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Navigating periodontal health: Insights from chair side diagnostics

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Abstract
Periodontitis is an inflammatory condition driven by infection that is brought on by dental plaque buildup. It also results in microbial changes that, in vulnerable people, can have a severe impact on the periodontium. When these lesions are discovered early and yet reversible, microbiological diagnostic techniques help provide a chance for non-invasive therapy. Among the methods used were microscopy, bacterial culture, immunological assays such as Evalusite, Oraquick, Fluorescent In-Situ Hybridisation, enzymatic assays such as Periogard, Perioscan, Pocket watch, MMP dipstick test, Periocheck, Biolise, and molecular biology techniques such as PCR, Terminal Restriction Fragment Length Polymorphism (T-RFLP), Pyrosequencing, Supported Oligonucleode Ligation and Detection (SOLiD). Chairside diagnostic tools have become more capable with the addition of biomarkers, AI, and multimodal diagnostic platforms. This has allowed physicians to deliver personalised treatment regimens and improve patient outcomes. We have complied data and presented an overview of chairside periodontal diagnostic instruments for the gingival sulcus advanced clinical examination, discuss chairside biomarker technology in detail, and provide the most recent advancements in dental imaging technology for measuring periodontal bone and tissues.

Keywords: Diagnostic aids, Periodontal probes, PCR, CBCT

Introduction
Periodontitis is an inflammatory condition caused by imbalance in the mouth's bacteria community and immune system response. It is the 11th most prevalent global disorder. [1] Periodontal disease are diagnosed and treated at chairside, with each tooth individually examined to determine the stage and grade [2]. However, clinical diagnostic tests can only evaluate disease's history, not its current activity [3]. Several oral biomarkers have been researched for periodontal diagnostics, including ions, volatile chemicals, bacteria, host proteins, and other genotypic and phenotypic markers [4-6]. With data compiled from previously published articles, this review paper provides an overview of chairside periodontal diagnostic tools, recent developments in dental imaging technology for measuring periodontal bone and tissues, and provides detailed information about current chairside biomarker technology.

Currently used chairside probing tools
For detection of pocket depth and clinical attachment loss
Pocket depth (PD) and clinical attachment loss (CAL) are often determined with aperiodontal probe (Figure 1). Both CAL and PD have been utilized as primary methods for analyzing periodontal disease [7]. Periodontal probes are designed to meet specific requirements, with first-generation probes created in 1936 by Charles H.M. Williams serving as the standard. These probes include Willam's, which has a 13mm stainless steel tip, the 8 Community Periodontal Index of Treatment Need (CPITN), which has a 0.5mm spherical tip, University of Michigan O probes with markings at intervals of 3mm, 6mm, and 8mm, University of North Carolina-15 probes marked with colour at each millimeter separation, and Naber's probe used to identify and quantify the extent of periodontal disease in furcation areas of teeth [8].
Second generation of probes, such as Pro-DenRx® Sensor Probe and True Pressure Sensitive Probe (TPS) Probe, use pressure sensitivity for consistent probing pressure [9].

These force-controlled probes, typically between 0.20 and 0.25 N, minimize patient pain and enable precise diagnostic findings [10]. Polson created electronic force-controlled probes in 1980, which provide control over pressure applied during insertion and visual guiding. Yeaple probe, a modified version of Polson's probe, is specifically used in research on dentinal hypersensitivity. Yeaple probe is designed to gradually elevate pressure until an auditory signal indicates the predetermined pressure has been reached [11].

Third-Generation (Automated) Probes were designed to reduce errors by incorporating uniform pressure, as well as digital readouts and computerized data storage for the probe's measurements. Foster-Miller probe serves as template for third-generation probes. This probe incorporates regulated probing force and automatic identification of the cementoenamel junction (CEJ) [12]. Florida Probe., Toronto Automated probe, and the InterProbe™, belongs to third-generation.

Fourth-Generation Probes describe probes that are three-dimensional (3D). These probes, are designed to record the sequential placements of probes along the gingival sulcus. Their objective is to progressively broaden the scope of linear probing to take into account the three-dimensional, continuous pocket that is being studied [13].

