calculus has significant scattering characteristics and can be distinguished from enamel [8].

Magnetic Resonance Imaging (MRI): A research comprising 25 individuals with dental implants found that MAVRIC [9]. (Multi Acquisition Variable-Resonance Image Combination) minimized the defects from dental implants (one of the primary concerns about using MRI in the oral cavity).

Other imaging techniques

- Ultrasound Imaging: This imaging technique has been demonstrated to be extremely accurate and reproducible for periodontal assessment [10]. For the identification of subgingival calculus, many ultrasound-based methods have been developed, like, Detectar, Keylaser II, and Dental Endoscope.
- Photoacoustic Imaging technique: Such an imaging approach combines visible as well as near-infrared emission along with acoustic sensing, and its applicability has been proven in detecting the depth of periodontal pockets [11].

Diagnosis *via* microbial analysis

It was revealed that microbial profiling of the important organisms in periodontal disorders aided in the clinical decision making approach on the supplementary use of systemic antimicrobial drugs [12].

Common microbiological analysis methods are as follows:

- Microscopic assay
- Enzyme-based assay
- Immunologic assay
    - Direct immunofluorescence
    - Indirect immunofluorescence
- Culture assays
- DNA probe assay

Periodontal therapy

Periodontal treatment is comprised of a variety of non-surgical and surgical techniques. Non-surgical therapy is primarily aimed at removing plaque along with its plaque-retentive characteristics (calculus, overhanging restoration margin, and so on) by scaling and root planning, and is always accompanied with oral hygiene recommendations.

When there are deep persistent periodontal pockets despite adequate plaque management, surgical treatment is recommended. Curettage, gingivo plasty, gingivectomy, muco-gingival operations, methods for lengthening of crown, root resection surgeries, plus periodontal reconstructive techniques are some of the other surgical treatments used to address natural and pathological periodontal anomalies. Different surgical periodontology techniques (traditional scalpel and laser operations, cryosurgery, electro cauterization, piezo surgeries) offer a variety of therapeutic choices for a variety of problems.

Scope of periodontics

Periodontics scope of practice expands significantly into other dental specialties.

Periodontics-orthodontics

The importance of orthodontic therapy in periodontics can always be overstated since the periodontal ligament, a fundamental component of the periodontium, which serves as the medium for orthodontic tooth movement. In patients with impaired periodontal health, great attention must be taken to assure that orthodontic therapy is being performed in periodontal tissues that are not inflamed. Another intriguing crossover between the concepts of these two specialties is “Periodontal Accelerated Osteogenic Orthodontics” which accelerates orthodontic movement of the tooth by combining selective alveolar cortectomy plus particulate bone grafting alongside orthodontic-therapy [13]. Orthodontic anchoring is frequently achieved with transient anchorage devices or mini-implants.

The most significant factor in treating hyperplasia in patients receiving orthodontic treatment is teamwork between the periodontist and the orthodontist. Before and throughout orthodontic treatment, clinicians must be capable of assessing patients' oral hygiene abilities. Periodic periodontal maintenance and care throughout orthodontic treatment would very certainly prevent such complications but also maintain gingival health [14].

Periodontics-prosthodontics

Any prosthodontic treatment's effectiveness is determined on the periodontium's robust foundation and periodontal-friendly restoration designs.

Periodontics-oral surgery

This multidisciplinary interface is made up of a variety of surgical treatments such as frenotomy, frenotomy, ridge augmentation operations, and so on. There seems to be solid evidence that there is considerable frequency of periodontal damage in the site of segmental osteotomy undergoing orthognathic procedures [15]. Orthognathic procedures have been shown to have a significant impact on the progression of gingival recessions [16].

Periodontics-restorative dentistry

The margins location, restorative shapes and contact, embrasure form, and restoration polishing must all be considered when designing a restoration to ensure periodontal health.

Periodontics-endodontics

Through the apical foramen, lateral canals, auxiliary canals, and dentinal tubules, the periodontium and endodontium share a close association. Such a natural continuity in anatomy also predisposes to a pathological continuity.

Periodontics-forensics

The interaction between these departments is appreciated all through age estimation utilizing Tooth Cementum Annulations (TCAs) and amino acid racemization (sample retrieved from gingiva because it is the most easily available), gingival epithelium assessment, and implant identification using implants (that withstand high temperature due to titanium's high melting temperature) plus implant recognition system [17].

