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Periodontal Screening, Where Are We Now? A Narrative Review

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KEYWORDS

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ABSTRACT

Prevention of diseases begins with screening. An ideal screening tool identifies patients at an early stage to facilitate appropriate treatment modalities with the aim of preventing symptom manifestation, reducing disease severity, and improving health outcomes. Disease screening has been a fundamental component of preventive medicine and dentistry. In the context of periodontal disease, the basic periodontal examination (BPE) is one of the screening tools available. There is a high prevalence of periodontal diseases worldwide, indicating a global issue. Despite the significance of periodontal screening, it remains underutilized both globally and locally. The lack of routine screening contributes to poor assessment and treatment of periodontal disease. This article focuses on the epidemiology of periodontal disease, the associated challenges, current screening practices, and the future directions of periodontal screening. By addressing these issues, early detection and management of periodontal disease can be improved, ultimately enhancing oral health outcomes.

INTRODUCTION

Epidemiology of periodontal disease

Periodontal disease is an extremely common chronic inflammatory illness that affects the periodontium in the oral cavity. The most common periodontal disease includes gingivitis, periodontitis, and peri-implant conditions. Globally, due to the high incidence of cases, periodontal disease casts a significant burden on the healthcare system, with severe periodontitis ranked as the sixth most prevalent disease [1]. Subjects with periodontal disease typically have worse quality of life (QoL) and oral health quality of life (OHQoL) scores than healthy individuals [2,3]. Periodontitis can negatively impact the functional limitation of the patients, apart from causing physical pain, physical incapacity, and psychological inability. Functional aspects of the stomatognathic system, for instance, mastication, swallowing, speech, as well as smile aesthetics, self-esteem, and social interactions can be compromised by periodontal disease [4]. It is also frequently associated with clinical conditions such as deep probing depth, gingival recession, loss of clinical attachment, and tooth mobility.

The patients may also present with symptoms such as redness, bleeding when brushing teeth, tooth loss, or prolonged halitosis, all of which may significantly lower the OHQoL of the patients and consequently affect the QoL. Periodontitis negatively impacts OHQoL, with Stage III and IV having a more significant impact than Stage I and II [5]. It has been reported that patients with Stage IV and Grade C periodontitis had the highest total Oral Health Impact Profile-14 scores, which were significantly associated with symptoms such as bleeding gums, sore gums, swollen gums, bad breath, loose teeth, and drifting teeth [6]. Nevertheless, periodontal therapy improves OHQoL, with non-surgical therapy showing greater

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benefits and being crucial for halting disease progression and enhancing QoL [2].

According to Preshaw et al., periodontal diseases are highly prevalent [7]. It is estimated that 4-76% of adults in developed countries suffer from periodontitis [8] and an even higher number of adults (50-90%) in developing countries suffer from it [9]. In addition, at least 11% of the global population experienced severe periodontitis. Over the past 35 years, the age-standardized prevalence rate of severe periodontitis has risen by 8.44% [10]. As reported recently, severe periodontitis and edentulism remain major public health issues in 2021, affecting over 1 billion and 353 million people, respectively. South Asia has the highest prevalence of severe periodontitis (17.57%), while Latin America and the Caribbean have the highest edentulism rate (7.39%). By 2050, over 1.5 billion people are projected to have severe periodontitis, and 660 million will be edentulous, with 19.67% of the edentulous population in China [11].

Jiao and co-workers stated that differences in the prevalence of periodontitis can also be attributed to underlying differences in socioeconomic status (SES), ethnicity, and exposure to other risk factors [12]. In China, their Fourth National Oral Health Survey (year 2015–2016) showed a high prevalence of severe periodontitis among smokers and elderly, with 43.5% of adults aged 65 to 74 affected with stage III/IV periodontitis [12]. Furthermore, 10.6% of middle-aged adults of 35 to 44 years old were also affected by stage III/IV periodontitis. In Latin America, a report on periodontal diseases among adults showed higher gingival bleeding among the lower SES population [13]. They also noted that smokers experienced less gingival bleeding than non-smokers, likely due to the masking effect of nicotine. Similar to the China's report [12], a higher prevalence of periodontitis was reported with increasing age, among males, heavy smokers, and low SES groups [13].