UltraSonographic (US) probe is the only fifth-generation probe available, utilizing ultrasonic waves to identify, visualize, and chart the upper limit of the periodontal ligament, without the need for penetration [14].

For Detection of Plaque and Calculus

Calculus detection probes use auditory readings to detect subgingival calculus [15]. DetecTar probe from DENTPLY Professional is the only calculus detection device available. It features a lightweight, well-balanced handpiece with an audible beep function. Perioscopy aids in subgingival root surface visualization with tens of magnifications. Diagnodent probe, a pen-like probe, introduces a painless laser beam into the tooth to identify auto-fluorescent signals from calculus lesions [16]. PerioScan has two modes of operation: a diagnosis setting for identifying deposits of calculus and a therapy setting with varying power levels for traditional ultrasonic debridement. Key Laser 3+ is capable of feedback-controlled calculus detection and removal [17].

For evaluation of the periodontal disease

Sensor-integrated probes, such as the Diamond Probe®/Perio 2000® System and Periotemp® Probe, are used to assess factors like temperature and sulphide content associated with periodontal disease. The Diamond Probe detects sulfides, indicating gram-negative bacteria activity, [18] while the Periotemp® Probe accurately measures temperature fluctuations in gingival tissues, detecting early signs of inflammation [19]. These probes can detect temperature variations of 0.1°C in periodontal pockets. [20]

Diagnosis using imaging tools

2D radiography

Dental 2D radiography, primarily intraoral and panoramic X-rays, helps in strategic planning of extractions, implant placement, and denture design by providing a comprehensive view of the mouth, but is not suitable for detecting periodontal disease activity [21]. Using a radiographic film (detector) that is positioned within the mouth, intraoral X-rays produce images. Intraoral radiographs are utilized as crucial evidence to assess the course of periodontitis [22].

Digital radiography has quickly gained popularity in clinics due to its ability to overcome the limitations of traditional film-based radiography, such as the need for printing and the constraints of time and space [23]. Digital radiographs, used in digital subtraction radiography (DSR), can be easily presented, saved, printed, and transferred to electronic devices. DSR uses digital radiographs to capture and overlay two photos of an object, allowing for direct visual comparison. Computer-assisted densitometric image analysis (CADIA) is a common technique used for subtraction radiography, measuring light input using an image analysis processor and a computerized video camera. Quantitative data is used to produce two radiographs of the same anatomical site for comparison [24]. The CADIA system assesses the changes in bone density in a furcation as well as regeneration of bone within the extraction socket [25].

Despite widespread acceptance of 2D imaging as a common tool for assessing oral health, it has intrinsic restrictions, due to the fact that it superimposes 2D plane picture over 3D structural information [26].

3 Dimensional imaging

Computed tomography (CT), a 1972 extraoral radiography technique, is used for oral health evaluation by creating three-dimensional models of structures by merging two-dimensional images. Despite providing high-resolution 3D images with enhanced accuracy, CT scans have potential drawbacks like increased radiation exposure and high costs [27].

Ten-fold decrease in radiation exposure is achieved when utilising the dental CBCT system, as opposed to the conventional CT method [28]. The collected data is subsequently utilized to generate three-dimensional photographs of the oral and maxillofacial regions, specifically in transverse, sagittal and buccal planes. CBCT technology provides greater benefits in evaluating bone and periodontal pocket conditions.

A number of axial cross-sectional images have been produced using tuned aperture computed tomography (TACT). This device generates holographic images that display three-dimensional views of teeth and pathologies [29]. This technology accurately identifies the precise area of loss or formation of alveolar bone, its shape, and also recurring cavities [30]. Cone-beam volumetric tomography (CBVT) is a CT-based technique, providing superior precision and resolution in assessing the exact and detailed outcomes of regenerative treatment [31]. In addition to precise 3D anatomical mapping for the estimation of bone density, QCT, or quantitative computed tomography, provides more precise information on density of bone minerals [32].

