

Index Copernicus ID 6818

ISSN 2231- 1823

Journal of the Society of  
Periodontists and  
Implantologists of Kerala



# JSPIK

Volume 11 • Issue 3 • DECEMBER 2019

[www.spik.in](http://www.spik.in)



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## President's message

*The only constant thing in the world is change*

Friends,

The world is changing in lightning pace and so is science. A look into the history of Periodontology reveals changes happening in almost all areas consistently from time to time. As clinicians, academicians and researchers in the field, we need to keep abreast with these changes. The most practical way to handle this scenario is to learn the changing concepts, get trained on new techniques and be updated with emerging trends in literature. I take this opportunity to request colleagues and fellow members in our society to embrace the changes and be competent enough in this thrilling field of Periodontics.

Friends, I had a wonderful tenure as the President of our society, which I really enjoyed serving you with my heart out. I feel I have done justice to the expectations bestowed upon me by SPIK fraternity. I should mention the name of my Secretary, Dr Jayan Jacob, a systematic and methodical person I have ever worked with, who was instrumental in fulfilling all our calendar events with all the colour and vigour. Special appreciation to Dr Sameera G. Nath and her editorial team for their efforts in bringing out our JSPIK issues regularly on time. Introduction of guest editorial section was indeed innovative and interesting. I take this opportunity to acknowledge Dr Majo Ambooken, Dr Mohammed Feroz, Dr Sabu Kurian, Dr Jose Paul, Dr C K Ashokan, Dr Arun Sadasivan, Dr Vivek Narayan, Dr Mahesh Narayan, Dr Tony Kurian, Dr Plato Palathingal, Dr Anto Joseph and all the executive committee members for their unstinted support and help extended to me in my tenure. Special reference to all past presidents and secretaries, especially Dr Baiju R.M., for the timely advice and guidance.

I request all SPIK members to carry this association forward with all the activities and benchmark events set by our predecessors, without losing the charm and glory. Let us group together under the umbrella of Periodontology, share our knowledge, clinical experience and expertise and keep ourselves updated with the changes happening in the field of Periodontology.

*The best way to handle change is..... accept change*

Yours in SPIK

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## Guest Editorial



**Dr REZY CHERU. T., MDS**

Completed graduation and post-graduation from Government Dental College, Trivandrum

- ◆ Secured first rank for BDS from the University of Kerala
- ◆ Recipient of 'Students Plaque Award' from the 'International College of Dentists'
- ◆ 'Appreciation award' from 'The Dental Council of India.'

**Other achievements and posts held:**

- ◆ Professor and Head of Periodontics of G.D.C.
- ◆ Director GDC Trivandrum and Calicut
- ◆ First Principal GDC, Trivandrum
- ◆ Joint Director of Medical Education, Govt. of Kerala
- ◆ Government nominee to Dental Council of India
- ◆ Steering committee member of health for Kerala State Planning Board.
- ◆ Dean, Faculty of Dentistry, University of Kerala
- ◆ Chairman pass board and member, P.G. Board of studies, University of Kerala
- ◆ First Principal of three newly started private dental colleges in Kerala – Mar Baselios, St. Gregorious and Indira Gandhi Institute of Dental Sciences

The oral problems indigenous to female population has become a field of research since 1960's. In women, certain diseases or conditions are unique and more prevalent, more serious or have different outcomes than in men. The dimorphism is due to the fluctuation of hormones in women during puberty, menstrual cycle, pregnancy, menopause and use of contraceptive medicines, which have a surprisingly strong influence of periodontal and oral tissues. Nutritional deficiencies, lack of education, poor socio-economic status and poor oral hygiene methods also affect the women's oral health.

There are abundant research evidence to support that periodontitis has direct relation with general health. A mother's oral health impacts not only her health, but also the health of the unborn child's developing teeth. Severe periodontitis in pregnant women can lead to low birth weight babies or preterm birth. Severe periodontitis in early life significantly increase the risk for certain systemic diseases like cardiovascular diseases, respiratory diseases, peptic ulcer and it affects the pathogenesis of diabetes, periodontal disease in olden women is directly related to the incidence of osteoporosis and vice versa. The possible reason for this is the entry of micro bacteria and their toxins released from dental plaque into the blood stream. From these, it is clear that prevention of dental diseases has a major role in improve in general health standards.