The 2011–2012 National Health and Nutrition Examination Survey (NHANES) in the United States of America (USA) reported that the prevalence of periodontitis was greatest among men (50.2%), Mexican Americans (59.7%), current smokers (62.4%), and those with self-reported diabetes (59.9%) [14]. A review by Corbet and colleagues reported a higher percentage of subjects with healthy periodontal status in the young age groups in higher middle- and high-income countries compared to low and lower-middle-income countries in the Asian and Oceanian regions [15]. It is consistent with a recent systematic review and meta-analysis that found lower prevalence in urban areas [16]. Both reviews highlighted that SES influences the accessibility and affordability of dental treatment, both of which impact the status of periodontal conditions.

What about Malaysia? Based on the National Oral Health Survey of Adults (NOHSA) 2010 conducted by the Oral Health Division, Ministry of Health (MOH) Malaysia, periodontal disease is increasing at an alarming trend [17]. The prevalence of periodontal disease rose from 90.2% in the year 2000 to 94.0% in 2010, with the prevalence of severe periodontal disease increasing abruptly from 5.5% to 18.2% within those 10 years. Furthermore, the most recent NOHSA 2020 report showed 94.5% adults having periodontal problems in the country, with 38.2% had periodontitis [18,19]. The OHQoL was reported to be worsened by periodontitis severity, tooth loss, and combinations of depression, anxiety, or stress [20]. It has also been reported that individuals with low SES in Malaysia are the most vulnerable to periodontal disease [21]. From these findings, it could be concluded that the prevalence of periodontal disease among the Malaysian population is high, aligning with the reports from other countries worldwide.

Overall, it is reasonable to conclude that the recent prevalence of periodontal disease, specifically periodontitis, is quite distressing globally, ranging from 28.8% to 76.0% [8,13,22-27] (Figure 1). Thus, it is imperative to ascertain the modifiable and non-modifiable risk factors of this condition to implement suitable prevention strategies.

Periodontal disease challenges

Why is periodontal health vital? Let's imagine the analogy of a building construction. For a building to be stable and safe, a strong and stable framework is the most critical factor for the building's foundation. If the framework and foundation of the building are unstable and fragile, it will collapse eventually. The same analogy applies to the periodontium. Periodontium is the supporting structure of a tooth and it creates a foundation for dental treatment [28]. As a general rule, if there is an unstable and unhealthy periodontium, no specific dental treatment including orthodontic treatment, restorative work such as crowns and bridges, or prosthetic replacement such as implant can be provided to prevent further worsening of the periodontal condition.

Having outlined the epidemiology of periodontal disease and the importance of periodontal health,

what are the challenges associated with the management of periodontal disease? Often undiagnosed, periodontal disease is a chronic, asymptomatic disease that progresses over time. Patients usually seek treatment only when they experience symptoms such as tooth migration, drifting, or tooth mobility. If these symptoms are present, a patient is most likely suffering from advanced periodontal disease and at risk of tooth loss. As a result, this compromises the masticatory function and aesthetics of the patients, subsequently affecting their OHQoL [4].

In essence, periodontal disease is a silent global epidemic that affects a vast number of people and has a significant economic impact. However, the prevalence estimates of this disease may be affected by the methods used in epidemiological research. For instance, the use of partial mouth versus full mouth recordings of periodontal state is a methodological issue in periodontal epidemiology [7]. When conducting oral screening of a large population, partial mouth recordings can be far more efficient than full mouth recordings. Nevertheless, it is widely known that partial oral recordings can lead to underestimation of the disease diagnosis and prevalence. The low diagnosis rate can be also attributed to challenges such as socioeconomic barriers, aging populations, poor awareness, and periodontal negligence [29]. Most people view periodontal health as a cosmetic issue rather than a health problem. Furthermore, poor awareness of periodontal health exists not just among the general public, but also among other healthcare professionals (HCPs). Additionally, periodontal negligence can also be caused by HCPs not performing periodontal screenings and examinations [29].