Magnetic resonance imaging

MRI, introduced in dentistry in 1981, is a valuable diagnostic tool due to its ability to produce high-quality images of soft tissues. It uses a magnetic field between 0.2 and 7 Tesla to detect electromagnetic waves from hydrogen atom nuclei. MRI has been used to observe lesions in the temporomandibular joint or jaw evaluate pulp vitality, aid in endodontic therapy, and plan implants. As it is more suitable for visualizing and distinguishing soft tissues, MRI remains a promising imaging technique for periodontal disease diagnosis and treatment planning [33, 34].

Intraoral scanners
Intraoral scanners are a new dental technique that replaces traditional impressions in prosthodontics, restorative dentistry, and orthodontics. 35 They use light to illuminate objects and send image data to a computer system, creating a digital 3D model. They estimate periodontal irregularities, tooth mobility, gingiva and tissue regeneration conditions [36].

Endoscopic Capillaroscopy
Endoscopic capillaroscopy is an imaging technique used to examine periodontal health by introducing a small optical fiber into the periodontal pocket. This device allows visualization and recording of minute blood vessels within the gingival crevice and periodontal pocket. The light used, 520 nm, illuminates the area, revealing red blood cells (RBCs) as dark spots against a green backdrop, enabling detailed microcirculation imaging [37] .

Chair side biochemical assay
Perio-Check (Ac Tech)
The quickest test now available for neutral proteases, including collagenases in GCF, is the chair side test. It has been shown that the levels of these enzymes in GCF increase as gingivitis advances and in regions where periodontitis has already developed.

Prognos-Stik (manufactured by Dentsply)
This technique identifies the existence of serine proteinase elastase in a sample of gingival crevicular fluid (GCF).

PerioGard™
PerioGard utilizes the quantification of aspartate aminotransferase (AST) enzyme levels in GCF. The test is intended to yield a positive result when the AST activity is greater than 800 µIU. It is unable to differentiate between sites that have significant inflammation but no attachment loss versus sites that have attachment loss [38].

PocketWatch™
The PocketWatch™ method examines the AST directly. PocketWatch™ enables the differentiation between active and idle sites. AST activity, as measured by PocketWatch™, serves as an indicator not just of cell death but also of the magnitude of the damaging areas.

Dip Stick Test
The MMP-8 test stick operates on the basis of immune-chromatography, employing two monoclonal antibodies that target distinct epitopes of MMP-8. The test stick results can be observed within a 5-minute timeframe. The antibody is capable of identifying both neutrophils and MMP-8 isoforms that are not of the polymorphonuclear (PMN) type.

The Integrated Microfluidic Platform for Oral Diagnostics (IMPOD)
This microfluidic technique enables automated saliva analysis by combining sample preparation (filtration, enrichment, mixing) with electrophoretic immunoassays to rapidly assess the levels of analytes in saliva samples. The sample volume required is very small, specifically 10 µL [39].

The Oral Fluid Nano Sensor Test (OFNASET)
OFNASET is a diagnostic tool used for detecting multiple biomarkers in saliva for oral cancer diagnosis. It's a microelectromechanical system (MEMS) that uses electrochemical detection to identify salivary protein and RNA biomarkers, achieving high sensitivity and specificity in real-time.

Electronic Taste Chips (ETC)
ETC, chemically sensitized beads, are used to quantify CRP and other inflammation biomarkers in saliva, allowing for the quantification of the difference in CRP levels between healthy individuals and periodontal disorders patients, and simultaneously tracking multiple biomarkers.

Oraquick
The OraQuick HIV type 1 (HIV-1) is a simple, qualitative, FDA approved rapid antibody test, designed to quickly detect the presence of HIV-1 antibodies using samples of oral mucosal transudate (OMT), whole blood, serum, or plasma. OraQuick is capable of detecting antibodies specific to the gp41 immuno-dominant domain.

Biolise
The test for measuring elastase activity in GCF was designed by Hermann JM, *et al*. GCF test measures elastase activity by centrifuging sample buffer and elastase standards at 5000 rpm for five minutes. A volume of 10 µL is transferred to a microtiter plate filled with 90 µL of assay buffer and 50 liters of a 10-3 M solution of the fluorogenic substrate MeO-Succ-ala-alapro-val-7-amino-4-methylcoumarin. The plates are coated with a detachable film and placed in an incubator at 25 °C for six hours. The software Biolise is used to determine Elastase activity in the samples [40].

