White Paper on Prevention and Management of Periodontal Diseases for Oral Health and General Health

FDI Global Periodontal Health Project Task Team

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Executive summary

This white paper provides oral health professionals with a comprehensive yet succinct summary of the main issues related to the global prevalence and impacts, aetiology and pathogenesis, prevention, diagnosis and treatment of periodontal diseases. It also identifies the key challenges in tackling the burden of periodontal diseases and provides an action plan for oral health professionals, policymakers, and other related actors.

The Introduction defines periodontal diseases, including specific definitions and descriptions of the signs and symptoms of plaque-induced gingivitis, being evidence of gingival inflammation without clinical attachment loss, and periodontitis, being inflammation accompanied by loss of clinical attachment and alveolar bone resorption. Notably, periodontitis is the major cause of severe tooth loss and edentulism in the adult population worldwide. It also describes the current classification of periodontal diseases (1999), gives a brief note on the forthcoming 2018 update from the World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions in November 2017, and emphasizes the screening and diagnostic procedures that dental professionals should follow to assess all patients' periodontal status. These procedures include medical and dental history/risk factor questions, extra- and intraoral examinations, radiographic assessment, and specific periodontal investigations. Section 2 goes on to detail the aetiology and pathogenesis of periodontal diseases, describing the process of inflammatory response to pathogenic oral biofilms. It also considers risk factors for periodontal diseases, addressing both modifiable (lifestyle, metabolic, dietary, socioeconomic and stress factors) and non-modifiable (genetic profile, gender, age, and certain systemic conditions) risk factors. Sections 3 to 5 address the importance of periodontal diseases. A summary of the epidemiology and global burden of periodontal diseases is provided, recognizing severe periodontitis as the sixth most prevalent disease or condition worldwide. Increasing disease prevalence with age, variations between global regions, and significant global socio-economic impacts are also highlighted (Section 3). Section 4 describes the process by which periodontitis can result in bacteraemia and increased levels of systemic inflammation, and its shared unhealthy lifestyle (e.g. tobacco smoking), metabolic and dietary risk factors with other chronic noncommunicable diseases (NCDs). Section 5 addresses the consequences and impacts of periodontitis, building on the information in Section 4 to describe the evidence for systemic diseases and conditions associated with periodontal infection and inflammation such as diabetes and cardiovascular diseases. It also describes the significant impact that periodontitis can exert on patients' quality of life and self-esteem, through social, functional and aesthetic impairments.

The prevention and treatment of periodontal diseases are covered in Sections 6 and 7. Primary prevention strategies, based on personal oral hygiene and professional periodontal care, and secondary prevention strategies including individualized long-term supportive care and risk management for patients, are described and elaborated. Prevention at the population level and the cost-benefit comparison of prevention strategies are also discussed (Section 6). Section 7 describes the process and outcomes of periodontitis treatments, looking at basic, anti-infective/inflammatory therapies, and more advanced surgical regenerative treatments for patients with severe periodontitis who exhibit persisting inflammation and unresolved lesions.

Section 8 outlines the current challenges in tackling periodontal diseases worldwide. Low awareness of periodontal health among the general public and oral health professionals, negligence of periodontal diseases in dental check-up procedures and dental education curricula, and reliance on dental implants despite associated risks, all pose critical problems and major challenges. Managing periodontal diseases in the face of socioeconomic inequalities and ageing populations is similarly identified as a challenge to tackle (Section 8). In response to these challenges, a number of solutions and calls for action are provided in Section 9. This includes specific strategies to raise awareness of oral/periodontal health among healthcare professionals and the public, improve prevention and effective

management of periodontal diseases, and enhance basic and continuing dental/medical education on periodontal diseases.

The white paper concludes by setting out an action plan to advance the uptake of these solutions and calls for action worldwide (Section 10). Concise, tailored and user-friendly communication tools are needed to ensure messages about periodontal health maintenance and disease prevention and treatment reach the right audiences, so that they may then adopt these preventive behaviours. It is therefore imperative to involve the broader dental team in prevention and treatment, and engage with the medical profession to deal with the common risk factors and interconnections of periodontal-systemic diseases. Collaborating with other stakeholders, such as community organizations and other health bodies, is important to advocate periodontal health and integrate oral/periodontal healthcare into all health policies and programmes for optimal oral health and general health.

Introduction

Section 1 Periodontal diseases: definition, classification and diagnosis

1.1 Definition of gingivitis and periodontitis

Periodontal diseases are chronic inflammatory diseases of bacterial aetiology that affect the tooth-supporting soft and hard tissues. Among the different conditions included within the term of periodontal diseases, plaque-induced gingivitis and periodontitis are of special relevance to periodontal healthcare and general health.

Plaque-induced gingivitis is defined as gingival inflammation without clinical attachment loss. It is characterized by the presence of redness and oedema of the gingival tissues, bleeding upon different stimuli, changes in the contour and consistency of the tissues, presence of supra/subgingival plaque and calculus, and no evidence of alveolar bone loss on radiographs[1].

Periodontitis is defined as an inflammation of the gingival tissues extending into the underlying attachment apparatus, which is characterized by loss of periodontal attachment owing to the destruction of periodontal ligament and loss of alveolar bone[2]. Signs and symptoms include oedema, erythema, bleeding, suppuration, bone and clinical attachment loss and, in advanced destruction, pockets deeper than 6 mm and even tooth mobility[3].

1.2 Classification: 1999 classification and 2017 update

In 1999, the International Workshop for a Classification of Periodontal Diseases and Conditions was organized by the American Academy of Periodontology (AAP), and the current widely used classification of periodontal diseases was then published[4]. Notably, the AAP and European Federation of Periodontology (EFP) organized a World Workshop on the Classification of Periodontal and Peri-implant Diseases and Conditions in November 2017, and a new classification will be introduced in 2018.

The currently used 1999 classification[4] consists of eight main groups of diseases and conditions, including gingival diseases, three types of periodontitis (chronic, aggressive and manifestation of systemic diseases) and four additional periodontal conditions (necrotizing periodontal diseases, abscesses in the periodontium, periodontitis associated with endodontic lesions and developmental or acquired deformities and conditions). In the new classification that will be available in March 2018, a new system of classification of periodontitis, based on staging and risk of disease progression, will be proposed.