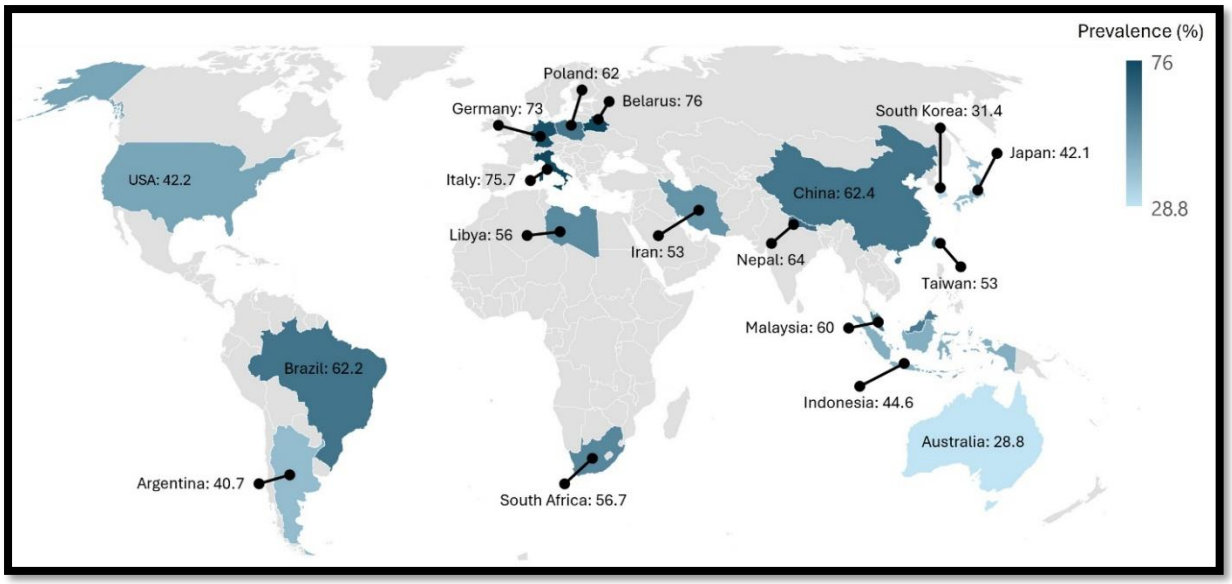

Figure 1 Worldwide prevalence of periodontitis

PERIODONTAL SCREENING

Periodontal screening tools

Periodontal screening is a simple, rapid, and cost-effective method to determine if a patient has periodontal disease. Although Preshaw emphasised that it can be difficult and complex to assess and diagnose periodontal problems, periodontal screening should be made compulsory given various detrimental effects, specifically periodontitis (attachment loss, alveolar bone loss, and ultimately tooth loss) that are mostly permanent and irreversible [7]. Throughout the years, several indices have been developed to evaluate periodontal diseases [30]. The Recession Index, Russell's Periodontal Index, and Periodontal Disease Rate Index were among the first periodontal screening tools developed in the 1950s. Meanwhile, Periodontitis Index, Dichotomous Periodontal Index and Genetic Susceptibility Index were recently developed in 2000s [30].

Nevertheless, some of the tools commonly used globally for periodontal screening purposes are the Community Periodontal Index For Treatment Needs (CPITN), Community Periodontal Index (CPI), Basic Periodontal Examination (BPE) and Periodontal Screening And Recording (PSR) Index. The World Health Organization (WHO) created the CPITN in 1982 to determine periodontal treatment needs among the population. CPITN is used to evaluate the prevalence and severity of periodontal disease

based on the probing depth and the status of the supporting tissues. However, CPITN did not focus on the degree of attachment loss or furcation involvement. In comparison, CPI emphasises the assessment of periodontal conditions rather than the periodontal treatment needs [31].

In relation to CPITN, Benigeri et al. reported that the dentition is divided into six sextants in the CPITN screening system: upper right (tooth 17 to 14), upper anterior (tooth 13 to 23), upper left (tooth 24 to 27), lower left (tooth 37 to 34), lower anterior (tooth 33 to 43), and lower right (tooth 44 to 47) [32]. The WHO periodontal probe is used in each sextant to assess calculus deposition, probing depth, and if any bleeding on probing (BOP). The score is obtained by the examination of specified index teeth (ten teeth including tooth 17, 16, 11, 26, 27, 37, 36, 31, 46, and 47) as recommended by WHO for epidemiological surveys or all teeth. However, only one of the following scores is recorded for each sextant: score 0 indicates no periodontal disease, score 1 for BOP, score 2 when calculus with plaque seen or felt by probing, score 3 for pathological pocket 4 to 5 mm, score 4 indicates pathological pocket 6 mm or more, and 'X' when only one tooth or no tooth is present.