Microbiological Test Kits
Table 1 shows the various chairside microbiologicals diagnostic aids periodontal clinical practice.

Omnigene
It is a genetic nucleic acid probe. OmniGene Diagnostics, Inc. has utilized genetic engineering principles to create DNA probe tests that are specific to eight periodontal pathogens including *P. gingivalis, P. intermedia, A. actinomycetem-comitans, F. nucleatum, E. corrodens, C. rectus, B. forsythus, and T. denticola.* Test results are delivered in a short amount of time-a few hours to a few days [41].

My PerioPath
The PerioPath utilizes a saliva sample to accurately detect and quantify the particular strains of bacteria responsible for periodontal disorders. By estimating the bacterial load, it is possible to identify high-risk microbes such as *A. actinomycetemcomitans, P. gingivalis, T. forsythia*, and *T. denticola*, moderate-risk pathogens such as *E. nodatum, F. nucleatum, P. intermedia, C. rectus, Parvimonas P. micros*, and low-risk pathogens such as *C. sputigena, and E. corrodens*.

N-benzoyl-DL-arginine-2-napthylamide (BANA) test
The BANA test is highly sensitive and can detect microorganisms like P.gingivalis, T.denticola, and T.forsythia. It works by breaking down peptide analog N-benzoyl-DL-arginine-2-naphthylamide (BANA), forming B naphthylamide. A reagent in the test's top strip interacts with B naphthylamide, creating a persistent blue color indicating the pathogen's presence. It is also used for detecting unstable

sulphur compounds in individuals with halitosis [42].

Perioscan

The hydrolysis reaction of N-benzoyl-DL-arginine-2-naphthylamide, or BANA, is used in Perioscan diagnostic kit. It was created especially to recognise bacterial proteases that resemble trypsin found in tooth plaque. Three distinct microorganisms are detected by the equipment (*T. denticola*, *P. gingivalis*, and *B. forsythus*) from plaque located beneath the gingival line, but it is unable to distinguish between them. [43]

Evalusite (Kodak)

A new membrane immunoassay is being sold in Europe and Canada. It connects antigen to a membrane-bound antibody, creating an immunocomplex. This complex is detected using calorimetric reaction. A plaque sample is created by adding detergent and mixing it. The antibody reacts with sample, targeting *A. actinomycetemcomitans, P. gingivalis, and P. intermedia*. The presence of these complexes is identified by introducing an enzyme-labelled second antibody and a colored enzyme substrate [42].

The Toxicity Prescreening Assay (TOPAS)

TOPAS identifies the indirect existence of bacteria through the detection of two indicators of gingival infection: bacterial toxins and bacterial proteins. This test can be used to assess the intensity of inflammation and the progression of the destructive process, thus differentiating among an active and inactive periodontal disease [44].

Institute for Applied Immunology (IAI) PADO Test 4.5

The PADO RNA probe can identify four periodontal bacteria using oligonucleotide probes complementary to conserved locations of the 16S rRNA gene. The minimal detection threshold for *P. gingivalis*, T. forsythia, and T. denticola is 104, while for A. actinomycetemcomitans is 103. However, the Pado Test has a large percentage of false negatives, suggesting that the number of positive locations or persons is underestimated [45].

Genetic Chairside Tests

PST® genetic susceptibility test

The Periodontal Susceptibility Test (PST®) is a genetic test that identifies individuals prone to periodontal disease by examining IL-1α and IL-1β gene. It helps formulate treatment regimens for new periodontal patients and assesses prognosis in patients requiring extensive periodontal or implant therapy. PST® is clinically used in two main scenarios: to identify individuals prone to serious periodontal disease and to improve patient care [46].

My perio ID

The MyPerioID test utilizes saliva to ascertain a patient's genetic predisposition to periodontal illnesses and identify those patients who are at an elevated risk of developing more severe periodontal infections. This test necessitates the transportation of saliva samples to lab to obtain the results.

