated toothpaste (1000-1450 ppm fluoride) twice daily is mandatory. In high caries-risk cases, dentists may recommend using high-fluoride (5000 ppm fluoride) toothpaste. Interdental cleaning can be carried out with the use of dental floss or an interdental brush.

Assisted toothbrushing is required for patients who have problems with self-care. For those whose manual dexterity has deteriorated, a modified toothbrush to improve handgrip or the use of an electric toothbrush may be helpful.

The inter-related medical and dental conditions

Medical and dental conditions are often interrelated. Some chronic systemic diseases commonly seen in older adults can directly affect the oral tissues. Medications that modify the immune / inflammatory response or reduce salivary flow can complicate oral health problems.

Dry mouth and reduced salivary flow

Saliva exerts an important protective effect on the oral cavity through its flow and composition. Its mineralising, buffering and antimicrobial properties are crucial for preventing dental caries and providing resistance to dental infections. Degenerative changes of the salivary glands, diseases such as diabetes mellitus and Sjögren's syndrome[15], head and neck radiotherapy[16], and an array of medications[17] including the antidepressants and some diuretics, can reduce saliva secretion. Compositional change of the saliva to low bicarbonate and phosphate concentration impairs its buffering capacity. A longer time is needed to neutralise the oral acid, hence inducing a higher caries risk.[18]

Although xerostomia, a condition when there is a sensation of oral dryness resulting from diminished saliva production, seldom presents as the main concern for patients seeking medical or dental care. it can affect up to one-third of older adults worldwide.[19] Complaints of xerostomia may be subtle and indirect: for example, choking when dry food is taken, dry cough, the tongue sticking to removable dentures. These problems can be avoided by not taking dry food or by having a sip of liquid when taking dry food. Since xerostomia is a subjective feeling, its presence can often be missed without asking the question, "do you feel your mouth is dry?".[20]

Clinically, saliva with decreased salivary flow is viscous, sticky, frothy and bubbly. Those patients often present with heavier dental plaque deposition, greater number of dental caries and the lesions are located at sites generally not susceptible to decay such as the lower lingual region **(Figure. 2)**, and more missing teeth, worse periodontal condition and heavily restored dentition, when compared to those with normal salivary flow rate. Their oral mucosa looks dry and friable and the tongue may appear dry and lobulated. They are also more prone to oral mucosal infections such as oral candidiasis. They may also experience difficulties in speaking, swallowing, taste alteration and have burning mouth syndrome. Their oral health-related quality of life is also reduced.

Dentists usually detect oral dryness by testing if the oral mucosa sticks to the dental mirror. Commercially available test kit can be used to check the unstimulated and stimulated salivary flow rates, and the pH and buffer capacity.

Some patients may develop a habit of consuming acidic food and drinks to stimulate salivary flow. This habit should be deterred because it can lead to tooth erosion. Tooth surface loss does not only jeopardise the aesthetics when the anterior teeth become shortened, it can also cause hypersensitivity or pain which may, depending on its severity, require root canal treatment. Restoration of the teeth can be complicated because of reduced clinical crown height and lack of interocclusal space.

Medical physicians can consider prescribing medications which are less xerogenic. However, if such alternative medicines are unavailable, it is useful to advise the patients to take the causative medications during the day when activities in the oral cavity are at the maximum, and avoid taking them before sleep when the salivary flow rate is low, and also the number of bacteria in saliva increases rapidly at night.[21]

Various palliative and preventive measures, including pharmacologic treatment with salivary stimulants, saliva substitutes, and the use of sugar-free chewing gum/lozenges may alleviate some symptoms of dry mouth and may improve the patient's quality of life.

Diabetes mellitus patients

Diabetes mellitus (DM) is a common endocrine disorder in older adults. DM is linked to many different dental problems and conditions such as periodontal disease, delayed wound healing, taste alteration and dental infections. The relationship between DM and periodontal disease is bi-directional.[22] Diabetic patients have a higher risk of periodontitis, and their periodontal conditions worsen control of diabetes treatments, while people with periodontitis have an elevated risk for dysglycaemia and insulin resistance. There is a high association/risk between poor periodontal conditions and diabetes complications.[23]

In addition, hyperglycaemia, hyperinsulinemia and dyslipidaemia cause increased oxidative stress, inflammation, increased sympathetic activity, and impaired insulin signalling in the salivary glands, resulting in salivary gland dysfunction and the flow of saliva is reduced.[24] Diabetic patients often complain of xerostomia. Reduced salivary flow also promotes dental plaque accumulation and therefore further worsens their periodontal health, making them more prone to dental caries and oral mucosa infection.[25] DM patients who use removable dentures are more susceptible to traumatic ulcers of the oral mucosa at the denture-bearing area than non-DM denture wearers, probably due to slower healing or delayed wound repair.

