Editorial

We are facing a global health crisis unlike any the world has seen in many decades; Covid 19 which has been characterized as a pandemic by the WHO.Covid-19 outbreak has affected all segments of population including dentists.

The dental professionals are directly exposed to the risk of contracting the disease as most of the procedures produce aerosols. This has caused undue apprehension among dental health professionals. Due to lockdown, the dental operatories are closed to prevent the spread of this virus.

Coping up with the changes this pandemic has brought in all walks of life does not seem to be easy. We should realize that the impact is going to last for quite a long time. Rather than trying to overcome this situation, we should try to adapt with the changed scenario. We should exercise utmost care and caution while dealing with the patients in order to prevent the spread of infection.

Our college has been closed since 20th March and all of us are staying at home. We have started conducting online classes well before getting the directions from KUHS. The College union has organized an Online Arts festival, DHWANI-2020; the first of its kind, and -a lockdown innovation, which is indeed a commendable effort of 'Renoviantz'. Their creativity and enthusiasm is well appreciated. I am happy that these are sparks of good hope during hard times.

Let us hope that this too shall pass. We should resume back to normal in a short while, by abiding to the norms and guidelines provided the government and ministry of health.

Dr Manoj Kumar KP
Chief Editor

KMCT DENTAL COLLEGE

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PERCEIVED SOURCES OF STRESS AMONGST DENTAL STUDENTS IN DENTAL COLLEGE: A CROSS SECTIONAL STUDY

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Abstract

Background: Stress is believed to cause detrimental effects on academic performance of students. Identification of the sources of stress is important in dental education program, as it gives opportunity to takevarious measures to prevent stress in the dental school environment. The rationale of the present study was to identify the various sources ofstress among dental school students in a private dental institution in Kerala, India. **Materials and Methods:** A questionnaire based crosssectional study was conducted among final year students and interns of the dental college. Questionnaire used in the study comprised themodified version of Dental Environmental Stressquestionnaire. A four pointlikert scale was used to record the responsesfrom the subjects. A total of 150 subjects participated in the study. Statistical analysis was done using SPSS package version 20.**Results:** Among the participants, 24.6% (37) were males and 75.4% (113) were females. Major stress factor was academic related (p=0.04), lack of confidence in clinical decision making (p=0.006) and insecurity regarding dental career (p=0.03). Mean stress scores were high for academic related 3.5±1.0, followed by career related 2.9±1.0 questions. **Conclusion:** It is evident that dental studentsencounter high levels of stress. Present study identified that the major stressors were academic related and career relatedrather than personal issues. Our study also focuses the importance of stress management programs to minimize the impact of stress on both academic and personal lives of the students.

Key Words: Dental students, stress, academic, interns

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Introduction

The term stress describes external demands (physical or mental) on an individual's physical and psychological well-being. It is normal for everybody to experience stress to some extent, but too much stress may be harmful. Attending a school, college or university is a rewarding experience but it is also a time of considerable anxiety and stress for students. Students are subjected to different kinds of experiences which makes them vulnerable to undergo a lot of stress.[1]

Stress in dental students may be multi-factorial, arising from both the academic and socio-cultural environment, and attributable to social support issues

(emotional and financial).[2] There is some evidence that interpersonal factors more importantly the continuous scrutiny of staffs and excessive demands on performance made by the faculty in the dental school is highly stressful for students.[3] There is a dearth of work regarding stress sources in Indian undergraduate dental students. Hence, this study was aimed to determine the potential sources of stress in undergraduate dental students. This knowledge could be used to institute requisite institutional changes, and encourage the healthy active strategies to combat stress and improve academic performance and psychological well-being of dental students. The aim of this study is to assess the factors associated with stress in dental students in a dental college.

Materials & Methods

An institution based cross-sectional study was conducted among final year students and interns of KMCT Dental College in Kozhikode, Kerala. Ethical clearance for conducting the study was obtained from the Institutional Ethics Committee. Informed consent was obtained from every subject prior to the start of the study.

The proforma was pilot tested on 10% of the population randomly selected. Study was done for a period of 2 months. Study population consisted of 4th (final year) and house surgeons of the dental college. A sample of 150 students were included in the study and participation in the study was voluntary.

Inclusion criteria: All the students from final year and Internship.

Exclusion criteria: Students not willing to participate, students absent during the day of study.

Sample size was calculate using the formula; total of 150 subjects will be selected.

$$N = \frac{Z^2_{\alpha/2} \times p \times (1- p) \times D}{E^2}$$

A self-administered questionnaire was distributed to the students in their classes prior to lectures. An opportunity to ask questions were provided and clarifications were made. Questionnaire used in the present study comprised the modified version of the questionnaire used in Dental Environmental Stress (DES) survey, which was validated and translated to suit the Indian dental environment. The responses to the items were based on a four-point Likert scale with response options of 1 = not stressful, 2 = slightly stressful, 3 = moderately stressful and 4 = very stressful.

Statistical analysis

The data will be analyzed using SPSS version 20. Descriptive statistics will be computed for all the independent and dependent variables. All the continuous variables will be subjected to test for normality and further independent t test will be performed. Level of significance kept at, $p<0.05$.

Results

A total of 150 subjects participated in the present study, 66.7% from final year and 33.3% were house surgeons (Table 1). The

Table 1: Distribution based on year of study

Year of study	N	%
Final year	100	66.7
House surgeon	50	33.3

Table 2: Distribution of various stresses among dental students (mean score)

Academics performance	Mean	SD
Amount of assigned work	1.8	0.9
Competition with peers for grades /marks	2.7	1.0
Lack of time to do assigned work	2.2	1.0
Inapproachability of the teaching staff	3.5	1.0
Fear of failing a course or the year	2.4	0.9
Clinic/patient related stress		
Patient being late/not showing	1.3	0.9
Patient cooperation/compliance	2.3	1.0
Lack of confidence in making clinical decisions	2.9	0.9
Completion of clinical cases/quota	2.4	1.0
Personal issues related to stress		
Difficulty in making friends	1.4	1.0
Relation with opposite sex	2.1	0.8
Financial constraints	1.9	0.9
Health problems	1.3	0.9
Drinking/drug dependency	1.6	0.6
Professional/career related stress		
Insecurity concerning dental career	2.9	0.9
Unemployment fear	2.7	0.8
Possibility to pursue post graduation or Clinic Set Up	2.5	1.2
Lack of confidence in career decision	2.5	1.0

students were in the age group of 18–23 years, with mean age group 20.49. Among the 150 students, 24% (36) were males and 76% (114) were females. Female students were more when compared to the male students in both the years.