Molecular Biology Techniques

Polymerase Chain Reaction (PCR)

PCR is a method used to identify genes of periodontal bacteria, such as *P. gingivalis, T. forsythia,* and *T. denticola*, linked to periodontal disorders. It allows for identification and measurement of microorganisms found in clinical samples like dental plaque or GCF. The process involves extracting DNA from samples, creating specialized primers, and amplification through cycles of denaturation, primer annealing, and extension. Real-time PCR (qPCR), allows for concurrent amplification and quantification of DNA, providing precise measurements of target DNA concentration. PCR aids in development of specific antimicrobial medicines and individualized treatment strategies [47].

Checkerboard DNA-DNA Hybridization Technology

The checkerboard DNA-DNA hybridization technique was designed by Socransky SS, *et al*. to investigate the oral microbial ecology. The assays employ DNA probes that are tagged with digoxigenin and encompass the entire genome. In this technology, DNA probes are employed to identify cells of different microbial species. They are employed in ecologic studies and epidemiological research, as it does not require bacterial viability [48].

Terminal Restriction Fragment Length Polymorphism (T-RFLP)

Terminal Restriction Fragment Length Polymorphism (T-RFLP) is a molecular method used to assess the oral microbiota linked to periodontal health and disease. It involves digesting amplified microbial DNA fragments using restriction enzymes, resulting in different lengths of terminal fragments. These fragments are isolated and observed using gel electrophoresis, allowing for the characterization of microbial communities based on their sizes. This technology, along with other molecular methods, provides a comprehensive understanding of microbial dysbiosis in periodontal illnesses [49].

Fluorescence in situ hybridization (FISH)

Fluorescence in situ hybridization (FISH) is a molecular biology procedure utilized to detect and track the presence or absence of certain nucleic acid sequences in cells or tissues. It can identify a single bacterial cell and is straightforward, quick, flexible, and sensitive. Species in periodontal pockets, caries, and periodontitis have all been identified and detected using FISH [49].

Pyrosequencing

Pyrosequencing is a DNA sequencing technology that is used extensively in periodontology to examine the oral microbiome and its impact on periodontal health and disease. This advanced sequencing technique utilizes the ability to identify the integration of nucleotides in real-time during the process of DNA synthesis. Pyrosequencing allows for the analysis of the taxonomic composition of the oral microbiota by sequencing the hypervariable sections of the bacterial 16s ribosomal RNA gene [42].

Other Chairside Diagnostic Tests

Lab on Chip technology

LOC technology offers a compact solution for laboratory activities, combining microfluidic channels, capture probes, and detection technologies on a single microchip. Its potential applications in periodontology include detecting pathogens, investigating inflammatory biomarkers, and analyzing genetic markers, making it a promising option for a smaller, more compact platform [46].

Osstell IDx

The Osstell IDx is a non-contact device developed by Osstell AB in Sweden that uses non-invasive procedures to test dental implant stability, specifically osseointegration. It uses Radiofrequency Ablation (RFA) with resonance frequency range of 3000-8500 Hz, allowing for an implant stability quotient between 0 and 100. The device includes an excitation source, transducer, and computerized analysis module [50].

Table

Table 1: Categorization of diagnostic tools in periodontal clinical practice according to sample source

Type of test	Source of test sample	
	Saliva	**GCF**
Biochemical assay	Integrated Microfluidic Platform for Oral Diagnostics (IMPOD) Ofnaset Electronic taste chip (ETC) Oraquick	Perio-check Prognos-stick Periogard TM Pocket watch TM Dip stick test Biolise
Microbiological tests	Culture methods Omnigene My PerioPath	BANA (N-Benzoyl DL-Arginine 2- Napthylamide) test Evalusite Perioscan Toxicity Pre-screening Assay (TOPAS) Institute for Applied Immunology (IAI) Pado test
Genetic tests	My Perio id Periodontal Susceptibility Test (PST	
Molecular biology tests	Polymerase Chain Reactions (PCR) Checkerboard DNA-DNA Hybridistion Terminal Restriction Fragment Length Polymorphism (T-RFLP) Fluorescent In-Situ Hybridisation (FISH) Pyrosequencing Supported Oligonucleode Ligation and Detection (SOLiD)	