In the United Kingdom (UK), the British Society of Periodontology (BSP) introduced the Basic Periodontal Examination (BPE) in 1986 to advocate the use of periodontal screening in routine dentistry practice [33]. It was a derivative of the Simplified Periodontal Examination (SPE) which was developed and used in New Zealand from 1984 to 1987. Landry and Jean reported that the Periodontal Screening and Recording (PSR) Index also evolved from the BPE [31]. In the USA, the SPE was first introduced in 1992 at the American Academy of Periodontology (AAP) meeting. Modifications were made for the use of SPE in North America. Following that, the American Dental Association (ADA) and the AAP adopted a new diagnostic index known as Periodontal Screening and Recording (PSR) Index.

The PSR Index is nearly identical to the CPITN, with one major difference: the asterisk (*) code. Both indices use the same evaluation method, which is based on three periodontal disease indicators: gingival bleeding on probing, calculus accumulation, and probing depth. Additionally, the PSR Index offers a more detailed assessment of periodontal status by documenting furcation involvement, tooth mobility, mucogingival issues, and gingival recession greater than 3.5mm. When any of these conditions are present, an asterisk (*) is added to the PSR score for the corresponding sextant [31].

In Malaysia, the BPE is the primary screening tool used. It is a straightforward and quick screening tool that can provide additional information to guide the primary management of periodontal disease. However, the BPE guideline is meant for initial periodontal assessment for a basic level of care and hence, it should only be used for screening and not for diagnosis. It can be used in all age groups except children below 7 years old. To perform BPE, a WHO probe with a 0.5 mm ball end and black band at 3.5 to 5.5 mm is used (Figure 2). In comparison with CPITN, there is an addition of an asterisk (*) to indicate furcation involvement [34].

Figure 2 Utilization of WHO probe to perform BPE

Periodontal disease can sometimes affect children and adolescents. Therefore, simplified BPE can be utilised for periodontal screening of children aged 17 years old and below [35]. Since there is a possibility of false pocketing on newly erupted teeth in children and young adolescents, only index teeth are examined under BPE, i.e. all four first permanent molars, upper right central incisor (UR1), and lower left central incisor (LL1). However, simplified BPE may not be suitable for children under the age of 7 due to their early dental development of the index teeth. False pockets, also referred to as pseudo pockets, can result from this condition. In children, this condition is common during the eruption of permanent teeth. Therefore, children aged 7 to 11 will only utilise BPE codes 0 to 2, whereas those aged 12 to 17 can use the entire range of codes 0, 1, 2, 3, and 4 under BPE on the index teeth. Nevertheless, the interpretation of each code and probe used is similar to the BPE performed in adult patients [36]. Figure 3 illustrates the comparison between BPE and simplified BPE.

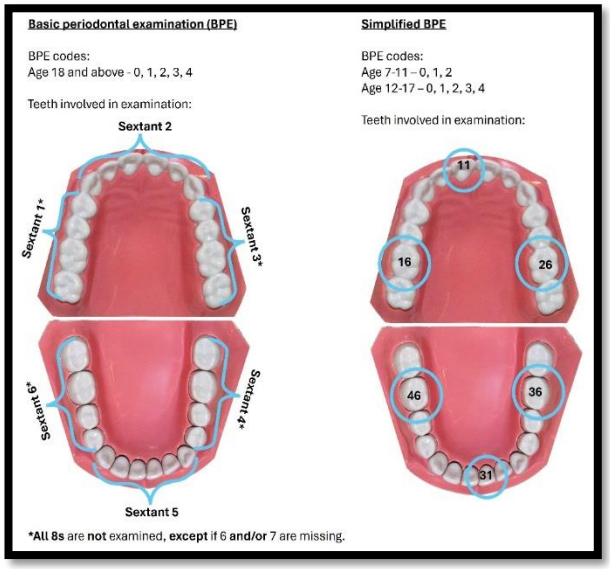

Figure 3 Comparison between BPE and simplified BPE

Overall, Landry and Jean felt that the CPITN should remain the epidemiological screening tool of choice as the severity and treatment requirements of periodontal diseases are closely linked with one another [31]. However, BPE or PSR Index are both acceptable modifications of the CPITN that can be used to facilitate a simple and rapid periodontal screening for general dental practitioners (GDP).