Periodontology and geriatrics

In the aged, age-related alterations may be noticed in every tissue of the periodontium (narrowing of the epithelium, decreased keratinization, flattening of rete pegs in gingiva; rise in the fibrous component of connective tissue; increase in the thickness of cementum; bone resorption). The treatment procedure for this group of patients must take into account any other systemic and psychiatric disorders, resistance and regeneration capacity, and the condition of the host immunological response.

DISCUSSION

According to an article by, there is now a demographic shift in which the number of elderly adults (>65 years) has overtaken the number of young persons (5 years), and the number of people aged 65 and older will reach 1.5 billion by 2050 [18]. As a result, dental professionals must enhance their understanding required to care for the elderly population, as this will become an important part of the dental profession's future.

Periodontal medicine

Periodontics has its implications in a variety of systemic diseases. Periodontal disease has been linked to repercussions in cardiology (Porphyromonas gingivitis releases the enzyme gingipain [19]. which is linked to platelet activation *via* the thrombin receptor, resulting in platelet aggregation), pulmonology (respiratory microbes may attach to too much plaque in patients with periodontitis and serve as a source of infection to inferior segment of respiratory tracts) [20]. Pregnancy (preeclampsia is connected to periodontitis and is a possible worry) [21]. Stroke and osteoporosis have all been linked to dental plaque as a large reservoir for germs that cause hospital-acquired pneumonia in institutionalized old people [22]. Periopathogens are known for their ability to cause bacteraemia and, as a result, localized infections [20]. As a result, periodontology should be considered an important aspect of preventive medicine.

Tissue engineering

Tissue engineering, which is based on three techniques, has gained prominence in periodontics due to its ability to regenerate periodontal tissue:

- Protein (proteins that regulate growth, differentiation, or maturation)
- Cellular (Mesenchymal stem cells are used) and
- Techniques based on gene therapy [23].

In periodontics, gene therapy has shown to be a promising treatment option. The introduction of the gene vector can be *in vivo* (here it is given directly to the target region) or *ex vivo*, depending on the approach (the target cells are collected, gene vectors are synthesized, and the cells are implanted at the target spot).

Host modulation

As a periodontal treatment, host modulation is becoming more popular. Various therapeutic treatments are utilized to suppress pro-inflammatory mediators' biologic action in the host.

Bio photonics

'Bio photonics' is a famous field among modern periodontology researchers. It is concerned with the area where photonics and biological sciences collide.

Photo Dynamic Treatment (PDT) is such an application that has demonstrated to increase outcomes when done in conjunction with SRP. Oxygen, photosensitizer, plus light are the three components of photodynamic treatment. The photosensitizer in its triplet condition, which develops after being excited by light, has two distinct methods of interacting with biomolecules- Type I and Type II [24].

Type I: Direct transfer of electron or hydrogen

Type II: Dioxygen generation

Microbes, filamentous fungi, and protozoa have all been proven to be susceptible to "photodynamic anti-microbial chemotherapy" (even drug-resistant variants) [25].

Micro-dentistry

In the domain of periodontology, micro-dentistry techniques led to the development of a periodontal endoscopy “The Perio-Scope” using fibre-optic technology for illuminating, magnifying, and visual recording of sub-gingival structures and tissues [26]. It provides for the utmost effective instrumentation while still assuring complete debridement. Endoscopic capillaroscopy devices have been created for visualizing periodontal-pocket and gingival crevices micro-vasculature employing comparable technologies [27]. This assists in the comprehension of the disease process at the moment, but it may turn out to be a useful diagnostic tool in the future.

Genomics, proteomics and nanotechnology

The future of periodontics appears to be bright, thanks to genomes, bioinformatics, as well as nanotechnology. Nutrigenomics is a rapidly developing scientific field that is thought to have consequences in the progression of periodontal diseases. Epigenetic changes in genes that

regulate nutrition (such as DNA methylation, histone alterations, and chromatin restructuring) might raise the risk of micronutrient illnesses including obesity and type 2 Diabetes Mellitus, both of which have a predilection for periodontal symptoms [28]. Proteomics is the science of genes and proteins and their functioning, which is now a promising research topic in periodontics. Parotid secretory protein plus hapto globin possess the ability to be used as indicators for identification and surveillance of periodontitis.

Periodontal disease biomarkers are divided into four categories:

- proteomic
- genetic
- microbial
- Other [29].