Figures

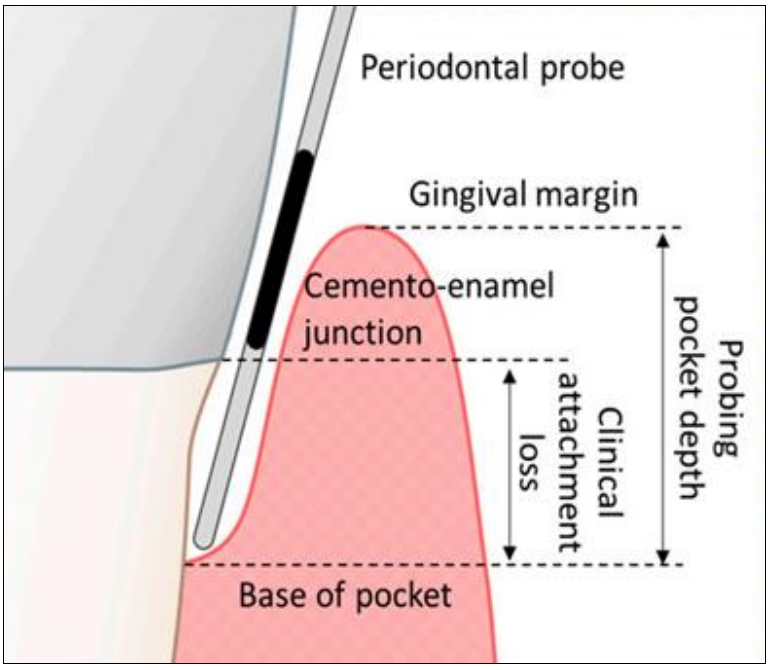

Fig 1: Schematic presentation of the measurement of pocket depth between tooth and gingiva using periodontal probe

Conclusion

Chairside diagnostic aids have become essential tools in the field of periodontology, providing doctors with crucial information on disease diagnosis, progression, and treatment response. By utilizing the improvements, medical professionals can further enhance early identification, diagnosis, and treatment of periodontal disorders, ultimately leading to improved dental health results for patients across the globe.

Conflict of Interest

Not available

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Not available

References

1. Nazir M, Al-Ansari A, Al-Khalifa K, Alhareky M, Gaffar B, Almas K. Global prevalence of periodontal disease and lack of its surveillance. Sci. World J.