Table 2 shows that among academic stressors the inapproachability of the teaching staff was considered as highest stress factor with a mean score of 3.5±1.0, followed by competition from peers (2.7±1.0). Lack of confidence in making clinical decisions was considered stressful (2.9±0.9) inside the clinics when working on a patient. Among the personal issues it was found that relation with opposite sex was causing high stress (2.1±0.8) in students. Major stress factor in career related issues was the insecurity concerning the dental career (2.9±0.7).

Table 3: Comparison of major stressors between both years

Major stressors	Final year Mean±SD	House surgeon Mean±SD	P value
Academics performance (Inapproachability of the teaching staff	2.30±1.03	1.94±0.97	0.04*
Clinic/patient related stress Lack of confidence in making clinical decisions	2.47±1.00	2.02±0.76	0.006*
Personal issues related to stress Relation with opposite sex	1.90±0.13	1.88±0.12	0.94
Professional/career related stress Insecurity concerning dental career	1.59±0.53	2.80±1.13	0.03*

Table 3 depicts that the stress score was significantly higher in final year students in terms of academic performances (p=0.04*) and patient related stress (p=0.006*). Carrier related stress was significantly higher in house surgeons when compared to final year students (p=0.03*). It was found that personal issues related stress was almost same in both the groups and showed no differences.

Discussion

Among the medical profession dental education is considered to be very stressful for students. The findings are consistent across different countries, universities, and curriculums.[3.5] Dental training includes clinical postings in various departments, completion of specified number of patient procedures called as "quotas", attending lectures, seminars, preclinical works and studying for examinations add 'to the overall stress.

This may be because the students may feel humiliated when staffs don't approve their work which they expect to do irrespective

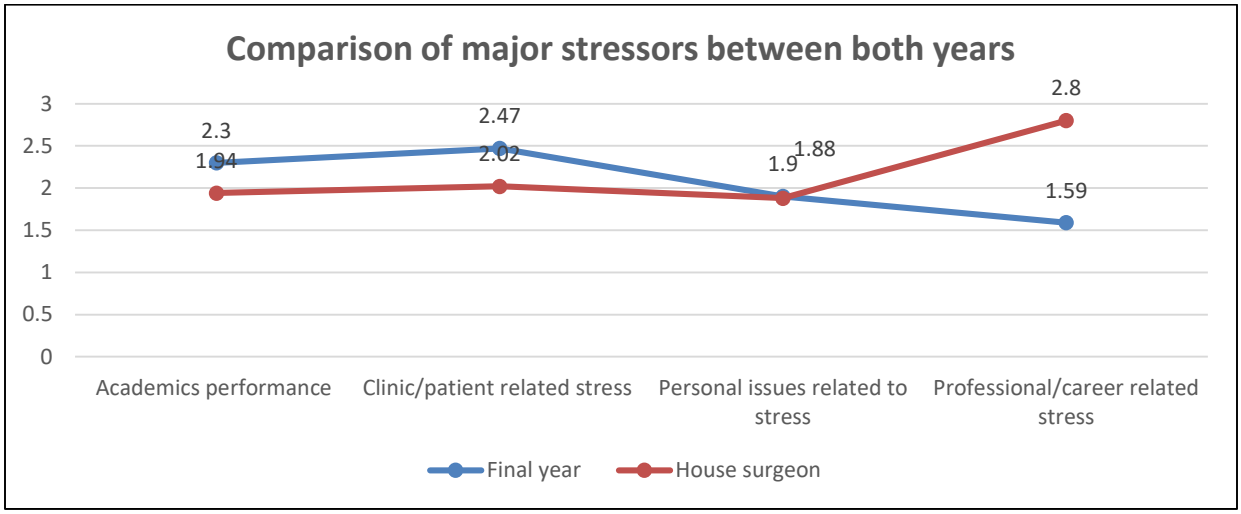

Figure 1: Comparision of major stressors between both years

of the nature of work, also when staff criticise them for their work. Unlike the other profession where the sole dependency on textbooks can cater students need in terms of knowledge but in clinics when it comes to treating a patient proper guidance from an experienced staff is mandatory to learn the skills.

During the clinical posting it's the difficulty in decision making regarding patient selection and treatments which put the students under the stress and also to cope up with the prescribed quotas by each university. Staff insisting to complete the quotas on time was reported to be a major stressor, as every speciality have there on regulation regarding quotas. It also depends on the general out patient in that particular college and also the number of students posted.

No significant difference was found in our studies in terms of student anxiety and stress related to the personal issues. Problems like drug dependency, financial

constraints or relationship issues are not significantly causing any stress in the students. Similar findings were observed in study conducted in Bangalore, India.

Worries regarding the future after BDS is the main concern for stress among the students and this is alarmingly high inhouse surgeons, majority of them are insecure about the future whether to practise dentistry after the course or to do a postgraduation. Unemployment is also one of the major factors for stress among the students but this was in contrary to the study done in Malaysia.[6]

An introspection and reconsideration of the existing curriculum in the dental education system is essential to foster a regime which is more student-centred and help in coping stress amongst students. Accordingto Schwartz et al, the establishment of student advisorsand counsellors within a dental school, combined with afaculty advising system and student-oriented programmes, havecontributed to an improved educational environment.[7]

Conclusion

Our study shows that the prevalence of perceived stress is high among dental students. In the present study it was found that students are worried about their academic performances, they are highly stressed in their clinical postings and academics. Insecurity regarding career was the major source of stress reported by the house surgeons. Students should be taught positive coping strategies and various stress managing techniques to improve the ability to cope with the stress in this demanding profession.

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INVITRO COMPARISON OF WORKING LENGTH DETERMINATION BY FIFTH GENERATION APEX LOCATOR AND BY RADIOGRAPHIC METHOD IN PERMANENT TOOTH

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Abstract

Background: The use of radiography has become a widespread method for determining working length in endodontics, although it is widely recognized that radiography has its own limitations. In order to render the assessment of working length increasingly accurate different electronic apex locators have been developed. The objective of this study is to compare in vitro working length determination by fifth generation apex locator and by radiographic method in permanent tooth. **Methodology:** Ten single rooted human teeth were used for the study. Access cavity was prepared to gain access to the root canal. For each tooth, the reference (or control) length, corresponding to the actual length, was determined, after which all the teeth were measured independently. Working length was measured by radiographic method and also by a fifth generation apex locator. The results were compared with the actual length. **Results:** The results showed 94.12% accuracy in readings of apex locator and 88.2% accuracy with radiographic readings. **Conclusion:** The use of apex locators was superior to the radiographic method.

Key Words: Apical constriction; working length; electronic apex locator.