1.3 Diagnosis

All patients requesting dental services should first be examined by means of a periodontal screening exam that allows for a rapid examination of the periodontal condition, and identifies which patients should be further evaluated with a comprehensive periodontal assessment. It should include the following aspects and be documented in the patient's record[5]:

- Medical history and risk factors, e.g. diabetes, smoking, hypertension, medications, substance abuse, HIV/AIDS, pregnancy, or other existing conditions that may affect treatments
- Dental history including the chief complaint(s)
- Extra-oral examination
- Intra-oral examination
- Teeth examination including occlusal aspects and pulpal status

- Radiographic examination
- Periodontal examination, including presence and distribution of plaque and calculus, assessment of periodontal and peri-implant soft tissues, and measurement of probing depth, gingival recession (or enlargement) and bleeding on probing at six sites per tooth. Furcation lesions and mucogingival aspects should be carefully explored.

Additional diagnostic aids can be considered in certain conditions, including genetic, microbiological and host biomarkers. Currently, great efforts are being made to validate tests that may identify periodontitis activity and risk of progression[6].

Section 2 Aetiology and pathogenesis of periodontal diseases

2.1 Pathogenesis

Periodontal diseases including gingivitis and periodontitis develop as a nonspecific inflammatory response to the challenge of oral biofilms, with the production of pro-inflammatory cytokines in periodontal tissues. The altered subgingival environment favours the colonization and overgrowth of putative periodontal pathogens. If the host response is effective, the gingivitis lesion can be controlled by the immune system. When the host response is inadequate and/or dysregulated, which can be significantly influenced by genetic, acquired or environmental factors as well as microbiological and other local factors, periodontitis onset and progression may occur[7,8].

2.2 Aetiological factors

The role of different bacterial species in the subgingival biofilm as the primary aetiological factor in periodontitis is indisputable. The microbiological characteristics of periodontitis show significant changes from those in periodontal health with co-association of different organisms into consortia, representing the critical shift of the oral microbiome from symbiotic states to dysbiotic ones[9]. It is worth noting that host response plays an important role in the pathogenesis of periodontal diseases. Indeed, the dysregulation of immuno-inflammatory pathways is crucial for persistent periodontitis lesions[10].

2.3 Risk factors

It is well noted that microbe-host interaction is the key element in the pathogenesis of periodontal diseases. However, various risk factors do influence and modify this interplay[11]. Among them, non-modifiable risk factors/indicators include genetic profiles, gender, age and some systemic conditions (such as leukaemia and osteoporosis). There are also modifiable risk factors/indicators, including lifestyle factors, e.g. smoking and alcohol, metabolic factors, e.g., obesity, metabolic syndrome and diabetes, dietary factors, e.g. dietary calcium and vitamin D deficiency, socioeconomic status and stress. In addition, local factors, such as levels of plaque and/or calculus, furcations, enamel pearls, root grooves and concavities, open contacts, malpositioned teeth, wearing dentures, and overhanging and/or poorly contoured restorations may increase the risk for periodontal diseases.

Why are periodontal diseases important?

Section 3 Periodontal diseases as prevalent conditions in humans: epidemiology and global burden

Scientific reports on the prevalence of periodontal diseases highlight that gingivitis may affect individuals with an almost universal prevalence, while the distribution of periodontitis clearly depends on the case definition, with partial mouth or index recording tending to underestimate the disease prevalence. Recent studies in the USA with full mouth recordings and new case definitions have estimated that 47% of the USA population over 30 years of age suffer from periodontitis, including 8.7% with mild, 30.0% with moderate and 8.5% with severe periodontitis[12]. Notably, the recent systematic reviews of the Global Burden of Disease Study (GBD) in 2010 that use a large dataset of 291,170 individuals (aged 15–99) from 37 different countries show that severe periodontitis is the sixth most prevalent among all 291 diseases and conditions investigated, affecting 11.2% of the global population, or 743 million people[13,14]. No major changes are observed in comparison with the data from 1990. In the latter report[14], considerable differences among countries and regions were found, with the lowest prevalence observed in Oceania (4.5%) and the highest in southern Latin America (20.4%). Yet, the overall prevalence of severe periodontitis increases with age, having a marked increase between the third and fourth decades of life, and reaching peak prevalence at the age of 38 years[14]. It has also been documented that in each age cohort, a small proportion of individuals carry the major burden of periodontal destruction[15]. Moreover, severe periodontitis has significant socio-economic impacts and it indeed accounts for a surprisingly high global cost (US$54 billion yearly) of lost productivity[16].

Section 4 Periodontitis as an infection and inflammation sharing risk factors with other chronic noncommunicable diseases (NCDs)

Periodontitis is linked with other systemic conditions, including NCDs. In general, three elements are crucial for such connections. Firstly, periodontitis is a serious infection. In an established periodontitis lesion, a wound surface of approximately 8-20 cm^2 is present around the soft-wall of the periodontal pocket. Between this ulcerated epithelial surface and tooth surface, there is plaque harbouring millions of microbes. It has been shown that bacterial cells from these subgingival biofilms may gain access to systemic blood circulation, after dental manipulations (such as scaling and tooth extraction) or even after daily-life activities, e.g. tooth brushing, flossing and chewing[17,18]. In fact, these bacteria can colonize and/or invade body tissues, and they have been detected in atheroma plaques[18]. Secondly, bacteraemia, together with the release of bacterial toxins and inflammatory mediators from the periodontal area, can increase the level of systemic inflammation[19]. Thirdly, periodontitis shares common risk factors with chronic NCDs[11,20], including lifestyle factors, e.g. smoking and alcohol consumption; metabolic factors, e.g. diabetes, obesity and metabolic syndrome; dietary factors, e.g. dietary calcium and vitamin D deficiency; and stress.

Section 5 Consequences and impacts of periodontitis

5.1 Local consequences

In periodontitis patients, evident signs and symptoms include gingival bleeding, gingival recession, spaces between teeth, tooth displacement and mobility, and eventually tooth loss resulting in impaired aesthetic and masticatory function and eventually edentulism. Halitosis has also been associated with periodontitis[21]. Many of these disease consequences lead to significant social, aesthetic and functional impairments, e.g. mastication[22].