2020;2020:2146160.
2. Ramenzoni LL, Lehner MP, Kaufmann ME, Wiedemeier D, Attin T, Schmidlin PR. Oral diagnostic methods for the detection of periodontal disease. Diagnostics. 2021 Mar 22;11:571.
3. Gul SS, Abdulkareem AA, Sha AM, Rawlinson A. Diagnostic accuracy of oral fluids biomarker profile to determine the current and future status of periodontal and peri-implant diseases. Diagnostics. 2020;10:838.
4. Nomura Y, Morozumi T, Nakagawa T, Sugaya T, Kawanami M, Suzuki F, *et al*. Site-level progression of periodontal disease during a follow-up period. PLoS One. 2017;12:e0188670.
5. Steigmann L, Maekawa S, Sima C, Travan S, Wang CW, Giannobile WV. Biosensor and lab-on-a-chip biomarker-identifying technologies for oral and periodontal diseases. Front. Pharmacol. 2020;11:588480.
6. Ghallab NA. Diagnostic potential and future directions of biomarkers in gingival crevicular fluid and saliva of periodontal diseases: Review of the current evidence. Arch. Oral Biol.. 2018;87:115-24.
7. Ramachandra SS, Mehta DS, Sandesh NM, Vidya Baliga M, Amarnath JM. Periodontal probing systems: A review of available equipment. Periodontics. 2009;3:16.
8. Williams CH. Some newer periodontal findings of practical importance to the general practitioner. J Can Dent Assoc. 1936;2:333-40.
9. Hefti AF, Preshaw PM. Examiner alignment and assessment in clinical periodontal research. Periodontol 2000. 2012;59:41-60.
10. Birek P, McCufloch CA, Hardy V. Gingival attachment level measurements with an automated periodontal probe. J. Clin. Periodontol. 1987;14:472-7.
11. Polson AM, Caton JG, Yeaple RN, Zander HA. Histological determination of probe tip penetration into gingival sulcus of humans using an electronic pressure-sensitive probe J. Clin. Periodontol. 1980;7:479-88.
12. Jeffcoat MK, Jeffcoat RL, Jens SC, Captain K. A new periodontal probe with automated cemento-enamel junction detection. J. Clin. Periodontol. 1986;13:276-80.
13. Watts TL. Assessing periodontal health and disease. Periodontics in Practice: Science With Humanity. 2000:33-40.
14. Hinders M, Companion J. Ultrasonic probe for periodontal disease. Rev. Progr. Quantitative NDE. 1999;18:1609-15.
15. Kasaj A, Moschos I, Röhrig B, Willershausen B. The effectiveness of a novel optical probe in subgingival calculus detection. Int. J. Dent. Hyg. 2008;6:143-147.
16. Archana V. Calculus detection technologies: Where do we stand now?. JML. 2014;7(Spec Iss 2):18.
17. Sculean A, Schwarz F, Berakdar M, Romanos GE, Arweiler NB, Becker J. Periodontal treatment with an Er: YAG laser compared to ultrasonic Instrumentation: A pilot study. J. Periodontol. 2004;75:966-73.
18. Zhou H, McCombs GB, Darby ML, Marinak K. Sulphur by-product: the relationship between volatile sulphur compounds and dental plaque-induced gingivitis. J Contemp Dent Pract. 2004;5:27-39.
19. Kung RT, Ochs B, Goodson JM. Temperature as a periodontal diagnostic. J. Clin. Periodontol. 1990;17:557-63.
20. Haffajee AD, Socransky SS, Goodson JM. Subgingival temperature (I). Relation to baseline clinical parameters. J. Clin. Periodontol. 1992;19:401-8.
21. Machado V, Proença L, Morgado M, Mendes JJ, Botelho J. Accuracy of panoramic radiograph for diagnosing periodontitis comparing to clinical examination J. Clin. Med. 2020;9:2313.
22. Corbet EF, Ho DK, Lai SM. Radiographs in periodontal disease diagnosis and management. Aust. Dent. J. 2009;54:S27-43.
23. McCann D, Fisch S. Dental technology: knocking at high-tech's door. JADA 1989;118:285-8.
24. Brägger U, Pasquali L, Weber H, Kornman KS. Computer-assisted densitometric image analysis (CADIA) for the assessment of alveolar bone density changes in furcations. J. Clin. Periodontol. 1989;16:46-52.
25. Khalid I, Kumar DS Y, Rao S. Use of Computer-Assisted Densitometric Image Analysis (CADIA) in Assessing Bone Density Changes in Extraction Socket. Indian J. Stomatol. 2011;2(3).
26. Fuhrmann RA, Bücker A, Diedrich PR. Assessment of alveolar bone loss with high resolution computed tomography. J. Periodontal Res. 1995;30:258-63.
27. Suomalainen A, Kiljunen T, Kaser Y, Peltola J, Kortesniemi M. Dosimetry and image quality of four dental cone beam computed tomography scanners compared with multislice computed tomography scanners. DMFR. 2009;38:367-78.
28. Vandenberghe B, Jacobs R, Bosmans H. Modern dental imaging: a review of the current technology and clinical applications in dental practice. European radiology. 2010;20:2637-55.
29. Nair MK, Seyedain A, Agarwal S, Webber RL, Nair UP, Piesco NP, Mooney MP, Grondahl HG. Tuned aperture computed tomography to evaluate osseous healing. J. Dent. Res. 2001;80:1621-4.
30. Tyndall DA, Kohltfarber H. Application of cone beam volumetric tomography in endodontics. Aust. Dent. J. 2012;57:72-81.
31. Cann CE. Quantitative CT for determination of bone mineral density: A review. Radiology. 1988;166:509-22.
32. Irie MS, Rabelo GD, Spin-Neto R, Dechichi P, Borges JS, Soares PB. Use of micro-computed tomography for bone evaluation in dentistry. Braz. Dent. J. 2018;29:227-38.
33. Assaf AT, Zrnc TA, Remus CC, Schönfeld M, Habermann CR, Riecke B, *et al*. Evaluation of four different optimized magnetic-resonance-imaging sequences for visualization of dental and maxillo-mandibular structures at 3 T. J. Craniomaxillofac. Surg. 2014;42(7):1356-63.
34. Prager M, Heiland S, Gareis D, Hilgenfeld T, Bendszus M, Gaudino C. Dental MRI using a dedicated RF-coil at 3 Tesla. J. Craniomaxillofac. Surg. 2015;43:2175-2182.
35. Ting-shu S, Jian S. Intraoral digital impression technique: A review. Journal of Prosthodontics. 2015;24:313-21.
36. Icen M, Orhan K, Şeker Ç, Geduk G, Özlü CF, Cengiz Mİ. Comparison of CBCT with different voxel sizes and intraoral scanner for detection of periodontal defects: an in vitro study. Dentomaxillofacial Radiology. 2020;49:20190197.
37. Townsend D, D'Aiuto F. Periodontal capillary imaging in vivo by endoscopic capillaroscopy. J Med Biol Eng. 2010;30:119-23.