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Introduction

Determining the correct working length is the main factor that leads to success in root canal treatments. Recent studies have shown that histologic results after endodontic treatment are superior when instrumentation and obturation are limited to the apical narrowing.

Effective disinfection of the root canal consists of complete removal of the necrotic pulp, microorganisms and debris, without affecting the periapical tissues. Therefore, correct measurement of the root canal length is essential.The technique commonly used to determine the working length is the radiographic technique.

However, it is a method that has limitations and disadvantages, since it presents two dimensional images of three-dimensional objects, is sensitive to the technique, and exposes the patient to ionizing radiation. But the main difficulty relates to the inability of radiographic imaging to determine variability in apical anatomy. This may inadvertently result in apical

perforations, over instrumentation, overfilling, postoperative pain, as well as deficient and incomplete instrumentation and obturation. Such events can evidently lead to unsuccessful endodontic therapy. However, this method is widely used because radiography is routinely present in dental surgeries dentist, assisting him in the diagnoses for example.

In 1962, Sunada demonstrated that the electrical resistance between the periodontal ligament and the oral mucosa is a measurable constant. Different generations of electronic devices (apex locators) have been developed to measure root canal length.[1]

Material and Methods

The study was done on 10 single-rooted human anterior teeth without caries, which had been extracted for periodontal reasons. The teeth were kept in 0.2% Chlorhexidine solution until use. Complete examination to discard the existence of root fractures was done and complete apex formation was confirmed in all the cases. Adequate access opening in the crown portion of the teeth were made, so as to have a straight line access to the root canal. The canal was irrigated with 5 ml of 2.5% sodium hypochlorite,[8] after which canal permeability was evaluated using a number 10 K-Flexofile (Mallifer). No obstruction was observed; therefore, all the teeth were included in the study and randomly numbered from 1 to 10.

Before electronically measuring the root canal length, a number 15 K-Flexofile was inserted into each canal, until the tip became visible through the foramen.The file was then withdrawn until a magnifying glass[10] (X 2.5) showed its tip to lie tangential to the apical foramen The silicone stop was adjusted to the level chosen as reference for root canal measurement and an endoblock (Dentsply) was used to measure the distance from the silicone stop to the file]. This measurement was recorded as the reference (or control) length, corresponding to actual length.

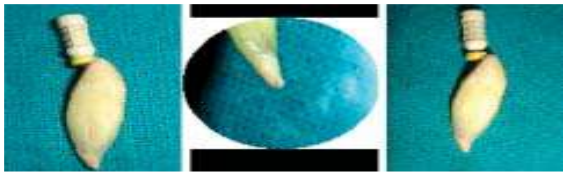

Figure 1:(a) file inserted in the canal (b) file veiwed from apical end with the help of magnifi cation (c) silicon stopper adjusted upto the established working length

An adequate amount of alginate was condensed within the molds, and upon setting, the corresponding tooth was embedded within the alginate, leaving approximately 5 mm of the root surface exposed. The tooth was kept in that position until the alginate had set completely. All measurements were made in intervals of two hours, with the alginate kept sufficiently humid for this period of time. During electronic measurement, the circuit was closed in invitro environment by inserting the labial clip of the corresponding locater into the alginate (in a cut made with the help of B. P. blade while the alginate was setting), stabilizing it with transparent adhesive tape and attaching the file holder to the file. Working length of each samples were determined radiographically.

Table 1: Observations

SAMPLE	REFERANCE	APEX LOCATOR	IOPA
S1	21mm	21mm	22mm
S2	20mm	20mm	20.9mm
S3	22.5mm	23mm	23.5mm
S4	22.5mm	23mm	23.5mm
S5	22mm	22mm	21.5mm
S6	24mm	24mm	24.8mm
S7	25mm	25mm	23.4mm
S8	22.5mm	22.5mm	23mm
S9	24mm	24.5mm	23mm
S10	22mm	22mm	21.9mm

Results

The results showed 94.12% accuracy in readings of apex locator and 88.2% accuracy with radiographic readings (Table 1).

Discussion

Working length determination with apex locators is easier, faster and can be indefinitely repeated without radiation exposure.[2-5]

The use of electronic devices to determine the working length has gained increasing popularity in recent years,[6-9] particularly after the introduction of the latest generation of apex locators, which not only allow measurements in the presence of humidity but also actually requires the presence of solution within the root canal to function properly.[10-12]

Conclusion

Within the limitations of the study it can be concluded that fifth generation apex locator readings are more reliable in working length determination. However a combination of methods can increase the accuracy of working length determination.

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METAGENOMICS IN PERIODONTAL PERSPECTIVE : A REVIEW

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Abstract

Metagenomics is the study of genetic material recovered directly from environmental samples.The oral microbiome, the complex ecosystem of microbes inhabiting the human mouth, harbours several thousands of bacterial types. The proliferation of pathogenic bacteria within the mouth gives rise to periodontitis. Metagenomics using next generation sequencing technologies helps to study the roles of pathogenic species and functions of specific genes in oral disease development. Through the sequencing of the 16S rRNA gene and whole community DNA a glimpse of genetic, metabolic, and ecological changes associated with periodontitis can be provided and thepower of whole-metagenome sequencing approaches incharacterizing the genomes of key players in the oral microbiome,including an unculturable TM7 organism can be demonstrated. In this review hypotheses regarding the role of bacteria and recent metagenomic studies aimed at elucidating bacterialroles in periodontitis will be discussed.

Key Words: metagenomics, oral microbiome, periodontitis

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Introduction

In today's world periodontal diseases and tooth decay are the two most prevaling ailments of the oral cavity and are the prime causes of tooth loss.[1] Presently, periodontitis and dental caries are generally diagnosed at late stages of disease, often leading to expensive and invasive dental treatment. Therefore, new diagnostic approaches capable of identifying periodontitis and dental caries at preclinical stages, favoring preventive treatment strategies, have become a requisite in the dental field.

The oral cavity harbors a diverse microbiota comprising more than 700-19,000 species/phylotypes unique bacterial species/phylotypes.[2,3] The microbiota plays a pivotal role in maintenance of oral homeostasis, as various oral habitats are colonized by characteristic bacterial community profiles organized in local biofilms. However, ecological changes, for example in relation to increased sugar intake, poor oral hygiene or alterations in the immune response can induce structural and functional alterations of local oral biofilms. Such alterations may in turn change the relation between the host and the resident microbiota from symbiosis to dysbiosis, thereby boosting the initiation and progression of periodontitis.[3]

As development of DNA sequencing technologies have progressed, metagenomics has become a popular

approach to microbial analysis. Metagenomics is a DNA sequencing approach in which a large amount of genomic DNA is randomly sheared and shotgun sequenced. Several recent studies have used a metagenomic approach to examine microbial roles in oral diseases.[4]

In this review we discuss hypotheses regarding the role of bacteria and recent metagenomic studies aimed at elucidating bacterial roles in oral diseases.