5.2 Systemic consequences through bacteraemia and systemic inflammation

It is evident that periodontitis is intimately associated with various systemic diseases such as diabetes and cardiovascular diseases[23]. As addressed above, periodontal infection and inflammation, as well as common genetic and acquired risk factors, are the scientific basis that explains the biological plausibility of the associations between periodontitis and systemic diseases. Currently, up to 57 diseases and conditions have been studied with regards to their connection with periodontitis[24]. Among them, a strong level of evidence, based on biological plausibility models, epidemiological studies and/or intervention studies, is available for diabetes[25], cardiovascular diseases[26] and adverse pregnancy outcomes[27], while emerging evidence has also been published for other relevant conditions[28].

5.3 Impact on quality of life

The impact of the oral health status on quality of life (QoL) has been extensively assessed by means of questionnaires dealing with oral health-related QoL (OHRQoL). In a systematic review of the effect of periodontal diseases on OHRQoL, 37 papers have been selected and 28 report a significant association, with eight studies confirming that OHRQoL is directly correlated to the severity and/or extent of the disease[29]. Periodontitis may induce different negative QoL consequences, including anxiety[30], feeling ashamed, low self-esteem and demonstrating vulnerability[31]. Conceivably, tooth loss significantly affects OHRQoL scores, with a higher effect when tooth loss affects the anterior region[32].

Are periodontal diseases preventable and treatable?

Section 6 Prevention of periodontal diseases

The early stage of local gingival inflammation is reversible and can be successfully treated by adequate oral hygiene and professional plaque control, while its advanced stage may lead to irreversible attachment loss and progress to periodontitis[33–35]. It is evident that periodontitis can be prevented through effective management of gingivitis and promotion of a healthy lifestyle[36,37].

6.1 Primary prevention

Since periodontitis generally develops from gingivitis, the primary prevention of periodontitis is based on the effective treatment of gingivitis. Daily performed personal oral hygiene using manual or powered toothbrushes is effective in reducing plaque and, as a consequence, has a beneficial impact on gingivitis, with greater benefits possibly resulting from powered toothbrush use[38]. However, mechanical plaque control using a toothbrush and fluoridated dentifrice alone is not sufficient to achieve interdental cleanliness. The additional use of flosses and/or interdental brushes is essential for removal of interdental plaque[39]. In addition, according to the Guidelines for Effective Prevention of Periodontal Diseases produced by the EFP (2015)[40], some specific mouth rinses offer benefit in the management and prevention of gingivitis, as do certain chemical agents in dentifrices as an adjunct to mechanical plaque removal[39,41].

Professional mechanical plaque removal (PMPR) significantly reduces plaque scores and improves gingival inflammation[39]. PMPR consists of supra- and sub- gingival removal of soft and calcified deposits on tooth surface, extending into the gingival crevice, using sonic/ultrasonic scalers, air polishing and hand instruments (scalers and curettes). Upon removal of these noxious deposits, the teeth should be polished in order to smooth the surface and prevent early re-accumulation of plaque. It is emphasized that PMPR should be combined with oral hygiene instructions (OHI)[42]. Repeated and individualized OHI are the key elements to achieve and maintain oral/periodontal health[43]. Therefore, oral/periodontal health education should start early in the pre-school period. Proactive behaviour change is essential to achieve sustained improvements in periodontal health status[37]. Patients should have access to regular professional care in order to get feedback on the efficiency of their daily oral hygiene measures[43]. In addition, control and effective management of risk factors, e.g. smoking cessation and diabetes control, are extremely important for primary prevention of periodontitis[43].

6.2 Secondary prevention

Secondary prevention of periodontitis aims to avoid disease recurrence in patients who have been successfully treated[44]. The optimal endpoints of active periodontal treatment are the reduction of clinical signs of periodontal inflammation with less than or equal to 15% of full-mouth bleeding on probing scores, absence of signs of active inflammation (e.g. suppuration at diseased pockets) and elimination of deep pockets (≥ 5 mm)[44]. This clinical state should be achieved by active periodontal therapy. It is mandatory that the endpoint of active periodontal treatment is documented in a meticulous periodontal examination, which is the basis for planning supportive periodontal treatment in secondary prevention.

Regular PMPR with respect to secondary prevention includes the same measures as in primary prevention accompanied by evaluation of oral hygiene, and if necessary reinforced OHI. It also encompasses subgingival debridement to the depth of periodontal pocket. Repeated periodontal examinations of residual pockets are necessary for

the early detection of deepening pockets (probing depth ≥ 5 mm) that require active therapy. At each appointment, patients should be educated about a healthy lifestyle and smoking cessation[45,46].

Life-long individualized supportive periodontal care based through an efficient recall system may be necessary, in order to establish the prerequisites for secondary prevention. The frequency of maintenance care should be individually determined, respecting the patient's susceptibility to disease recurrence and progression. Risk assessment tools may help to group patients in different risk levels, and predict the probability of disease recurrence, yet until today their clinical benefits have not been proven at an individual level[43].

6.3 Prevention at the population level

It is crucial to increase the population's awareness of the relevance of proper individual oral hygiene as part of a healthy lifestyle that avoids manageable risk factors[43]. Early education in appropriate daily hygiene measures and the importance of certain risk factors, e.g. smoking, in the development of periodontal diseases, through the good teamwork of school teachers and other educators, medical professionals, dental hygienists and dentists, is of great importance. To facilitate patient communication and behavioural changes through oral hygiene practices, the incorporation of treatment goal setting, planning and self-monitoring may be useful[46,47].

6.4 Cost and benefits

Successful prevention avoids the initiation and recurrence of periodontal disease, and thus the major cause of tooth loss and need for subsequent restorative measures could be well controlled and minimized. This proactive measure would dramatically reduce expenditure for crown and bridgework as well as dental implants, even in an ageing population. However, economic assessments and real costs are not generally available in the literature[48]. Apart from financial aspects, life-long preservation of patients' own dentition is of the greatest value and may enhance the health state of the individual with good quality of life.