The current consensus guidelines advocat e improving early diagnosis, prevention and co-management of diabetes and periodontitis.[23] DM patients are advised to maintain good oral hygiene not only for preventing periodontal disease but also for better glycaemic control. Regular dental visits for denture maintenance to avoid denture trauma are necessary.

Stroke, dementia and muscular disease

Sufferers of these conditions often have deterioration in self-care ability. They require assistance to carry out basic daily living activities. People with dementia usually present with poor oral hygiene, heavy dental plaque deposition, gingival bleeding, periodontal pockets, mucosal lesions and reduced salivary flow.[26] For stroke survivors, apart from increased dental plaque accumulation, poorer periodontal health and infection of the oral mucosa, they also show impairment in mastication and swallowing

which restricts their food intake.[27] Sarcopenia patients with low muscle strength combined with poor manual dexterity may find it challenging to grip the clasps of a removable denture for its retrieval. In addition, their neuromuscular control for stabilising a complete denture, especially on the lower arch, may be compromised. They require a longer training time to cope with new dentures. Likewise, tooth loss is common in older adults with sarcopenia. Compounded by the loss of strength of the masticatory muscles, many sarcopenic individuals experience problems with mastication.

Masticatory function and diet

Masticatory function is an important factor influencing the quality of life in older adults.[28] A recent systematic review pointed out that masticatory performance is significantly reduced in older adults with sarcopenia, diabetes, chronic obstructive pulmonary diseases, and functional dyspepsia.[29]

The diet of people with deteriorated masticatory function is typically soft, low in fibre content, and high in carbohydrates and fat.[30] This type of diet poses a high risk for many chronic diseases including atherosclerosis and cancer.[31] Moreover, deterioration in masticatory muscle strength and salivary flow may result when jaw activity is reduced. High carbohydrate content of meals and increased meal frequency result in a prolonged and ample substrate supply for cariogenic and caries-producing bacteria, hence, increasing the risk of dental caries.

Tooth-loss and teeth replacement

Tooth-loss is the endpoint of dental disease, as a result of the severe and cumulative destruction of the tooth or its supporting structures. After tooth extraction, teeth adjacent to the extraction site may drift towards each other and the opposing tooth may over-erupt. Loss of teeth can adversely affect aesthetics, speech, and chewing function.

Edentulism (or total teeth loss) also affects oral food intake, and in the long run, can lead to malnutrition. Moreover, tooth loss has a negative impact on social life, self-esteem and oral-health related quality of life.[32] Older adults with multiple missing teeth also have a higher risk of dementia than those with more teeth.[33] Unwanted tooth movement also affects oral intake, and in the long run, can lead to malnutrition.

Replacement of missing teeth

Not all missing teeth needs to be replaced. For example, dentists seldom replace the missing third molars and, in some cases, even the second molars are not replaced. Nonetheless, missing teeth need to be replaced for restoring aesthetics and function, and maintaining arch integrity to prevent unwanted tooth movement due to the loss of neighbouring or opposing teeth.

Dental prostheses are commonly used for tooth replacement. In Hong Kong, about two-thirds of the older population wear some type of dental prostheses.[34] Dental prostheses can either be fixed or removable and are supported by natural teeth, mucosa or dental implants. Dental prostheses are considered a plaque retentive factor since the artificial material attracts plaque accumulation and there are many stagnant areas underneath the prosthesis where dental plaque and food debris can accumulate. Additional effort has to be paid to maintain cleanliness of the prostheses in addition to the daily oral hygiene procedures of the natural teeth.

Dental implants expand the treatment modality for tooth replacement and have become popular in the past decade or two. Success of dental implant therapy relies on careful patient selection which takes into account their medical and dental conditions, as well as compliance with oral hygiene measures. Diabetic patients showed more marginal bone loss than non-diabetic patients, albeit no significant difference in the rate of implant failure.[35]

For diabetes mellitus patients, their condition has to be well controlled before considering implant therapy. BRONJ (Bisphosphonate-related osteonecrosis of the jaw), after implant surgery and other oral and maxillofacial surgeries have been reported in patients receiving bisphosphonate treatment. Poor oral hygiene is one of the risk factors. If this occurs, the oral surgeon needs to remove the implant and resect the necrotic bone.[36] To prevent BRONJ, discontinuation of bisphosphonate may be necessary before implant surgery and maintenance of good oral hygiene is required.