As per the last Census, the percentage of women is 48.5% in India, whereas 52.02% in Kerala. Life expectancy of men is 66.4 and that of women is 69.6. Increased number and life expectancy of women indicate the need to ensure systematic and dedicated efforts to educate importance of excellent oral hygiene measure which is unquestionably important factor in the prevention of periodontal and oral diseases.

It is, therefore, the prime duty of the dental profession to plan appropriate dental health programs, covering both rural and urban areas with administrative and financial support of the government, to educate women population to improve their oral health and also to provide prompt treatment for periodontal and oral diseases.



## Secretary's Message

Dear SPIK members,

Our organization is cruising forward in its mission of enhancing and updating scientific knowledge and fostering camaraderie among all categories of members through organized efforts to ensure delivery of state of the art periodontal treatment in the society. JSPIK has been playing a major role in this mission since the last many years and our editor Dr. Sameera Nath deserves a big applause for her untiring efforts in ensuring its timely publication.

In the last quarter SPIK successfully completed two scientific programs and two periodontal health programs. On June 16, a CDE titled "Everyday Periodontics" was conducted in association with IDA Malabar focusing on general practitioners, which was a well-attended and appreciated program. On September 22, our mid-term scientific program "Periodontics; Bridging Dentistry" was held at Thrissur, hosted by the Department of Periodontics, PSM Dental College, Akkikavu. On behalf of SPIK, I express our sincere gratitude to the esteemed SPIK members, Dr. Arun Sadasivan, Dr. C K Ashokan, Dr. Jose Paul and our President, Dr. Harikumar Menon who contributed to the success of these programs as faculty. I congratulate the organizing team of our mid-term conference under Dr. Sanjeev R and Dr. Plato Palathingal for all their efforts.

On the public front, we observed the National Oral Hygiene Day in the most befitting manner. The official SPIK program was held on August 1 at Govt. Girls Higher Secondary School, Kodungallur with awareness classes, health talks, dental exhibition and various competitions for students. SPIK also participated in an awareness road show conducted in Kothamangalam town. I would like to place on record the appreciation towards Dr. Mahesh Narayanan, Periodontal

Health Care Convener in successfully organizing the program. SPIK extends its gratitude to Malabar Dental College, Edapal and Mar Baselios Dental College, Kothamangalam for associating with SPIK in conducting the Oral Hygiene Day activities.

The digital presence of SPIK, [www.spik.in](http://www.spik.in) has undergone a thorough upgrade conforming to the latest web requirements. I thank our website consultant Dr. Rajeev Simon for his technical support in this process. I request all SPIK members to utilize our website in the best possible manner. Suggestions towards further improvements are solicited from all.

The activities planned down the lane this SPIK year are the UG and PG Scholarship Exams and the Annual Conference and Post-graduate Scientific Convention. The seventh SPIK undergraduate scholarship exam is scheduled to be held in November, hosted by the Department of Periodontics, KMCT Dental College, Kozhikode. The first post-graduate scholarship exam is planned in the month of December, the further details of which shall be intimated shortly. The Annual Conference shall be held on January 4 and 5, 2020 in Muvattupuzha, hosted by the Department of Periodontics, Annoor Dental College, Muvattupuzha under the able leadership of Dr. Jose Paul. I sincerely request all SPIK members to participate in the same and make it a memorable event.

We are also planning to update the membership directory of SPIK by the next Annual Conference. All members are requested to go through the SPIK website and intimate regarding any omissions or modifications in the existing list.

Lets continue to facilitate dentistry.

**Dr. Jayan Jacob Mathew**  
Secretary, SPIK

# Plasma Cell Gingivitis- An Enigma in Diagnosis

Hiba Muhammed<sup>1</sup>, Santhosh V.C<sup>2</sup>, Mariyam Ashraf<sup>3</sup>

## ABSTRACT

Plasma cell gingivitis, which is also called atypical gingivitis or plasma cell gingivostomatitis, is a rare benign inflammatory condition of unknown etiology. It presents clinically as a diffuse, erythematous and papillary lesion of the gingiva, which frequently bleeds, with minimal trauma. Here we have documented a case of plasma cell gingivitis due to the indiscriminate use of a herbal tooth paste. A 39 year old male presented with enlarged and edematous gingiva is treated.