Section 7 Treatment of periodontal diseases

As outlined in the "Prevention of periodontal diseases" section above, mechanical plaque control is one of the key factors for successful management of gingivitis, which should be accompanied by repeated instructions and control of personal oral hygiene. Recent meta-analyses and systematic reviews reveal that plaque scores may be reduced by 42% using manual toothbrushes, and powered toothbrushes may provide additional benefits of reducing plaque and gingivitis compared to manual toothbrushes over both the short- and long-term[38,39]. Essentially, patients should be proactively educated to live a healthy lifestyle, and strongly supported in smoking cessation as well[45,46]. Overwhelming evidence shows that periodontitis can be successfully treated in the majority of patients. Long-term studies demonstrate that the mean annual rate of tooth loss is less than 0.1 tooth per patient after effective periodontal treatment, if patients adhered to a secondary prevention programme in a specialist practice. In contrast the irregular compliers had an annual rate of tooth loss that ranged from 0.6 to 1.8 teeth during a five-year observation period[49].

7.1 Basic treatment

Anti-infective therapy[50,51] aims for complete removal of supra- and subgingival biofilms from the bottom of the pockets using sonic/ultrasonic scalers, air polishing and hand instruments. Effective cleaning with debridement of infected root surfaces requires specific training to enable adequate elimination of calculus and soft deposits. However, a complete removal of the bacterial biofilm may not be possible, depending upon the complexity of root anatomy, especially in multi-rooted teeth with furcation involvement lesions. In addition to mechanical therapy, adjunctive use of antiseptics and antibiotics

in some selected severe cases could improve treatment efficiency to some extent.

Successful treatment is characterized by adequate plaque control, significant resolution of gingival inflammation with markedly reduced percentage of bleeding sites, decrease of probing depth below 5 mm and gain of periodontal attachment. Therefore, treatment efficiency must be evaluated after completion of the active therapy and an adequate healing period with meticulous supervision and control of personal oral hygiene. In many cases and at many sites, anti-infective therapy may be sufficient to successfully treat periodontitis, and patients may then receive long-term, regular supportive periodontal care for secondary prevention[50,52].

7.2 Surgical treatment

Sites with persisting signs of inflammation and remaining deep pockets may require further treatment. Depending upon the patient's profile, local site and topography of the defect, surgical therapy can consist of conservative surgical interventions, e.g. open flap debridement, resective treatment and regenerative procedures as appropriate. The aims of all surgical interventions are to remove remnants of the bacterial biofilms and calculus from the infected root surfaces, and eliminate niches through resective or regenerative measures to establish the prerequisites for long-term successful control of plaque biofilms by self-performed oral hygiene measures and supportive professional care[50,53,54].

7.3 Costs and benefits

The ultimate goal of periodontal treatment is the long-term retention of natural dentition in a healthy, functional and aesthetically acceptable state[55]. There are no long-term prospective randomized clinical trials available addressing the cost-effectiveness of different treatment modalities[56]. It has recently been demonstrated that regenerative surgical therapy, though generating initially higher expenses for patients, requires less re-interventions within a 20-year long-term perspective because of less recurrence of the disease than after routine access flap surgery[57].

An appropriate financial reimbursement scheme through insurance providers is of fundamental importance for general acceptance of periodontal treatment concepts by the dental profession, depending upon the basic economic situation in a certain country and the related hourly charges for dental practice as well as the time required for basic periodontal treatment and surgical interventions. Despite all the scientific evidence, inappropriate reimbursement may result in premature extraction of treatable teeth followed by expensive restorative and prosthodontic treatments, e.g. dental implants.

What are the current problems/challenges and recommended actions?

Section 8 Current problems and major challenges of periodontal care

Periodontal diseases are truly a 'silent' global epidemic with a huge disease burden and socio- economic effects[13,14,16,37,58–60]. Unfortunately, awareness of periodontal health remains low worldwide, and the majority of people affected do not initiate early care, due to various personal, cultural and socio-economic factors[58,60–62]). It is currently of foremost importance to identify the main problems and challenges, and seek new strategies for tackling the disease to advance oral and general health as well as healthy ageing.

8.1 Low awareness

Low awareness of gingivitis and periodontitis and their consequences is a major problem worldwide. It is a common phenomenon not only among the general public and individuals with an existing periodontal disease, but also among healthcare professionals. A recent report indicates that disease awareness (80%), aetiology (75%) and periodontally-related risks (71%) are the most important knowledge deficits in the general public[63]. Among adults aged over 30 years in the USA classified as having periodontitis, only 27% are aware of the disease[64]. Although the association of periodontitis with systemic diseases has increasingly attracted people's attention in the last two decades, a substantial lack of understanding and limited knowledge of oral health and hygiene practices have been reported in medical students from India[65] and cardiologists in the USA[66].

In June and July of 2017, a periodontal health survey was conducted by the FDI World Dental Federation among all its member National Dental Associations (NDAs). The report shows that awareness of periodontal health is perceived to be low or very low (62%) among the general public and oral health professionals[67]. One reason for the low awareness among the general public may be due to the fact that oral health and oral care are not part of the healthy lifestyle recommended by the World Health Organization (WHO). It is also noted that oral/periodontal health is not reflected in national health policies or guidelines that mainly focus on targeting chronic NCDs[67].

8.2 Periodontal negligence

In the recent survey by FDI[67], it has been reported that only 51% of the NDAs indicate that periodontal screening is mandatory in a routine dental check-up. In most countries, basic periodontal training is available in the core dental curriculum, while periodontology is a registered specialty in only half of the countries surveyed, and other oral health professionals also provide periodontal care. There is certainly room for improvement to share the burden of periodontal prevention.

In general, oral/periodontal health is not perceived as a health issue, but rather a 'cosmetic' problem by many individuals and patients, due to various reasons. People may believe that their missing teeth can effectively be replaced and reconstructed by dental implants. The use of dental implants has made it possible to retain aesthetics, masticatory capacity and a good quality of life for many patients. The flipside of this coin is that dental implants are conceivably deemed as the obvious treatment of choice in terms of management of periodontitis patients with multiple tooth loss and edentulism. In spite of the evidence demonstrating the superiority of teeth supported constructions in comparison to implant supported ones over time[68], implant therapy is frequently advertised as 'teeth for life'. Recent data suggest that the prevalence of peri-implantitis

is high (22%, range: 1% to 47%)[69]. Notably, infections around implants are generally more difficult to handle than periodontitis, and surgical treatment of peri-implantitis has a reported success rate in the range of 11-47%[70–72]. Another important factor that has favoured extraction of periodontally involved teeth and replacement with dental implants is that it is generally more profitable for the dentist than the treatment of periodontitis. However, it should be seriously recognized that use of dental implants in periodontally susceptible individuals poses an increased risk for the development of peri-implantitis[73].