The practice of periodontal screening

With regard to undiagnosed cases of periodontal disease, specifically periodontitis, some research has proposed that this can be attributed to the suboptimal practice of periodontal screening. This condition is also believed to influence the actual prevalence of periodontal disease. For instance, it is compulsory for dental students to perform periodontal screening on every patient as part of the clinical examination. However, do all practicing dentists perform this procedure for every patient during a clinical examination? Given past trends, will it become a standard practice once they begin working as GDP? A study from Saudi Arabia reported that 64% of GDP does not regularly perform periodontal screening [37]. Next, a study by Meers et al. reported that in Flemish dental practices, 64% conducted periodontal screening using the Dutch Periodontal Screening Index (DPSI), 28% with probing pocket depths, 4% with radiographs, and 4% performed no screening at all [38]. Approximately 45% of GDP in Turkey performed periodontal probing but the frequency of screening reduced among those with increased dental experience [39]. Another study in Canada revealed that only a small portion of dentists used proper radiographs, took complete probing depth measurements, and screened for periodontal disease using the recommended PSR Index [40].

In Australia, Darby et al. reported that the majority of dentists (79.7%) screened all new patients for periodontal disease. According to the Victorian Dental Practice Board's guidelines, each patient's periodontal status should be recorded, including gingivitis, probing depth, supra- and subgingival calculus, and oral hygiene status. However, approximately 20% of them still failed to comply with the guidelines, which could lead to serious legal consequences [41]. It shows that there is a liability associated with the practice of periodontal screening. Another study by Tugnait et al. also revealed that even though 91% of dentists used BPE as a screening tool for new patients, only 56% used it for all patients [42].

What about the practice of periodontal screening in Malaysia? In a recent survey on perceived knowledge, confidence, and problems with BPE among third-year dental students [43], half of them (50%) perceived BPE as useful, another 50% believed themselves to be competent, while only 20% reported having high knowledge and skills. Another study by Vaithilingam et al. reported that 55.6% of dentists in Penang and Negeri Sembilan routinely screened for periodontal disease, but only 35.9% performed the screening when they had time and 8.5% never conducted any screening. According to the same study, 62.4% of subjects were well familiarised with BPE, 10.9% used it frequently, and 67.1% only used it when necessary [44]. In view of these research findings, periodontal diseases are likely to be underdiagnosed and poorly managed.

The challenges associated with periodontal screening

Periodontal screening is also associated with challenges. It was emphasised in the study that time plays a significant role in periodontal screening and treatment for some dentists [30, 32]. It was stated by the dentists that they are already overworked and are not able to perform periodontal procedures on their own [38]. Similarly, the time factor is also reported to be one of the barriers to performing BPE among dental students [43]. Among the other challenges documented were the difficulty in probing posterior teeth, the difficulty in probing many sites, the inability to recall the codes, and the inability to obtain cooperation from patients [43]. Locally, low periodontal screening levels in Malaysia were attributed to a lack of emphasis on routine screening and a shortage of periodontal probes [45].

Another interesting finding was that even if the GDP performed periodontal screening and the patients required further periodontal treatment, some private GDP would not refer the patients to their specialist counterparts due to the fear of losing patients after referral [37]. The provision of periodontal treatment is determined by a variety of factors, including the clinician factor such as training, past experience of successful treatment outcomes, ability to motivate patients, and periodontal treatment fees and duration [41]. Additionally, patient factors such as awareness of periodontal disease, reluctance to seek periodontal treatment, lack of motivation and financial constraints also influence periodontal treatment provision [38,41]. This can potentially contribute to periodontal negligence.

Future direction and strategies of improvement

As discussed earlier, health care professionals (HCPs) as well as the general public are unaware of the importance of periodontal health. Proposed by Herrera et al., periodontal health literacy should be improved among the public, oral and medical HCPs [29]. Multidisciplinary teamwork is the key to developing a long-term sustainable strategy for global oral health. There is a growing recognition that periodontal diseases share risk factors with other chronic non-communicable diseases (NCDs), and the inflammatory burden of periodontitis may impact other chronic NCDs. Thus, both dental and medical HCPs need to be aware of this relationship [29].