Metagenomics for studying oral microorganisms

Current evidence suggests that the human is a "super-organism". More than 1013 individual microorganisms co-exist with the 1012 cells in the human body.[5] This collective microorganisms makes up the human microbiome. Oral microbiota represents a major human microbiome that affects human health because it affects the microbiota at other sites, for example, those of the respiratory and gastrointestinal tracts. in the past two decades several molecular biological techniques have been applied to identify and classify uncultivable oral microbial species; such as:

- Restriction Fragment Length Polymorphism (RFLP),[6]
- Random Amplified Polymorphic DNA fingerprinting (RPAD),[7]
- Denaturing Gradient Gel Electrophoresis (DGGE),[8]
- Quantitative Real-time Polymerase Chain Reaction (qPCR),[9]
- Microarray Chip,[10] and
- Checkerboard Hybridization[11] and others.

Recently, the next generation sequence technologies (NGS) allow the analysis of a large number of microorganisms in different niches without bacterial culture.

NGS technologies have dramatically increased sequencing capabilities.[11] These NGS technologies have been applied in studies of the human microbiome including studies of the oral microbiome.

Two basic DNA sequencing approaches have been commonly applied to study uncultivated oral microbial communities—16S rRNA sequence analysis and metagenomics.[11]

Community and gene composition of human dental plaque obtained through metagenomic sequencing

Xie .G et.al 3reported a metagenomic analysis of a healthy human plaque sample using a combination of second-generation sequencing platforms. A total of 860 million base pairs of non-human sequences were generated. Various analysis tools revealed the presence of 12 well characterized phyla, members of the TM-7 and BRC1 clade, and sequences that could not be classified. Both pathogens and opportunistic pathogens were identified, supporting the ecological plaque hypothesis for oral diseases. Mapping the metagenomic reads to sequenced reference genomes demonstrated that 4% of the reads could be assigned to the sequenced species. Preliminary annotation identified genes belonging to all known functional categories. Interestingly, although 73% of the total assembled contig sequences were predicted to code for proteins, only 51% of them could be assigned a functional role. 2.8% of the total predicted genes coded for proteins involved in resistance to antibiotics

and toxic compounds, suggesting that the oral cavity is an important reservoir for antimicrobial resistance.

Signatures of Periodontal Disease Revealed through metagenomics

Through the sequencing of the 16S rRNA gene and of whole community a glimpse at the global genetic, metabolic, and ecological changes associated with periodontitis in 15 subgingival plaque samples, four from each of two periodontitis patients, and the remaining samples from three healthy individuals were obtained. The power of whole-metagenome sequencing approaches in characterizing the genomes of key players in the oral microbiome, including an unculturable TM7 organism were also demonstrated. the disease microbiome to be enriched in virulence factors, and adapted to a parasitic lifestyle that takes advantage of the disrupted host homeostasis were also revealed. Furthermore, diseased samples share a common structure that was not found in completely healthy samples, suggesting that the disease state may occupy a narrow region within the space of possible configurations of the oral microbiome.[12] The pilot study by Bo Liu[12] et.al demonstrated the power of high-throughput sequencing as a tool for understanding the role of the oral microbiome in periodontal disease.

Metagenomic sequencing reveals microbiota and its functional potential associated with periodontal disease

In a study, the sequencing of 16 metagenomic samples collected from dental swabs and plaques representing four periodontal states were reported. Insights into the microbial community structure and the metabolic variation associated with periodontal health and disease were obtained. It was observed that there is a strong correlation between community structure and disease status. A number of functional genes and metabolic pathways including bacterial chemotaxis and glycan biosynthesis were over-represented in the microbiomes of periodontal disease. A significant amount of novel species and genes were identified in the metagenomic assemblies. The study enriches the understanding of the oral microbiome and sheds light on the contribution of microorganisms to the formation and succession of dental plaques and oral diseases.[13]

Metagenomic analysis of saliva reveals disease-associated microbiota in patients with periodontitis

The hypothesis that salivary microbial presence and activity could be an indicator of the oral health status was tested. Stimulated saliva samples were collected from 10 periodontitis patients and 10 healthy individuals. Salivary microbiota was characterized using metagenomics in order to compare community composition and the gene expression between the groups. A significant disease-associated higher relative abundance of traditional periodontal pathogens such as Porphyromonas gingivalis and Filifactor alocis and salivary microbial activity of F. alocis was associated with periodontitis. Using metagenomics it was shown that

relative abundance of specific oral bacterial species and bacterial gene expression in saliva associates with periodontitis.[14]

Composition Analysis of the Oral Microbiota Associated with Periodontal Disease

Understanding the structure of the microbiota community associated with periodontitis is essential for improving classifications and diagnoses of various types of periodontal diseases and will facilitate clinical decision-making. 16S rRNA metagenomics approach was used to investigate and compare the compositions of the microbiota communities from 76 subgingival plaque samples: 26 from healthy individuals and 50 from patients with periodontitis. a total of 12 phyla, 124 genera, and 355 species were identified and differences were observed between health- and periodontitis-associated bacterial communities at all phylogenetic levels. It was discovered that the genera Porphyromonas, Treponema, Tannerella, Filifactor, and Aggregatibacter were more abundant in patients with periodontal disease, whereas Streptococcus, Haemophilus, Capnocytophaga, Gemella, Campylobacter, and Granulicatella were found at higher levels in healthy controls.[15]

Future of metagenomics

- Identification of genetic variations associated with oral diseases may be used to develop new diagnostic markers for clinical applications.[3]
- bacterial profiles can be used to understand which microorganism(s)and which genes or metabolic pathways play keystone functions in dysbiosis of oral disease.[2]

Conclusions

Metagenomics is in an early stage of application to the oral microbiome. However, both bacterial profiles and genomic profiles can be examined and compared in metagenomics to study relationships between microbial diversity, genetic variations, and oral diseases.

Future longitudinal studies are warranted to reveal whether salivary screening of metabolic gene expression can identify oral diseases at preclinical stages.

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NANOTECHNOLOGY IN PERIODONTOLOGY : A REVIEW

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Abstract

Nanotechnology is the study of small things. It is the research and development of materials, devices, and systems exhibiting physical, chemical, and biological properties that are different from those found on a larger scale. Thus nanotechnology can be best understood as a broad collection of technologies from diverse fields such as physics, materials science, engineering, chemistry, biochemistry, medicine, and optics each of which may have different characteristics and applications. Therefore, the purpose of this review is not only to cover the development of nanotechnology in all areas and its impact on periodontal diseases but also it focuses on the development of nano materials and their potential to be used in managing periodontal diseases, including diagnosis and treatment.