Key messages

1. Medical and dental diseases are interrelated. Diseases such as DM have a negative effect on the periodontal condition while poor periodontal health worsens control.
2. Good oral hygiene practices through toothbrushing twice daily and interdental cleaning is essential for dental disease prevention.
3. Dry mouth and reduced salivary flow render patients at a high risk of dental caries. Regular professional fluoride application is needed. Physicians can consider altering the medications or advise the patients to avoid taking them before sleep.
4. The primary care checks if the patient has any dental problem make a general oral examination, and advise the patient to seek dental care.

In busy primary care clinics

In a busy primary care clinic, the primary care physician may ask if the patient has any discomfort with the teeth and oral tissues, and take a general examination of the oral cleanliness by observing the extent of dental plaque deposition on an annual basis. Advise the patients to see a general dental practitioner for a comprehensive dental examination if the oral hygiene is sub-optimal or if they have any oral and dental discomfort. It is recommended that patients with medical disease should visit a dentist at least half-yearly for check-ups and preventive care which include scale and polish, fluoride application and adjustment of dental prostheses if needed.

Conclusion

Older adults are often simultaneously affected by medical and dental diseases. These diseases are interrelated. It is prudent for physicians to be aware of the common dental diseases and how they affect the progress of medical diseases. Likewise, dentists should also be cognizant of the patients' medical conditions so as to provide timely and appropriate treatment for them. Dental and medical professionals need to collaborate to provide suitable and well-planned treatment for the benefit of our patients.