38. Persson RG, Alves ME, Chambers DA, Clark WB, Cohen R, Crawford JM, *et al*. A multicenter clinical trial of PerioGard™ in distinguishing between diseased and healthy periodontal sites: (I). Study design, methodology and therapeutic outcome. J. Clin. Periodontol. 1995;22:794-803.
39. Herr AE, Hatch AV, Giannobile WV, Throckmorton DJ, Tran HM, Brennan JS, Singh AK. Integrated microfluidic platform for oral diagnostics. Ann. N. Y. Acad. Sci. 2007;1098:362-374.
40. Herrmann JM, Gonzáles JR, Boedeker RH, Vonholdt J, Meyle J. Microassay for the detection of elastase activity in the gingival crevice. J. Clin. Periodontol. 2001 Jan;28:31-37.
41. Srivastava N, Nayak PA, Rana S. Point of care-a novel approach to periodontal diagnosis-a review. J. Clin. Diagn. Res. 2017;11:ZE01.
42. Ko TJ, Byrd KM, Kim SA. The chairside periodontal diagnostic toolkit: Past, present, and future. Diagnostics. 2021;11:932.
43. Srivastava N, Nayak PA, Rana S. Point of care-a novel approach to periodontal diagnosis-a review. J. Clin. Diagn. Res. 2017;11:ZE01.
44. Pucau CG, Dumitriu A, Dumitriu HT. Biochemical and enzymatic diagnosis aids in periodontal disease. OHDMBSC. 2005;4:19-25.
45. Priyanka N, Kalra N, Shanbhag N, Kumar K, Seema Brijet B, Avani PR. Recent approaches in saliva as a credible periodontal diagnostic and prognostic marker. AOSR. 2012;2:40-6.
46. Maheaswari R, Kshirsagar JT, Lavanya N. Polymerase chain reaction: A molecular diagnostic tool in periodontology. J. Indian Soc. Periodontol. 2016;20:128-35.
47. Savitt ED, Keville MW, Peros WJ. DNA probes in the diagnosis of periodontal microorganisms. Arch. Oral Biol. 1990;35:S153-9.
48. Ivaturi MS, Bhat AR, Potdar RS. Advanced Chairside Diagnostic Aids for Periodontal Diagnosis-A Review. JCRD 2021;15(9).
49. Steigmann L, Maekawa S, Sima C, Travan S, Wang CW, Giannobile WV. Biosensor and Lab-on-a-chip Biomarker-identifying Technologies for Oral and Periodontal Diseases. Front. Pharmacol. 2020;11:588480.
50. Climent HM, García SR, Santos JR, Ruiz RMM, Palacin FA, Calvo LP, *et al*. Assessment of Osstell ISQ's reliability for implant stability measurement: A cross-sectional clinical study. Medicina oral, patologia oral y cirugia bucal. 2013;18:e877.

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