**Keywords:** Plasma cell gingivitis, atypical gingivitis, herbal tooth paste, management, case report.

## Introduction

Plasma cell gingivitis (PCG) is a benign inflammatory condition that is uncommon and of unclear etiology.<sup>1</sup> Other terms that have been used are idiopathic gingivostomatitis<sup>2</sup> atypical gingivostomatitis,<sup>3</sup> allergic gingivostomatitis hypersensitivity,<sup>4</sup> and plasmacytosis. It is characterized by sharply demarcated erythematous and edematous gingiva often extending up to the mucogingival junction, which frequently bleeds on slightest trauma.<sup>5</sup> Gingival ulceration is rare.<sup>6</sup> A localized lesion referred to as plasma cell granuloma has also been described.<sup>7</sup> It is regarded as an immunological reaction to allergens especially mint, cinnamon present in tooth paste and chewing gums.<sup>8</sup> Some herbs such as chili, pepper and cardamom may also be considered as important factors in etiology of plasma cell gingivitis.<sup>9</sup> Other categories of this disease are neoplastic lesions or lesions of unknown causes.<sup>10</sup>

Lesions may mimic that of acute leukemia and histologically imitate multiple myeloma and extramedullary plasmacytoma.<sup>11</sup> Hence, the diagnosis requires hematological screening in addition to clinical and

histopathological examinations.<sup>12</sup> The present case report outlines the case of plasma cell gingivitis, which is suspected to have occurred following the use of herbal tooth paste.

## Case report

A 39 year old male, reported to Department of Periodontology, KMCT Dental College, Manassery, Kozhikode, Kerala with a chief complaint of swelling in his gums in upper front region since 7 months. He also noticed spontaneous bleeding while chewing and increased bleeding during tooth brushing. No pain or other symptoms were noticed.

Past medical history was noncontributory. There was no use of any medications which are known to cause gingival enlargement. He reported the swelling to be small in size which gradually increased to current size in 7 months time. Upon detailed history taking it was revealed that patient noticed the changes in his gingiva when he switched on to a new paste. He was using anti hypersensitivity tooth paste for long and had changed to herbal tooth paste of a very worldwide

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popular company.

On intra-oral examination, the oral hygiene status of the patient was found to be fair. There was diffuse enlargement in the labial aspect of maxillary anterior region, involving marginal, attached gingiva and interdental papilla extending from first premolar on either side (Fig. 1). The lesion was pink in colour. The surface appeared bulbous and free of vesicles or ulcerations with loss of stippling. Gingival margin was 3-4mm coronal to CEJ and encroaching the clinical crowns gingival margin was rolled out and loss of contour was noted. It was non-tender on palpation and there was spontaneous bleeding on probing in the same area.

A thorough hematological screening performed which included complete blood count, Hb, CT, BT, ESR. All were found to be within normal limits except a mild elevation in ESR. Orthopantomogram revealed angular bone defects distal to 11, 21 (Fig. 2).

From the above findings a provisional diagnosis of plasma cell gingivitis was made.

### Treatment plan

Phase I therapy included thorough oral prophylaxis

to eliminate any local factors involved. Review the patient after 2 weeks to assess the gingival status and to check whether there is resolution of inflammation. If there is no notable tissue changes then advise for phase II therapy, which includes excision of the enlargement. The excised tissue to be send for histopathological examination before final diagnosis is made.

### Case management

Patient was counseled and the details of his gingival disease and its management was communicated. Upon obtaining a written consent, the Phase I therapy was initiated, which included thorough oral prophylaxis and oral hygiene instructions. Patient was restrained from the use of herbal tooth paste which was supposed to cause the condition. After 2 weeks a slight reduction in inflammation of the gingiva was noticed. The enlargement though was still persistent had appeared more fibrotic (Fig. 3). Phase II was considered 2 weeks after the review.