References

1. Marsh PD. Dental plaque as a microbial biofilm. *Caries Res.* 2004;38(3):204-211.
2. Featherstone JD. Dental caries: a dynamic disease process. *Australian dental journal.* 2008;53(3):286-291.
3. Griffin SO, Griffin PM, Swann JL, *et al.* New coronal caries in older adults: implications for prevention. *J Dent Res.* 2005;84(8):715-720.
4. Hariyani N, Setyowati D, Spencer AJ, *et al.* Root caries incidence and increment in the population - A systematic review, meta-analysis and metaregression of longi tudinal studies. *J Dent.* 2018;77:1-7.
5. Kassebaum NJ, Bernabe E, Dahiya M, *et al.* Global burden of untreated caries: a systematic review and metaregression. *J Dent Res.* 2015;94(5):650-658.
6. Zhang J, Leung KCM, Sardana D, *et al.* Risk predictors of dental root caries: A systematic review. *Journal of dentistry.* 2019;89:103166.
7. Chu CH, Mei ML, Lo EC. Use of fluorides in dental caries management. *Gen Dent.* 2010;58(1):37-43; quiz 4-5, 79-80.
8. Hendre AD, Taylor GW, Chavez EM, *et al.* A systematic review of silver diamine fluoride: Effectiveness and application in older adults. *Gerodontology.* 2017;34(4):4 11-419.
9. Zhang J, Sardana D, Li KY, *et al.* Topical Fluoride to Prevent Root Caries: Systematic Review with Network Meta-analysis. *J Dent Res.* 2020;99(5):506-513.
10. Chapple ILC, Mealey BL, Van Dyke TE, *et al.* Periodontal health and gingival diseases and conditions on an intact and a reduced periodontium: Consensus report of workgroup 1 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. *J Clin Periodontol.* 2018;45 Suppl 20:S 68-S77.
11. Hanisch M, Hoffmann T, Bohner L, *et al.* Rare Diseases with Periodontal Manifestations. *Int J Environ Res Public Health.* 2019;16(5).
12. Kinane DF, Marshall GJ. Periodontal manifestations of systemic disease. *Australian dental journal.* 2001;46(1):2-12.
13. Rivera-Hidalgo F. Smoking and periodontal disease. *Periodontol* 2000. 2003;32:50-58.
14. Van Strydonck DA, Slot DE, Van der Velden U, *et al.* Effect of a chlorhexidine mouthrinse on plaque, gingival inflammation and staining in gingivitis patients: a syst ematic review. *J Clin Periodontol.* 2012;39(11):1042-1055.
15. Leung KCM, McMillan AS, Leung WK, *et al.* Oral health condition and saliva flow in southern Chinese with Sjogren's syndrome. *International dental journal.* 2004;5 4(3):159-165.
16. Pow EH, McMillan AS, Leung WK, *et al.* Salivary gland function and xerostomia in southern Chinese following radiotherapy for nasopharyngeal carcinoma. *Clinical oral investigations.* 2003;7(4):230-234.
17. Wolff A, Joshi RK, Ekstrom J, *et al.* A Guide to Medications Inducing Salivary Gland Dysfunction, Xerostomia, and Subjective Sialorrhea: A Systematic Review Spo nsored by the World Workshop on Oral Medicine VI. *Drugs R D.* 2017;17(1):1-28.
18. Bardow A, Moe D, Nyvad B, *et al.* The buffer capacity and buffer systems of human whole saliva measured without loss of CO2. *Arch Oral Biol.* 2000;45(1):1-12.
19. Pina GMS, Mota Carvalho R, Silva BSF, *et al.* Prevalence of hyposalivation in older people: A systematic review and meta-analysis. *Gerodontology.* 2020;37(4):317 -331.
20. Thomson WM. Dry mouth and older people. *Australian dental journal.* 2015;60 Suppl 1:54-63.
21. Sotozono M, Kuriki N, Asahi Y, *et al.* Impact of sleep on the microbiome of oral biofilms. *PloS one.* 2021;16(12):e0259850.
22. Preshaw PM, Alba AL, Herrera D, Jepsen S, *et al.* Periodontitis and diabetes: a two-way relationship. *Diabetologia.* 2012;55(1):21-31.
23. Sanz M, Ceriello A, Buysschaert M, *et al.* Scientific evidence on the links between periodontal diseases and diabetes: Consensus report and guidelines of the joint workshop on periodontal diseases and diabetes by the International Diabetes Federation and the European Federation of Periodontology. *J Clin Periodontol.* 2018; 45(2):138-149.
24. Ittichaicharoen J, Chattipakorn N, Chattipakorn SC. Is salivary gland function altered in noninsulin-dependent diabetes mellitus and obesity-insulin resistance? *Arc h Oral Biol.* 2016;64:61-71.
25. Dorocka-Bobkowska B, Zozulinska-Ziolkiewicz D, Wierusz-Wysocka B, *et al.* Candida-associated denture stomatitis in type 2 diabetes mellitus. *Diabetes Res Clin Pract.* 2010;90(1):81-86.
26. Delwel S, Binnekade TT, Perez R, *et al.* Oral hygiene and oral health in older people with dementia: a comprehensive review with focus on oral soft tissues. *Clinical oral investigations.* 2018;22(1):93-108.
27. Kwok C, McIntyre A, Janzen S, *et al.* Oral care post stroke: a scoping review. *J Oral Rehabil.* 2015;42(1):65-74.
28. Ikebe K, Hazeyama T, Morii K, *et al.* Impact of masticatory performance on oral health-related quality of life for elderly Japanese. *Int J Prosthodont.* 2007;20(5):478 -485.
29. Fan Y, Shu X, Leung KCM, *et al.* Associations of general health conditions with masticatory performance and maximum bite force in older adults: A systematic revie w of cross-sectional studies. *Journal of dentistry.* 2022;123:104186.
30. Wakai K, Naito M, Naito T, *et al.* Tooth loss and intakes of nutrients and foods: a nationwide survey of Japanese dentists. *Community Dent Oral Epidemiol.* 2010;38 (1):43-9.
31. Walls AW, Steele JG, Sheiham A, *et al.* Oral health and nutrition in older people. *J Public Health Dent.* 2000;60(4):304-30.
32. Nordenram G, Davidson T, Gynther G, *et al.* Qualitative studies of patients' perceptions of loss of teeth, the edentulous state and prosthetic rehabilitation: a system atic review with meta-synthesis. *Acta Odontol Scand.* 2013;71(3-4):937-951.
33. Fang WL, Jiang MJ, Gu BB, *et al.* Tooth loss as a risk factor for dementia: systematic review and meta-analysis of 21 observational studies. *BMC Psychiatry.* 2018; 18(1):345.
34. Department of Health. Oral Health Survey 2011. Hong Kong: Government Printer, 2013.
35. Moraschini V, Barboza ES, Peixoto GA. The impact of diabetes on dental implant failure: a systematic review and meta-analysis. *International journal of oral and m axillofacial surgery.* 2016;45(10):1237-1245.
36. Rupel K, Ottaviani G, Gobbo M, *et al.* A systematic review of therapeutical approaches in bisphosphonates-related osteonecrosis of the jaw (BRONJ). *Oral Oncol.* 2014;50(11):1049-1057.

Katherine CM Leung, BDS, MDS (with distinction), PhD (HK), FHKAM (Dental Surgery)
Clinical Associate Professor;
Associate Dean (Taught Postgraduate Education);
Clinical Manager of the IAD-MSC.
Faculty of Dentistry, The University of Hong Kong
Correspondence to:Dr. Katherine CM Leung, Faculty of Dentistry, The University of Hong Kong, Prince Philip Dental Hospital, 34 Hospital Road, Sai Ying Pun, Hong Kong SAR.
E-mail:kcmleung@hku.hk