Key Words: Nanotechnology, Physics, Material science, Periodontal disease

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Introduction

Periodontal disease is one of the major dental illnesses that affect millions of people around the globe. Being a chronic inflammatory disorder, it is characterized by inflammation and degeneration of the teeth surrounding structures including gums, alveolar bone, periodontal ligament (PDL) and cementum.[1,2] The disease starts with anaerobic gram-negative bacterial invasion around the gingival sulcus leading to the migration of the gingival epithelium along the tooth surface forming periodontal pockets.[3] This when left untreated can lead to deposition of calculus by the microbes and consequently results in the destruction of the tooth neighboring structures and loss of teeth.[4,5] Delivering drug to the gingival epithelium has been the major challenge for the formulation scientists due to the complexity of the anatomy of the route and the contours of the lesion which leads to the drug's poor penetration to the area. There are various proposed local drug delivering devices which include films, fibers, gels and strips etc., but unfortunately, these approaches were only partially successful due to the difficulty in accessing the periodontal pockets.

However, the recent nanotechnology innovations are increasingly providing a suitable solution for the treatment of many dental disorders including periodontal disease. Nanotechnology is the engineering of molecularly precise structures. The term "nanotechnology" was coined by Professor Kerrie E. Drexler, a lecturer and researcher of nanotechnology. The prefix "nano"

means 10-9 or one billionth of a unit. The Nano scale is approximately 1000 times smaller than a micro scale, which is approximately 1/80000 the diameter of a human hair. These small scientific scales were first revolutionized by Richard Feynman at his famous speech at the Annual Meeting of the American Physical Society in 1959 entitled: "There is plenty of room at the Bottom". He proposed that machines and tools that make smaller machine tools could in turn be used to make even smaller machines and tools, right down to molecular levels. In his historical lecture in 1959, he concluded by saying, "This is a development, which I think cannot be avoided"[6].

A dental field of nanotechnology called nanodentistry is very promising and have demonstrated various treatment opportunities in dentistry in areas such as dental re-naturalization, local anesthesia, teeth hypersensitivity cure,[7] periodontal regeneration,[8] controlled drug delivery[9,10] and overall oral health maintenance,[11] among others. This highly promising field may ensure the attainment of near perfect oral health by way of using nanomaterials, nanorobotics, biotechnology, etc.[12,13] Nanodentistry will make it possible to induce local anesthesia efficiently in the years to come, through the aid of nanorobots. Colloidal carriers containing active analgesic dental nanorobotic particles in millions and/or antibacterial agents could be directly installed into the patient's gingivae. These nanorobots would be able to make surface contact with the mucosa/crown and eventually get to dentin by moving painlessly through the gingival sulcus to the target site.[7] The future roles of nanotechnology approaches seem to influence almost every aspect of human life, and with its advancement, researchers are acquiring abilities to understand and manipulate materials at the nanoscale.[14]

There are various promising nanotechnology-based approaches in the field of nanodentistry that are being investigated or developed for dental therapy such as nanofibers, nanotubes, nanocapsules, nanopores, quantum dots (QDs), dendrimers, nanoshells, nanofillers, nanorods, nanorings, fullerenes, nanospheres, nanowires and nanobelts.[15,16] Some of these approaches have demonstrated satisfactory outcomes toward minimizing undesirable side-effects for various active agents while maximizing the therapeutic activity. This review covers various recently investigated nanotechnology-based approaches for the treatment of periodontal disease, with emphasis on the keys roles which these approaches play towards achieving effective therapy

Roles of nanotechnology-based approaches

In nanodiagnostics

Over the years, many strategies have been designed and implemented for the diagnosis of dental illnesses including periodontal disease. However, most of them suffer accessibility problem, hence the need for concerted efforts to improve diagnostic tools and techniques. Nanotechnological innovations provide scientists and researchers with the new hope for progress in this direction through the advent of

nanodiagnostics and its rapid transformation. Nanodiagnostics is a phenomenon that involves the use of nanotechnological advancement for clinical and molecular diagnostic purposes. The increased demands for highly sensitive and early disease detection tools has led to the development of this novel technology, in order to meet the demands of clinical diagnostics.[17] Nanodiagnostics would significantly reduce the waiting time for results after a test is conducted. The technology will help in the use of nanodevices for early disease diagnosis at molecular and cellular level.[17]

Quantum dots (QDs)

QDs are among the most promising nanostructures for diagnostic applications. These are tiny semiconductor nanocrystals that are stable, non-toxic and glow brightly when stimulated by ultraviolet light. Their strong light absorbance property qualifies them to be used as fluorescent labels for biomolecules. Their roles are beyond diagnostic applications, as they have also been found to play the role of photosensitizer and carrier.[12]

QDs can attach an antibody to the target cell upon stimulation by UV light, and consequently yield a reactive oxygen species that is capable of destroying the target cells.[12] Some other roles of QDs are their ability to be embedded into dental resins to tune the emission color of the resin. Lead-free and cadmium-free QDs are employed in periodontal therapy to enhance the healing of inflamed periodontal tissues.[18]

Nanoscale cantilevers

Nanoscale cantilevers are tiny beams resembling a row of diving boards or those as in atomic force microscopy, and they are fabricated by using semiconductor lithographic techniques.[19] Nanoscale cantilevers exercise its function through nanomechanical deflections and are used for deoxyribonucleic acid (DNA) hybridization to monitor molecular events. When nanoscale cantilevers are coated with certain receptor molecules, they can bind to specific DNA-substrates; bacterial cells; or viruses, and the overall effect would be the detection of single molecules (DNA or protein); specific pathogenic bacteria or viruses. Nanoscale cantilevers are developed as an integral division of larger diagnostic tools that can provide sensitive and rapid detection of inflammation and cancer-associated molecules, of which periodontal disease could be an important target. Nanoscale cantilevers can scan sample and yield hybridization with the single-stranded DNA when the targeted sequence is determined. This is another important feature of cantilevers that can permit multiple analyses .[17]

Gold nanoparticles

Gold nanoparticles are among the novel diagnostic tools for healthcare investigations. They are developed from thin gold layers or tiny gold spheres and possess good detection sensitivity for various targets.[20] Gold nanoparticles that are coated with silver shells possess strong light-scattering properties with improved detection capacity.[20] These essential diagnostic materials can allow rapid, direct

and economically feasible analysis of samples from whole blood. Gold nanoparticles can be functionalized to detect specific targets due to their high surface-to-volume ratios which offer higher selectivity as compared to conventional approach.[21,22] Early diagnosis of periodontal disease is essential in order to initiate suitable therapy and prevent its progression to advance form of the disease. The unique essential optical features of gold nanoparticles, as described above make them a key role players in the early and rapid diagnosis of periodontal disease.