To address the limited capacity and resources of medical HCPs in screening for periodontal disease, a simple and efficient questionnaire-based screening tool for periodontitis has been developed. This tool utilizes self-reported oral health (SROH), demographics, and/or salivary biomarkers, and is designed for use by medical professionals in non-dental settings [46]. Recently, the seven-item patient-reported Periodontitis Risk Scores questionnaire, developed by the German Society for Periodontology, has been used to screen for periodontitis using patient-reported data. It is particularly useful outside dental settings, can be self-administered, and helps patients decide whether to seek oral health advice. It can be utilized by general practitioners, diabetologists, and cardiologists, fostering better medical-dental integration [47]. Additionally, a self-reported questionnaire on periodontal risk factors, combined with the Periodontal Screening Index (PSI), reliably detects periodontitis patients using patient-reported data on risk factors and indicators [48]. Although using a questionnaire as a periodontal screening tool is cost-effective and non-invasive, it lacks the comprehensiveness needed for a proper diagnosis.

As a result of the challenges associated with periodontal screening in daily clinical practice, alternative methods such as online self-guided version of the periodontal health screening module was developed [45]. The newly developed module is comprised of three components: (i) history taking, (ii) clinical assessment, and (iii) case decision. It was highly accepted by dental trainees and private general dentists due to its simplicity and ease of understanding, its design, along with its perceived benefits for faster and better decision-making [45].

Traditional periodontal disease diagnosis relies on probing and radiographs, which may be uncomfortable or painful for some patients. Additionally, probing errors and the overlapping of images can compromise the accuracy of the results [49]. Fifth-generation ultrasonographic probes are three-dimensional, painless, non-invasive, and allow for earlier detection of periodontal disease with more reliable measurements. Ultrasonic periodontal probing detects smaller anatomical changes, enabling earlier tissue breakdown detection and providing histologic information like tissue thickness and inflammation [50]. However, further research is required to validate its capability in periodontal screening and diagnosis.

The development of point-of-care diagnostic devices for detecting periodontitis has emerged as a promising advancement. These include paper-based test strips, which are simple to use, and lab-on-a-chip (LOC) devices that can identify oral pathogens responsible for periodontal tissue destruction, making them suitable for chairside use. Saliva testing is one of the most common applications for paper-based test strips and LOC devices. The saliva test is a simple screening tool that can be used to detect periodontal disease. Screening tests that measure neutrophils in saliva, indicating the presence and severity of periodontal attachment loss, have been used [51]. Ninety percent of Canadian dentists would use it to educate patients about periodontal disease. They agreed that colour change helps with education and quick screening, but treatment planning still needs probing and radiographs [51]. Meanwhile, the test paper strip method developed to detect salivary haemoglobin and lactate dehydrogenase in saliva has proven to be a useful screening test for periodontal diseases and an alternative to the CPI [52]. Periodontal biomarker analysis with test strips

can be viewed as a quick and simple tool for differentiating between periodontitis and healthy patients [53]. Although saliva tests are relatively easy to conduct at chairside, they are unlikely to be practical in clinical settings due to the time-consuming and cumbersome nature of serial rinses, as well as individual variability.

On the other hand, electrochemical sensing methods, while effective, are costly, not ideal for chairside use, and lack cost-efficiency [49,54]. Meanwhile, in-mouth wireless sensors mark a groundbreaking development in the diagnosis and monitoring of oral health. These devices can be easily positioned within the mouth and deliver instant data on various parameters related to periodontal health [54]. Various radiographic imaging techniques, such as cone beam computed tomography (CBCT) and optical coherence tomography, have also been introduced to assist in the screening of periodontal disease [50]. The integration of advanced artificial intelligence (AI) technologies into radiograph has also become a growing trend in the detection of periodontal disease [55]. Different AI models, including Faster R-CNN, are being employed to identify periodontal bone loss, periodontally compromised teeth, and conditions such as gingival inflammation, calculus, and dental plaque. Another example is the Faster R-CNN model is notable for detecting periodontal bone loss in panoramic radiographs. AI tools are also valuable for predicting tooth loss in Stage IV periodontitis patients when combined with periodontal risk assessment models, which consider factors like demographics, smoking status, and periodontal severity before and after treatment. Despite the benefits of AI-assisted imaging for detecting periodontal diseases, these methods are mainly used for severe cases and are not effective for early detection [56].

Additionally, AI-powered models for analysing intraoral photographs in periodontal screening are becoming an emerging trend. AI models can detect subtle gingival changes in photographs that routine inspections may miss, aiding large-scale periodontal screening programs [55]. Integrating electronic health records with AI technologies, along with using patient-specific clinical data such as periodontal parameters and physical examination findings, shows promise in screening and diagnosing periodontal diseases [55]. Figure 4 summarizes the evolution of various tools in periodontal screening.