8.3 Socio-economic barriers

Socio-economic factors are reported to have an impact on the presence of periodontal diseases[37]. Male gender, low socio-economic status and being over 50 years of age are associated with a higher risk for periodontitis[74]. In the same review, the authors summarize the data on toothbrush purchases, which show the purchase of less than two toothbrushes per person per year in all South American countries. In another review of elderly people in the US with a mean age of 73 years[75], 8% live below the 100% Federal Poverty Level and less than 40% saw a dentist in the past year. Almost two-thirds (62.3%) exhibit one or more sites with at least 5 mm of clinical attachment loss, and almost half present with one or more sites with periodontal pockets. It should also be highlighted that oral care is usually not part of public health services, and access to professional care is difficult in many areas of the world. Accordingly, service availability and economic barriers are the major causes of periodontal health inequalities in the world.

8.4 Ageing population

Over the years, the pace of world population ageing has increased consistently. Subsequently, functional decline occurs, and the prevalence and incidence of chronic diseases are on the rise. As such, ageing is an important risk for developing medical conditions. For instance, the prevalence of dementia increases significantly with age. A recent report demonstrates that the global prevalence of severe tooth loss has decreased by 45%[14]. It implies that more teeth are retained, while at the same time it is a challenge for the dental profession to maintain the teeth and oral cavity in healthy and functional status. The increasing percentage of people who are elderly, have chronic diseases, and are taking medications, poses a great challenge for the dental community. It has been shown that individuals with dementia exhibit a higher prevalence of caries and present more frequently with root remnants, as utilization of their oral healthcare services becomes scarce[76]. These patients also exhibit an increased likelihood of tooth loss and untreated caries as well as presenting with poor oral and denture hygiene, as compared with non-demented persons[77.] Therefore, socio-economic factors, general health status and multiple- drug therapies will be the important elements in the management of older adults with periodontitis in the future[78].

Section 9 Recommendations, solutions, calls for action and perspectives

Overall, health promotion and disease prevention via multidisciplinary teamwork should be the key to developing a long-term sustainable strategy for global oral health[79]. To accomplish this goal, oral health professionals and other healthcare workers need to be aware that periodontal diseases share risk factors with other major chronic NCDs, and the inflammatory burden of periodontitis may have a critical impact on other NCDs. In this regard, the expanded role of dentists needs to be emphasized, specifying that the dental team also looks after general health and does not merely address oral health and restorative issues. This notion should be shared and promoted in dental education and continuing professional development. Moreover, there is a need to drive behaviour change among dentists, hygienists and other healthcare professionals.

9.1 Advocacy and awareness of oral/periodontal health

In enhancing public and professional awareness of the benefits of maintaining good oral health, it is the time to focus on disease prevention and promotion of the benefits of a healthy mouth. The incentive for performing good home care should be oral health maintenance rather than tackling disease. Generally, it is challenging to motivate young individuals to brush their teeth effectively to avoid oral/periodontal diseases that may occur in 30 years' time. The critical question is often, 'If I do this, what is in it for me now?'

- Periodontal health literacy should be improved. The ability to build periodontal literacy is essential for proactive awareness of periodontal health and disease prevention among the public and dental professional communities[80]. The benefits of a healthy mouth, such as healthy gums with papillae between the teeth, better taste, good breath, a charming smile, improved quality of life, no unnecessary load on the immune system, as well as lower personal cost and time spent on disease treatment, should be communicated proactively by the dental personnel.
- Each individual plays a proactive role in enhancing the awareness of oral/periodontal health, health promotion, disease prevention and self-care measures for keeping optimal oral health and general health throughout the life course.
- The link between oral diseases and general diseases should be communicated intensively to the medical profession to establish an interdisciplinary team to better manage the individuals already affected by periodontal disease.
- Raising general attention to improper plaque control and gingivitis from childhood, in order to prevent periodontal diseases and thereby avoid early attachment loss. More efforts should be made to raise the awareness of periodontal health and appropriate care among general dental practitioners and other healthcare professionals.
- Advocating governments to incorporate oral health into general health policies, and establishing strategic partnerships with non-governmental organizations (NGOs) and other health alliances for promoting optimal oral health and general health. It is well noted that the European Heart Association has included periodontitis as a 'clinical condition affecting cardiovascular disease risk' in their 2016 European Guidelines on Cardiovascular Disease Prevention in Clinical Practice[81]. The American Diabetes Association has resolved that, among the referrals for initial care management of a patient with diabetes, referral to a dentist for comprehensive dental and periodontal examination should be included[82].

9.2 Prevention and early diagnosis

Prevention is the key for promoting global oral health[83]. It is evident that periodontitis can be prevented through effective control of gingivitis and promotion of a healthy lifestyle at both individual and population levels[36,39].

- The general public should be motivated to maintain healthy gums as part of their healthy lifestyle through regular health campaigns, in collaboration with dental and medical communities.
- Recognizing that proper home care is the key to maintaining a healthy mouth. The sign of bleeding gums when brushing is an indication of gingivitis, and timely professional dental care is recommended, along with improved home care.
- Highlighting that periodontal diseases are chronic NCDs that shares risk factors with other NCDs, e.g. tobacco smoking.
- Undertaking active work on smoking cessation programmes and dietary advice through the common risk factor approach is essential to prevent periodontal diseases.
- Basic periodontal screening and examination are fundamentally important for early diagnosis in daily dental practice.
- Early diagnosis is essential for simplified and cost-effective periodontal care as well as achieving more predictable treatment outcomes.
- The common notion that a healthy tooth is superior to implant therapy needs to be actively shared with both the public and dental communities.
- Periodontists and general dentists, together with dental hygienists and other oral health workers/healthcare professionals, should engage in strong interprofessional teamwork in the prevention and treatment of periodontal diseases.