Nanotubes

Nanotubes such as boron nitride or carbon rods are very small and are used as electrodes with single-stranded DNA probes for detection sensitivity in the attomole range, and in hybridization of the target DNA or protein. They can also be adapted for analytes other than DNA, e.g., by attaching enzyme to detect substrate analyte.[19] Its internal and external surfaces can be chemically functionalized to entrap drugs, and their unique open-ended barrels may make the internal surface accessible and allow incorporation of certain active molecules within the tubes easily.[16] Therefore, the inner volumes of the tubes can be filled with any suitable chemical or biochemical agent for delivery to the targeted location. Examples of nanotubes include fullerene carbon nanotubes, organosilicon polymer nanotubes, peptide nanotubes and template-synthesized nanotubes.[16]

Nanopores

These are tiny (molecular-scale) structures that have great sensitivity and detection capability of the conformation and location of a single molecule that is situated in the pore lumen.[23,24] The nanoholes of nanopores can permit passage of DNA and can also make DNA sequencing even more efficient. The characteristic change in the nanopores conductance enables researchers to be able to electrically elucidate single-molecule kinetic pathways as well as quantify the target easily.[24] Through nanopore technological innovations, it became possible to count and/or distinguish between a variety of unlike molecules in a complex mixture.[17] For instance, the technology can allow the differentiation between hybridized or unhybridized unknown DNA and RNA molecules that differ only by a single nucleotide.[17] This technology could be applied in periodontal disease diagnosis at the molecular level.

In prevention

For a very long time, conventional dentifrices such as gargles, mouthwashes, toothpaste and throat paints have been the most commonly used traditional products for maintaining oral hygiene and oral preventive measures, until recently when nanotechnology provide novel approaches for preventive measures against oral cavity diseases such as periodontal disease and dental caries.[10] Certain agents in nanoscale can be incorporated in these conventional dentifrices to aid in repelling the deposition of bacterial biofilms (plaque and tar) and/or prevent dental caries by remineralization of early carious lesions, and in desensitization

of abraded teeth.[25] Some ceramics like calcium phosphates and nanosized calcium carbonate particles (also called hydroxyapatite) has been reported to be a suitable ingredient for dentifrices that can be effectively used in the process of enamel remineralization. Among these ceramics, hydroxyapatite gain more attention being it the prototype in bone as well as tooth apatite crystals, and also one of the main constituents of natural bone. Study conducted by Nakashima et al. (2009)[26] showed that there is 48.8% improvement on the remineralization of artificially produced subsurface enamel lesions when the nanosized calcium carbonate particles were incorporated in dentifrices. Furthermore, nanocarbonate apatite has proven to be very efficacious desensitizing dentifrice when compared with the conventional agents.[27]

Mouthwashes containing silver nanoparticles and triclosan-loaded nanoparticles have exhibited plaque control actions which are vital for the prevention of periodontal disease. Silver nanoparticles demonstrated strong antibacterial effects in dental products, because of the antibacterial properties of silver.[28,29] Studies showed that nanoparticles of silver imparted high antibacterial activity on dental resins, which significantly reduces building-up of biofilm as well as lactic acid production by the oral bacteria without interfering with the resins' mechanical and physical properties.[30] In one investigation, carbonate hydroxyl apatite nanoparticles have been found to be highly effective in repairing some tooth defects (micrometer-sized) in vitro, and some of its nanocrystals were incorporated in dentifrices like mouthwash solutions and toothpaste and used as commercial products.[26]

Other preventive nanotechnology-based approach for periodontal disease is fabrication of products for oral health care that are integrated with bioinspired apatite nanoparticles alone or together with proteinaceous substances (like casein phosphopeptides).[31] Casein phosphopeptide demonstrated an important role in biomimetic strategies for overall bacterial biofilm management. Casein phosphopeptide coupled with amorphous calcium phosphate nanocomplexes reduces bacterial adherence on the tooth surface by adsorbing the bacterial macromolecules, as well as binding to the surfaces of bacterial cells and to the components of the intercellular plaque matrix. Similarly, in vitro experiments demonstrated that clustered and non-aggregated hydroxyl apatite nanocrystallite particles can bind on the bacterial surface, and then interact with its adhesins in order to disrupt the attachment of the microbes on the tooth surface.[25]

In treatment

Bone grafting

Dental bone grafting is a procedure for recovering tooth bone that was lost following severe periodontal disease, and it involves recreation of the lost bone. Bone grafting may also be used to maintain bone structure after tooth extraction. Bone grafting is faced with limitations such as a limited supply of grafting materials, variable resorption, high failure rates and persistent pains.[8] These limitations have

evoked massive research for solutions to these limitations. 3D scaffold matrices and nano-engineered particles that promote the growth of new bone have been the main areas of focus,[8,32] and scaffold have been successfully used in various fields of tissue engineering such as periodontal regeneration and bone formation. Various alloplastic bone grafts with nanoscale particle sizes are being developed and tested. One of the recent and most promising among them are nano-hydroxyapatite (n-HAP) bone grafts, which is available in crystalline, chitosan-associated and titanium-reinforced forms.[33] When compared with the 'plain' chitosan scaffolds, 'n-HAP' composite bone graft scaffolds demonstrated greater biocompatibility, superior mechanical properties and also appeared to induce better cellular responses.[34] In another development, n-HAP and nanosized crystals of calcium sulphate have been synthesized and evaluated on intrabony defects. Both the nanocrystalline materials demonstrated clinically significant treatment outcomes in terms of bone regeneration and resistance to degradation than their conventional counterparts.[35] Similarly, a nanoceramic composite material with antibacterial effect has been developed, by encapsulation/ entrapment of zinc oxide nanoparticles, nanocalcium phosphate and walled carbon nanotubes in alginate polymer matrix. The nanoceramic composite show promising result for bone grafting, that includes regeneration of bone caused by intrabony defects and enhancement of hydroxyapatite formation in bone defects. In another similar investigation, a precursor of hydroxyapatite called octacalcium phosphate has been synthesized and it has demonstrated a great role in apatite crystal development. The investigation provided evidence that this octacalcium phosphate stimulates bone formation which is even more than that stimulated by synthetic hydroxyapatite in bone defects. Although the precise mechanism of action has not been fully elucidated, but it is likely that the octacalcium phosphate precursor plays a role in bone forming cells stimulation through interaction with the closely encircling tissue.[36]