When utilized in periodontology, proteomics and genomics, as well as salivary diagnostics, hold a lot of promise because they can uncover biomarkers for diagnostic and disease intervention targets. With the advancement of nanotechnology, new areas of periodontology research have become available. In the domain of controlled drug delivery, nanomaterial such as nanotube, hollow sphere, and core shell architectures are gaining traction. The emulsification-diffusion technique [30] was used to test triclosan-loaded nanoparticles, and the results were positive. The goal of periodontal tissue regeneration using nanotechnology is to regenerate the lost structure utilising tissue engineering and materials known as "Nano scaffolds," which influence physiological as well as biological processes to increase the objective's performance [31]. Scaffold systems for periodontal tissue regeneration treatments have also been developed at the Nano scale.

Dermatoglyphics in Periodontics: It is seen that in patients with persistent periodontitis, fingerprints showed more whorls and fewer arch in both the right hand and left hand [32]. Dermatoglyphics has the potential to be a valuable tool for the prevention and diagnosis of oral disorders that are influenced genetically, either directly or indirectly.

Probiotics

Probiotics are a type of bacterial replacement treatment that has been shown to be useful in eradicating harmful germs from the mouth [33]. The ability of a bacterium to attach to and colonise diverse surfaces of the oral cavity is a need for it to operate as a probiotic for oral health benefits. Probiotics are beneficial because they have been shown to lower the pH of the oral cavity and have an antioxidant effect that prevents plaque and calculus accumulation. After being activated by Probiotics, dendritic cells induce the production of Th_1 (T-helper cell 1: for internal infections) and Th_2 (T-helper cell 2: for external infections). Through “toll-like receptors,” probiotics boost immunity [34].

Periodontal vaccine

After realizing the potential uses of periodontal vaccination, a promising research route has opened up. Periodontitis is linked to systemic complications such as atherosclerosis, diabetes, respiratory illnesses, premature low-weight delivery, rheumatoid arthritis, and more. As a result, the need to develop novel preventative strategies is pressing.

Stem cell therapy

The stem cells of periodontal ligament are found in the periodontal ligament’s peri-vascular zone and thus are thought as to represent a sub-population of the mesenchymal pluripotent stem cells which appear like pericytes [35]. PDLSCs are used to stimulate periodontal regeneration [36]. Despite the fact that there are still gaps in making periodontal regeneration using stem cells a therapeutic option, convincing evidence for its potential applications is driving a substantial portion of research on the subject.

Extracorporeal shock wave therapy

Extracorporeal Shock Wave Therapy was introduced into dentistry as a consequence of research into new and improved treatment techniques. ESWT employs shock waves of a specific energy to induce a brief pressure disruption in the targeted tissue, which causes a reaction. ESWT has the ability for bone tissue regeneration, quick periodontal recovery, anti-inflammatory qualities, and other benefits and it may be used in periodontal therapy with the right adjustments [37].

Artificial intelligence

AI is a branch of science and engineering dealing with the computational understanding of what's been generally referred to as intelligent behaviour, as well as the designing of things that display such behaviour [38]. Despite the fact that it is still in its infancy, considerable research is being performed on using Artificial Intelligence into dentistry. Software is now being designed that combines more detailed CBCT scans with computer science to identify even the tiniest irregularities and suggest a suitable treatment plan based on a number of prior scans. Such technology can be beneficial in that the patient understands the nature of their condition just few moments following the scan and has a promising therapeutic strategy in mind, making the job of dentist easier. Artificial intelligence might be used in implantology to automatically determine the best implant locations as well as angulations for each patient. By assisting in the initial identification of periodontal alterations, furcation engagement, bone resorption, and grading bone mass, deep learning AI is employed in the early diagnosis, diagnosis, and treatment planning of periodontal illnesses utilising intraoral radiographs. Patients may now estimate the degree of plaque in their buccal cavity on their mobile phone with the use of an electronic toothbrush [39].

CONCLUSION

In the last decade, periodontology has rapidly spread into a variety of scientific domains, and future trends will include topics such as:

- Stem cell biology
- Nanotechnology
- Biophonotics
- Periodontal Vaccines

Technologies have aided physicians and researchers in assimilating information from many fields. One such day is not far off, technology will completely alter dentistry, and we will be accustomed to error-free clinical procedures with more precision and improved patient care. Though technology will never be able to replace a dentist's judgment, it will undoubtedly assist the dentist in making decisions.

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