9.3 Effective management of periodontal diseases

It has been demonstrated that the cost for medical care can be reduced in patients treated for periodontal diseases. Evidence from big insurance data demonstrates that the medical costs and hospitalizations for individuals diagnosed with type 2 diabetes, cerebral vascular disease, coronary artery disease and pregnancy remarkably reduce by 40.2%, 40.9%, 10.7%, and 73.7% respectively if they are treated for periodontal diseases[84]. Notably, effective non-surgical treatment of periodontitis can lower blood glucose levels in diabetic patients with periodontitis[85,86], and improve endothelial function[87].

- There is a need to increase professional and public awareness of the potential savings for medical care, through delivery of effective periodontal care in specific cohorts of patients.
- The dental team needs to be educated to take a more active role in health promotion and disease prevention for the general well-being of the people.
- Dental personnel should use the opportunity of regular maintenance appointments to screen for pre-diabetic and diabetic patients, through chairside testing and/or medical referral for confirmation[25].
- Socio-economic data can be helpful for raising policymakers' awareness. However, there are currently limited data available for this purpose. Data on oral health outcomes, e.g. quality of life, and feasible service models need to be established for formulating and refining oral health policy.

9.4 Basic dental education and professional dental/medical education

- Periodontal health literacy and essential knowledge of periodontal diseases and care, e.g. diagnosis, basic treatment and referral, should be adequately incorporated in dental education curricula, basic medical education and continuing education programmes.
- Periodontal health is an essential component of healthy ageing.

Section 10 Action plan

The dental community shares the goal of promoting and maintaining good oral health through life with governments, NGOs and other stakeholders, including oral healthcare industries. Very recently, the first-ever global consensus on a proactive strategy for prevention, diagnosis and treatment of periodontal diseases has been reached by the main international organizations in periodontology and 46 national societies of periodontology around the world[37]. It is now imperative to call for global action on the promotion of oral/periodontal health and disease prevention for the benefits and well-being of humankind, through global healthcare alliances and collaborative teamwork.

- Developing global strategies for promoting oral/periodontal health, and refining action plans to meet the demands and needs of individual countries/regions.
- Producing toolkits with straightforward professional recommendations.
- Making concise and user-friendly periodontal health leaflets to reach various target audiences worldwide.
- Collaborating with governments, NGOs, corporate partners and other stakeholders in the promotion of oral/periodontal health and health education in public communities, e.g. school systems, elderly service networks, medically compromised and impaired groups and those with special needs. Educating other dental professionals, e.g. dental hygienists and dental assistants, to assist dentists in undertaking proactive measures for oral/periodontal health promotion.
- Engaging with the medical profession to highlight periodontal diseases as chronic NCDs that share risk factors with other NCDs. The following notions, strategies and approaches could be taken and implemented:
  - The mouth and body are intimately linked and interact bi-directionally, e.g. diabetes and periodontitis.
  - Promoting oral health and general health via the common risk factor approach.
  - The dental clinic as a perfect place for primary prevention of relevant systemic diseases including common NCDs.
  - Dental-medical co-management schemes for cost-effective healthcare and improved treatment outcomes. Two-way referral may be considered as appropriate.
- Liaising with major stakeholders in global health, such as WHO and the World Health Professions Alliance, to integrate oral health into general health, primary care, and as an essential component of a healthy lifestyle.