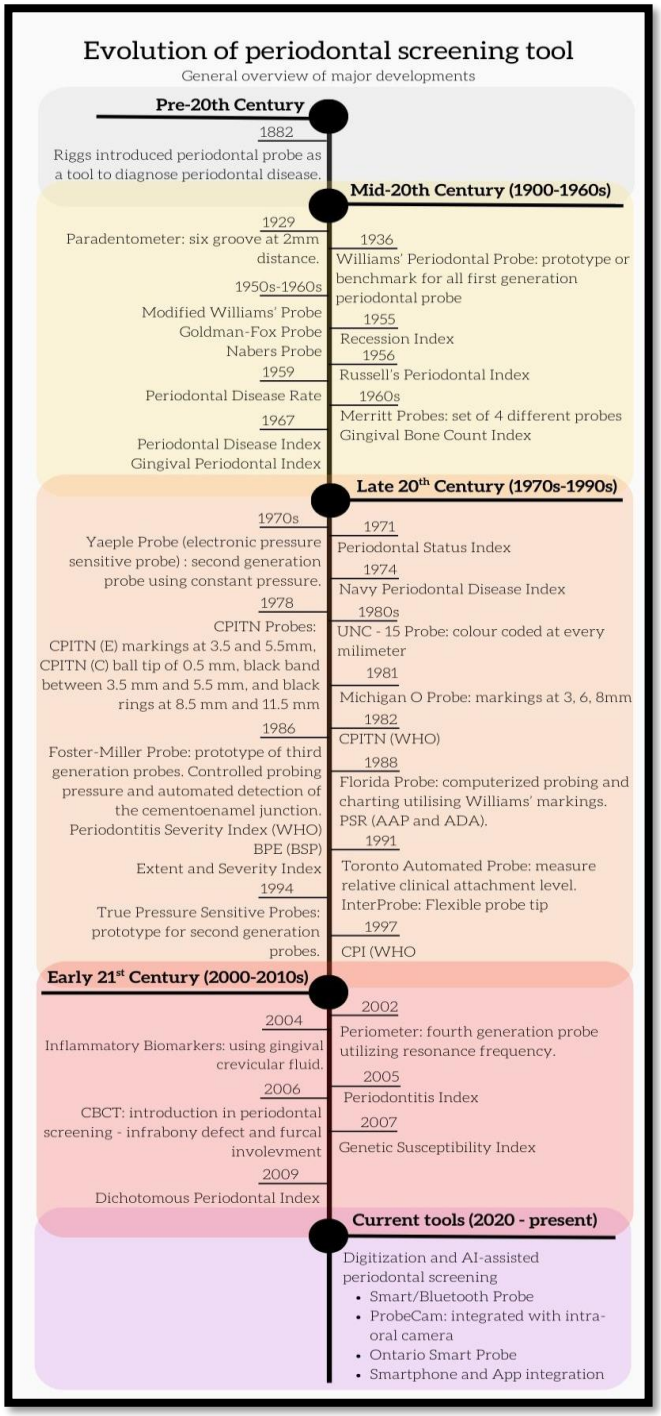

Figure 4 Development of periodontal screening tools

With advancements in knowledge and technology, there is a potential for personalized medicine to be integrated into periodontal disease screening, including the assessment of biomarkers, the periodontal microbiome, genetic profiles and epigenetics, and the use of artificial intelligence in alveolar bone radiology [57]. Nevertheless, these techniques have yet to be clinically validated, and their potential remains to be fully interpreted. The current evidence is not sufficiently consistent to be

conclusive for clinical application or generalization to practice. Therefore, it is important to emphasize that conducting a basic periodontal examination and screening in daily dental practice remains essential for early diagnosis.

CONCLUSION

Let's take a moment of reflection on periodontal screening. The practice of periodontal screening for every patient is still lacking globally and locally. Even though periodontal screening is a basic clinical examination, it can exert a significant effect on patient care. However, despite the importance of periodontal screening, it is often overlooked, resulting in poor assessment of periodontal disease and treatment. In short, the importance of periodontal screening cannot be overstated. With appropriate planning and implementation of screening, periodontal disease can be prevented. The screening of periodontal disease should be mandatory for all dental practices worldwide.

DECLARATION OF INTEREST

Authors declare no conflict of interest.

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