In drug delivery

An ideal drug delivery system should be able to transport active compound(s) to the intended site of action safely. In the present context however, ideal drug delivery should be able to make optimum contact with the mucosal surfaces in the periodontium and should prolong the residence time at the targeted site (i.e. in the periodontal pocket), and should also intensify contact with the junctional epithelium so as to enhance the epithelial transport of poorly absorbable drugs. This is a desirable approach in order to improve the regeneration ability of damaged tissues and to effectively treat periodontal disease.[10] Nanotechnological drug delivery approaches are highly promising in achieving these goals. It provides an avenue by which therapeutic molecules could be capsulated/loaded in carriers, such as nanoparticles or scaffolds, to allow targeted, sustained and controlled release to the intended location.[10] Nanoparticulate drug delivery systems are

among the most popular fields of current research for periodontal treatment and regeneration. Better penetration of the active moiety into the junctional epithelium (site of action) combined with optimal drug release profiles are among the important benefits of this approach.

Lipsomes

Their extremely lipid bilayer is very chemically reacting therby providing a means to conveniently tissue "tags" on covalent basis. Such "tags" can be antibodies, antigens,cell receptors, nucleic acid probes etc. this provides significant versatility in assay formats. With diametres ranging in size from 50-800nm, their aqueous core encapsulates up to millions of molecules of signal generating "markers" that can be detected in various means. The encapsulants mainly includes detectable dyes, optically and flurometrically detectable dyes, enzymes and electroactive compounds.[37]

Niosomes

Non-ionic surfactant vesicles studied as an alternative for liposomes. The vesicles are similar to liposomes in physical properties and are prepared in the same way under variety of conditions from unilamellar and multilamellarstuctures. They have the potential for controlled and targeted drug delivery along with enhanced drug penetration.[37]

Micelle

An aggregate of amphipathic molecules in water with its nonpolar portion on the interior surface and polar portion on the exterior surface of the exposed water. These are known to have anisotropic water distribution within their structure, thus making hydrophobic drug encapsulated into its core. The position of a soluabilized drug in a micelle will depend on its polarity, nonpolar molecules will be soluabilized in the miceller core, and substances with intermediate polaritywill be distributed along the surfactant molecules in the intermediate positions.[37]

C60

These are spherical molecules about 1nm diameter comprising 60 carbon atoms arranged as 20 hexagons and 12 pentagons, thus they find application as nano pharmaceuticals with large drug payload in their cage like structure.[28] Pinon-Segundo et al produced and characterized triclosan-loaded nanoparticles by the Emulsification – diffusion process, in an attempt to obtain a novel delivery system adequate for the treatment of periodontal disease.[38] The nanoparticles were prepared using poly (D, L-lactidecoglycolide), poly (D,L-lactide) and cellulose acetate phthalate. poly (vinyl alcohol) was used as stabilizer. These triclosan nanoparticles behave as a homogeneous polymer matrix-type delivery system, with the drug (triclosan) molecularly dispersed.[39] Tetracycline incorporated into microspheres is available as Arestin for drug delivery by local means into periodontal pocket.[38]

Nanotechnology in dental implants

Nanotechnology can be used in the surface modifications of dental implants since surfaces properties such as roughness and chemistry play a determinant role in

achieving and maintaining their long-term stability in bone tissue.[40] Deficient formation of bone around the biomaterial immediately after the implantation is the most common reason for failure of dental implant.The coating of nano particles over the dental implants, improves the adhesion and integration of surrounding tissues.[41]

Biologically active drugs such as antibiotics or growth factors can be incorporated in the implants. eg: Nanotite™ Nano-Coated Implant. Recently three nano-structured implant coatings are developed:

- Nanostructured diamond: They have ultrahigh hardness, improved toughness over conventional microcrystalline diamond, low friction, and good adhesion to titanium alloys.[42]
- Nanostructured processing applied to hydroxyapatite coatings: This is used to achieve the desired mechanical characteristics and enhanced surface reactivity and has been found to increase osteoblast adhesion, proliferation, and mineralization.[42]
- Nanostructured metalloceramic coatings: These provide continuous variation from a nanocrystalline metallic bond at the interface to the hard ceramic bond on the surface.[42]

Conclusion

The advancement of nanotechnology in dental science has brought tremendous progress in periodontal disease therapy. The technology offers significant promise in the disease's early diagnosis even at molecular and cellular level, thereby reduces the waiting time for results. It also play an important roles in the prevention of the disease, through using nanoscale agents to repel bacterial biofilms deposition and accumulation on the tooth surface, and by remineralization and desensitization of abraded teeth. Nanodentistry have also make the development of potent restorative nanomaterials possible. Such materials can promote the growth of new bone structure in intrabony defect and can also be used for tooth regeneration and for aesthetics purposes. Moreover, there have been significant progress in periodontal drug delivery systems through the recent nano technological advancement, whereby therapeutic agents could be loaded in carriers that can facilitate targeted, sustained and controlled release of the loaded drug(s) to the intended location. Certainly, nanotechnology-based drug carrier systems will play a vital role in future drug delivery systems for not only periodontal disease, but for a lot of other oral cavity diseases. Investigations are underway for more exploitation of the effectiveness and significance of these vital therapeutic drug carrier systems. These advances may simplify periodontal disease treatment and may help bring dental care closer to millions of people around the globe that doesn't have access to high-quality oral healthcare.

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THE GOLDEN 72 HOURS: A CASE REPORT ON REHABILITATION WITH BASAL IMPLANTS

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Abstract

Rehabilitation of partially and completely edentulous patients with implant supported prosthesis has become a widely accepted treatment option.The conventional Branemark system involves loading of the implant after 4-6 months of the placement .This obvious disadvantage leaves the patient with no teeth or removable prosthesis which is not preferred.Basal implantology is an alternative implant system,uniquely designed to be accomodated in the basal cortical bone areas.Implant placement in severely atrophic jaw is especially challenging because of the poor quality and quantity of the implant bed and sometimes patients will be reluctant to undergo extensive surgical procedures. But these basal implants particularly take advantages of the bone available to avoid bone augmentation procedures and dental implants when placed in the basal bone can be immediately loaded with teeth as it is very stable ,does not get resorbed throughout life and forms the stress bearing part of our skeleton.