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References

1. American Academy of Periodontology (2000a). Parameter on plaque-induced gingivitis. *J Periodontol* 2000; 71: 851–852.
2. American Academy of Periodontology (2000b). Parameter on chronic periodontitis with slight to moderate loss of periodontal support. *J Periodontol* 2000; 71: 853–855.
3. American Academy of Periodontology (2000c). Parameter on chronic periodontitis with advanced loss of periodontal support. *J Periodontol* 2000; 71: 856–858.
4. Armitage GC. Development of a classification system for periodontal diseases and conditions. *Ann Periodontol* 1999; 4: 1–6.
5. American Academy of Periodontology (2000d). Parameter on comprehensive periodontal examination. *J Periodontol* 2000; 71: 847–848.
6. Armitage GC. Learned and unlearned concepts in periodontal diagnostics: a 50-year perspective. *Periodontol 2000* 2013; 62: 20–36.
7. Bartold PM, Van Dyke TE. Periodontitis: a host-mediated disruption of microbial homeostasis. Unlearning learned concepts. *Periodontol 2000* 2013; 62: 203–217.
8. Meyle J, Chapple I. Molecular aspects of the pathogenesis of periodontitis. *Periodontol 2000* 2015; 69: 7–17.
9. Mira A, Simon-Soro A, Curtis MA. Role of microbial communities in the pathogenesis of periodontal diseases and caries. *J Clin Periodontol* 2017; 44: S23–S38.
10. Cekici A et al. Inflammatory and immune pathways in the pathogenesis of periodontal disease. *Periodontol 2000* 2014; 64: 57–80.
11. Genco RJ, Borgnakke WS. Risk factors for periodontal disease. *Periodontol 2000* 2013; 62: 59–94.
12. Eke PI et al. Prevalence of periodontitis in adults in the United States: 2009 and 2010. *J Dent Res* 2012; 91: 914–920.
13. Marcenes W et al. Global burden of oral conditions in 1990-2010: a systematic analysis. *J Dent Res* 2013; 92: 592–597.
14. Kassebaum NJ et al. Global Burden of Severe Periodontitis in 1990-2010: A Systematic Review and Meta-regression. *J Dent Res* 2014; 93: 1045–1053.
15. Baelum V, López R. Periodontal disease epidemiology – learned and unlearned? *Periodontol 2000* 2013; 62: 37–58.
16. Listl S et al. Global Economic Impact of Dental Diseases. *J Dent Res* 2015; 94: 1355–1361.
17. Parahitiyawa NB et al. Microbiology of odontogenic bacteremia: beyond endocarditis. *Clin Microbiol* Rev 2009; 22: 46–64.
18. Reyes L et al. Periodontal bacterial invasion and infection: contribution to atherosclerotic pathology. *J Clin Periodontol* 2013; 40: S30–S50.
19. Van Dyke TE, van Winkelhoff AJ. Infection and inflammatory mechanisms. *J Clin Periodontol* 2013; 40: S1–S7.
20. Sheiham A, Watt RG. The common risk factor approach: a rational basis for promoting oral health. *Community Dent Oral Epidemiol* 2000; 28: 399–406.
21. De Geest S et al. Periodontal diseases as a source of halitosis: a review of the evidence and treatment approaches for dentists and dental hygienists. *Periodontol 2000* 2016; 71: 213–227.
22. Borges T de F et al. Changes in Masticatory Performance and Quality of Life in Individuals With Chronic Periodontitis. *J Periodontol* 2012; 84: 325–331.
23. Tonetti and Kornman. Periodontitis and Systemic Diseases - Proceedings of a workshop jointly held by the European Federation of Periodontology and American Academy of Periodontology. *J Clin Periodontol* 2013; 40: S1–S209.
24. Monsarrat P et al. Clinical research activity in periodontal medicine: a systematic mapping of trial registers. *J Clin Periodontol* 2016; 43: 390–400.
25. Chapple ILC, Genco R. Diabetes and periodontal diseases: consensus report of working group 2 of the Joint EFP/AAP Workshop on Periodontitis and Systemic Diseases. *J Clin Periodontol* 2013; 40: S106–S112.
26. Tonetti MS, Van Dyke TE. Periodontitis and atherosclerotic cardiovascular disease: consensus report of working group 1 of the Joint EFP/AAP Workshop on Periodontitis and Systemic Diseases. *J Periodontol* 2013; 84: S24–S29.
27. Sanz M, Kornman K. Periodontitis and adverse pregnancy outcomes: consensus report of working group 3 of the Joint EFP/AAP Workshop on Periodontitis and Systemic Diseases. *J Clin Periodontol* 2013; 40: S164–S169.
28. Linden GJ, Herzberg MC. Periodontitis and systemic diseases: a record of discussions of working group 4 of the Joint EFP/AAP Workshop on Periodontitis and Systemic Diseases. *J Periodontol* 2013; 84: S20–S23.
29. Buset SL et al. Are periodontal diseases really silent? A systematic review of their effect on quality of life. *J Clin Periodontol* 2016; 43: 333–344.
30. Karlsson E, Lymer U-B, Hakeberg M. Periodontitis from the patient's perspective, a qualitative study. *Int J Dent Hyg* 2009; 7: 23–30.
31. Abrahamsson KH, Wennström JL, Hallberg U. Patients' views on periodontal disease; attitudes to oral health and expectancy of periodontal treatment: a qualitative interview study. *Oral Health Prev Dent* 2008; 6: 209–216.
32. Gerritsen AE et al. Tooth loss and oral health-related quality of life: a systematic review and meta-analysis. *Health Qual Life Outcomes* 2010; 8: 126.
33. Loe H, Theilade E, Jensen SB. Experimental gingivitis in man. *J Periodontol* 1965; 36: 177–187.
34. Theilade E, Theilade J. Role of plaque in the etiology of periodontal disease and caries. *Oral Sci Rev* 1976; 9: 23–63.
35. Page RC et al. Advances in the pathogenesis of periodontitis: summary of developments, clinical implications and future directions. *Periodontol 2000* 1997; 14: 216–248.
36. Jepsen S et al. Prevention and control of dental caries and periodontal diseases at individual and population level: consensus report of group 3 of joint EFP/ORCA workshop on the boundaries between caries and periodontal diseases. *J Clin Periodontol* 2017; 44: S85–S93.
37. Tonetti MS et al. Impact of the global burden of periodontal diseases on health, nutrition and wellbeing of mankind: A call for global action. *J Clin Periodontol* 2017; 44: 456–462.
38. Van der Weijden FA, Slot DE. Efficacy of homecare regimens for mechanical plaque removal in managing gingivitis a meta review. *J Clin Periodontol* 2015; 42: S77–S91.
39. Chapple ILC et al. Primary prevention of periodontitis: managing gingivitis. *J Clin Periodontol* 2015; 42: S71–S76.
40. *Guidelines for effective prevention of periodontal diseases.* European Fedederation of Periodontology, 2015 (https://www.efp.org/perioworkshop/workshop-2014/guidelines.html, accessed 17 November 2017).
41. Serrano J et al. Efficacy of adjunctive anti-plaque chemical agents in managing gingivitis: a systematic review and meta-analysis. *J Clin Periodontol* 2015; 42: S106-138.
42. Needleman I, Nibali L, Di Iorio A. Professional mechanical plaque removal for prevention of periodontal diseases in adults–systematic review update. *J Clin Periodontol* 2015; 42: S12–S35.
43. Tonetti MS et al. Principles in prevention of periodontal diseases. *J Clin Periodontol* 2015; 42: S5–S11.
44. Sanz M et al. Effect of professional mechanical plaque removal on secondary prevention of periodontitis and the complications of gingival and periodontal preventive measures. *J Clin Periodontol*; 42.
45. Ramseier CA et al. Bleeding on probing as it relates to smoking status in patients enrolled in supportive periodontal therapy for at least 5 years. *J Clin Periodontol* 2015; 42: 150–159.
46. Ramseier CA, Suvan JE. Behaviour change counselling for tobacco use cessation and promotion of healthy lifestyles: a systematic review. *J Clin Periodontol* 2015; 42: S47–S58.
47. Newton JT, Asimakopoulou K. Managing oral hygiene as a risk factor for periodontal disease: a systematic review of psychological approaches to behaviour change for improved plaque control in periodontal management. *J Clin Periodontol* 2015; 42: S36–S46.
48. Braegger U. Cost–benefit, cost- effectiveness and cost–utility analyses of periodontitis prevention. J Clin Periodontol 2005; 32: 301–313.
49. Trombelli L, Franceschetti G, Farina R. Effect of professional mechanical plaque removal performed on a long- term, routine basis in the secondary prevention of periodontitis: a systematic review. *J Clin Periodontol*; 42.
50. Graziani F et al. Nonsurgical and surgical treatment of periodontitis: how many options for one disease? *Periodontol 2000* 2017; 75: 152–188.
51. Laleman I et al. Subgingival debridement: end point, methods and how often? *Periodontol 2000* 2017; 75: 189–204.
52. Van der Weijden GA, Timmerman MF. A systematic review on the clinical efficacy of subgingival debridement in the treatment of chronic periodontitis. *J Clin Periodontol* 2002; 29: 55–71;

53. Heitz-Mayfield LJA et al. A systematic review of the effect of surgical debridement vs non-surgical debridement for the treatment of chronic periodontitis. *J Clin Periodontol* 2002; 29: 92-102; discussion 160-162.

54. Deas DE et al. Scaling and root planing vs. conservative surgery in the treatment of chronic periodontitis. *Periodontol 2000* 2016; 71: 128–139.

55. Hirschfeld L, Wasserman B. A long-term survey of tooth loss in 600 treated periodontal patients. *J Periodontol* 1978; 49: 225–237.

56. Gjermo PE, Grytten J. Cost-effectiveness of various treatment modalities for adult chronic periodontitis. *Periodontol 2000* 2009; 51: 269–275.

57. Cortellini P et al. Periodontal regeneration compared with access flap surgery in human intra-bony defects 20-year follow-up of a randomized clinical trial: tooth retention, periodontitis recurrence and costs. *J Clin Periodontol* 2017; 44: 58–66.

58. Jin LJ et al. Global oral health inequalities: task group--periodontal disease. *Adv Dent Res* 2011; 23: 221–226.

59. Petersen PE, Ogawa H. The global burden of periodontal disease: towards integration with chronic disease prevention and control. *Periodontol 2000* 2012; 60: 15–39.

60. Chapple ILC. Time to take periodontitis seriously. *BMJ* 2014; 348: g2645.

61. Chan S, Pasternak GM, West MJ. The place of periodontal examination and referral in general medicine. *Periodontol 2000* 2017; 74: 194–199.

62. Jin LJ. Interprofessional education and multidisciplinary teamwork for prevention and effective management of periodontal disease. *J Int Acad Periodontol* 2015; 17: 74–79.

63. Varela-Centelles P et al. Periodontitis Awareness Amongst the General Public: A Critical Systematic Review to Identify Gaps of Knowledge. *J Periodontol* 2015; 87: 403–415.

64. Luo H, Wu B. Self-awareness of 'Gum Disease' Among US Adults. *J Public Health Manag Pract JPHMP* 2017; 23: e1–e7.

65. Dayakar MM et al. A survey about awareness of periodontal health among the students of professional colleges in Dakshina Kannada District. *J Indian Soc Periodontol* 2016; 20: 67–71.

66. Mosley M et al. North Carolina Cardiologists' Knowledge, Opinions and Practice Behaviors Regarding the Relationship between Periodontal Disease and Cardiovascular Disease. *Am Dent Hyg Assoc* 2015; 89: 38–48.

67. *Survey shows less than half of NDAs monitor and evaluate periodontal disease*. FDI World Dental Federation, 2017 (http://www.fdiworlddental.org/news/20171101/survey-shows-less-than-half-of-ndas-monitor-and-evaluate-periodontal-disease, accessed 7 November 2017).

68. Pjetursson BE et al. Comparison of survival and complication rates of tooth-supported fixed dental prostheses (FDPs) and implant-supported FDPs and single crowns (SCs). *Clin Oral Implants Res* 2007; 18: 97–113.

69. Derks J, Tomasi C. Peri-implant health and disease. A systematic review of current epidemiology. *J Clin Periodontol* 2015; 42: S158-171.

70. Aghazadeh A, Rutger Persson G, Renvert S. A single-centre randomized controlled clinical trial on the adjunct treatment of intra-bony defects with autogenous bone or a xenograft: results after 12 months. *J Clin Periodontol* 2012; 39: 666–673.

71. Carcuac O et al. Adjunctive Systemic and Local Antimicrobial Therapy in the Surgical Treatment of Peri-implantitis: A Randomized Controlled Clinical Trial. *J Dent Res* 2016; 95: 50–57.

72. Heitz-Mayfield LJA et al. Anti-infective surgical therapy of peri-implantitis. A 12-month prospective clinical study. *Clin Oral Implants Res* 2012; 23: 205–210.

73. Renvert S, Quirynen M. Risk indicators for peri-implantitis. A narrative review. *Clin Oral Implants Res* 2015; 26: 15–44.

74. Oppermann RV et al. Epidemiology of periodontal diseases in adults from Latin America. *Periodontol 2000* 2015; 67: 13–33.

75. Eke PI et al. Periodontitis prevalence in adults ≥ 65 years of age, in the USA. *Periodontol 2000* 2016; 72: 76–95.

76. Teng P-R, Lin M-J, Yeh L-L. Utilization of dental care among patients with severe mental illness: a study of a National Health Insurance database. *BMC Oral Health* 2016; 16: 87.

77. Syrjälä A-MH et al. Dementia and oral health among subjects aged 75 years or older. *Gerodontology* 2012; 29: 36–42.

78. Renvert S, Persson GR. Treatment of periodontal disease in older adults. *Periodontol 2000* 2016; 72: 108–119.

79. Jin L et al. Global burden of oral diseases: emerging concepts, management and interplay with systemic health. *Oral Dis* 2016; 22: 609–619.

80. Kumarswamy A et al. Group E. Consensus paper. Interprofessional education and multidisciplinary teamwork for prevention and effective management of periodontal disease. *J Int Acad Periodontol* 2015; 17: 84–86.

81. Piepoli MF et al. 2016 European guidelines on cardiovascular disease prevention in clinical practice. *Eur Heart J* 2016; 37: 2315–2381.

82. *American Diabetes Association position statement: standards of medical care in diabetes*. American Diabetes Association, 2017 (https://professional.diabetes.org/content/clinical-practice-recommendations, accessed 28 November 2017).

83. Oral health: prevention is key. *Lancet* 2009; 373: 1.

84. Jeffcoat MK et al. Impact of Periodontal Therapy on General Health. *Am J Prev Med* 2014; 47: 166–174.

85. Muthu J et al. Effect of Nonsurgical Periodontal Therapy on the Glycaemic Control of Nondiabetic Periodontitis Patients: A Clinical Biochemical Study. *Oral Health Prev Dent* 2015; 13: 261–266.

86. Teshome A, Yitayeh A. The effect of periodontal therapy on glycemic control and fasting plasma glucose level in type 2 diabetic patients: systematic review and meta-analysis. *BMC Oral Health* 2016; 17: 31.

87. Tonetti MS et al. Treatment of periodontitis and endothelial function. *N Engl J Med* 2007; 356: 911–920.

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