Key Words: basal implant,immediate loading,atrophic ridge

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Introduction

It is indeed a traditional endeavor to rehabilitate an amputated part (limb or tooth) by means of a bone anchored substitute or prosthesis. The introduction and success of an osseointegrated dental implant has forever changed the philosophy and practice of dentistry.The Branemark protocol for original implants required long healing periods of several months for osseointegration to take place before fabrication of the final prosthesis immediately after surgery led to the discovery of basal implants.

Basal implantology or bicortical implantology utilizes the basal cortical portion of the jaw bones for retention of the implants which are designed in a unique way to accommodate in the basal cortical bone.The basal bone has a lesser rate of resorption because of its highly dense structure.Thus the implants which takes support from this bone offers excellent and long lasting solution for tooth loss. This case report highlights the application of single piece immediate implants (Simpladent) in a full mouth rehabilitation patient.

Case Report

A 45 year old female with normal gait and stature reported to the Department of Prosthodontics,KMCT Dental College with a chief complaint of missing teeth in the upper arch and inability to eat properly.She was terribly unhappy with her aesthetics too. Intraoral examination revealed that the patient just had one tooth present in her maxillary arch and 6 teeth in the mandibular anterior region. Various treatment options were suggested which included removable denture after total extraction, conventional implant supported fixed prostheses, or basal implant supported fixed prosthesis. The patient wanted the treatment to be done in a minimal time with fixed option as she was highly concerned about her aesthetics and was not comfortable with removable prosthetic options.Taking her CBCT findings into consideration, it was decided to rehabilitate the patients mouth with basal implant supported fixed partial denture.A routine blood examination was done for the patient and the results were within normal limits.

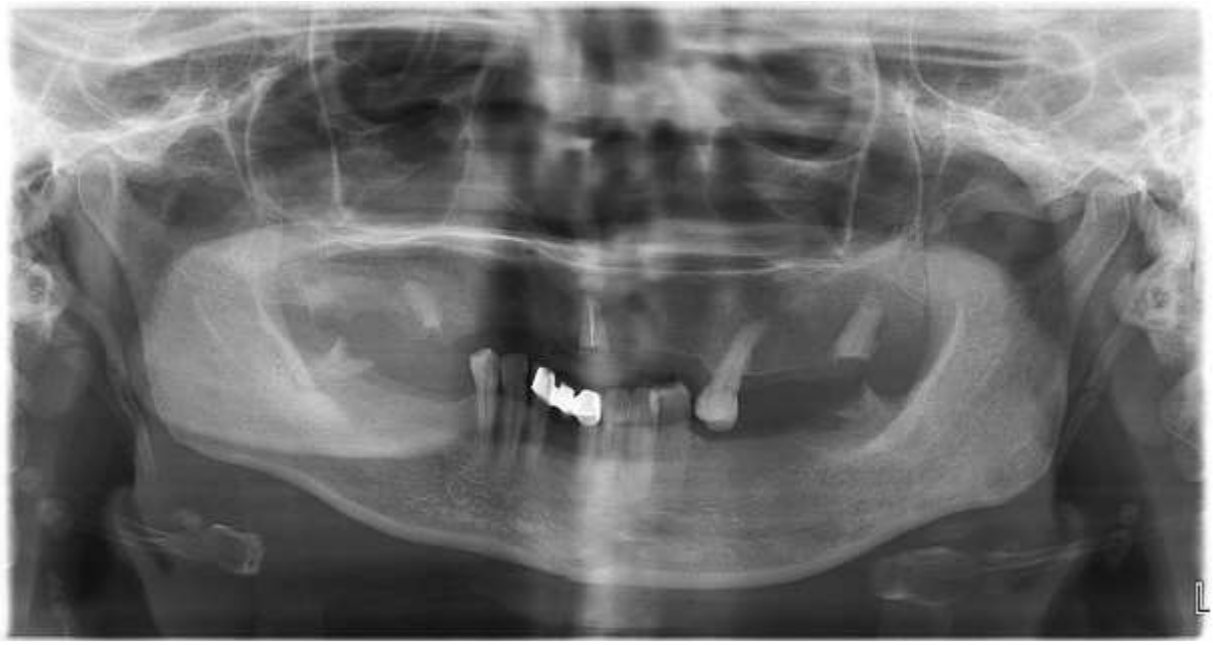

Figure 1: Pre operative OPG of the patient

Figure 2: Intraoral view of maxillary arch

Figure 3: Intraoral view of mandibular arch with copings on 37,47 for CPD

Figure 4: Extraction of remaining teeth

Figure 5: Initial basal implant placed along the pterygoid

Figure 6: Basal implants placed anteriorly

On day one, the remaining teeth in the maxillary arch were extracted atraumatically and curettage was done. A flapless immediate procedure was then followed to place the implants. Maxillary impressions were made using additional silicone impression material. The mandibular posteriors were to be replaced with a cast partial denture. Tentative jaw relations were recorded using aluwax.

Figure 7: 10 implants placed in the maxillary arch

Figure 8: Tentative jaw relation recorded with aluwax

Figure 9: Impression copings placed

Figure 10: Impression recorded

Figure 11: Retrieved cast

Figure 12: Wax up prior to casting with metal

For the second day, a metal framework was fabricated in the departmental lab.Accordingly, adjustments were made in the patients mouth and a successful metal try in was established. Once done, intermaxillary records were made.

Figure 13: Wax trial done

Figure 14: Metal trial done

Figure 15: Jaw relation recorded

On the third day, all the implants were functionally loaded with cement retained metal acrylic prosthesis, which would be replaced with fixed partial denture after a year or two based on the prognosis and

aesthetics. The cast partial denture for the lower arch was also inserted and the occlusion was checked accordingly.

Figure 16: Try in done

Figure 17: Final prosthesis insertion

Figure 18: Final OPG

Discussion

Immediate loading of basal implants when placed in the dense cortical bone can attain high primary stability. The bone remodeling starts within 72 hours and weakens the peri-implant bone structures, hence rigid splinting of the metal framework should be done as early a possible. This splinting will thereby distribute the masticatory forces from the bone to other cortical areas.

In this case, ten implants were placed in the maxillary jaw engaging the basal bone, using handgrip instruments. Out of the ten BCS implants, the maxillary anterior region was engaged with four implants and the remaining 6 were placed posteriorly two each in the tuberopterygoid region and one in the premolar-molar region. The pterygoid region provided the most stability then any other part of the maxillary arch.

The BCS implants are smooth surface implants with aggressive threads and an be placed in already infected roots.Excellent primary stability can be achieved along the vertical surface of the BCS implants with no need for corticalization.

Conclusion

A basal implant-retained prosthesis is the best choice in edentulous situations, especially in the case with atrophic ridges. This is the only way by which the psychological concerns of the patient can be solved.

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