A surgical approach was planned for the gingival enlargement. Internal bevel gingivectomy was done from first premolar to first premolar on either side (Fig. 4). Thorough debridement was done and flaps were sutured back using 3-0 silk sutures (Fig. 5). Coe-



Fig 1: Diffuse swelling in the upper anterior region

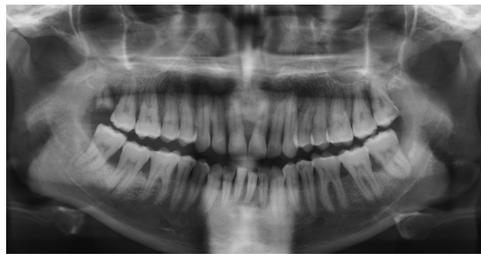


Fig 2: OPG showing bone defects in relation to 11, 21



Fig 3: Preoperative intraoral view (2 weeks after oral prophylaxis and home care measures)



Fig 4: Internal bevel gingivectomy performed



Fig 5: Sutures placed



Fig 6: periodontal pack given

pack was placed and post operative antibiotics and analgesics were prescribed (Fig. 6). The specimens were sent for histopathological examination (Fig. 7).

2 weeks after excision, the surgical site was healing and the lesion showed remission (Fig. 8). The sutures were removed. Patient recalled after 1 month. 1 month post operative surgical site showed complete healing and the enlargement was completely resolved (Fig. 9).

### Histopathology

Histological examination showed long narrow and thin rete ridges. Focal areas of surface epithelium shows atrophy. The underlying connective tissue was infiltrated with extremely dense chronic inflammatory infiltrate, predominantly of plasma cells. Numerous endothelium lined dilated vascular channels engorged with RBCs and extravasated RBCs were seen (Fig. 10).

So a final diagnosis of plasma cell gingivitis was made. The patient was instructed to avoid possible

allergen (the herbal tooth paste).

### Discussion

Plasma cell gingivitis (PCG) is a rare condition characterized by well demarcated erythematous and edematous gingiva usually extending to mucogingival junction. In the present case lesion was present in the anterior maxilla and is consistent with the previous reports.<sup>10,13</sup> The etiology of PCG is not clear, but due to the obvious presence of plasma cells many authors suggest that it is an immunological reaction to allergens; these latter may occur in toothpaste, chewing gum, mint pastels and certain food.<sup>8,9,14</sup> This condition was first reported by Kerr et al in 1981 resulting from an allergic reaction to one of the flavoring agents like cinnamon in chewing gums.<sup>13</sup> Three categories of plasma cell gingivitis has been proposed based on the etiology of the condition.<sup>15</sup>



Figure 7: Excised tissue



Figure 8: Post operative 2 weeks



Fig 9: Post operative 1 month

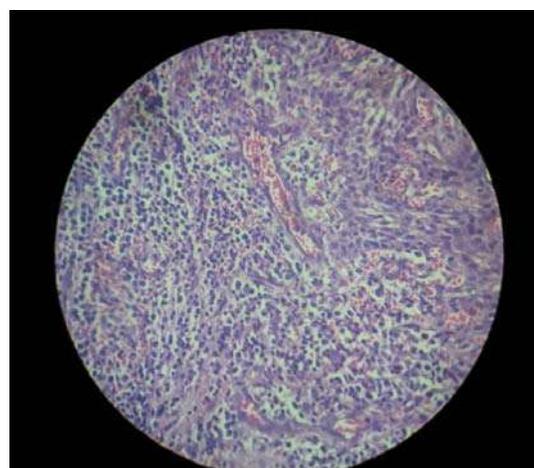
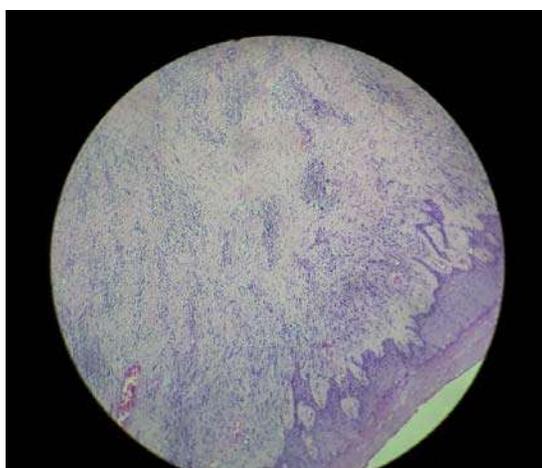


Fig 10: Histopathological sections at magnification 10x and 40 x

- Lesions caused by an allergen
- Neoplastic lesions
- Lesions of unknown origin

The present case belongs to first category as the changes had developed after prolonged use of herbal tooth paste. The differential diagnosis of the condition is very important because of its similarity with some other aggressive conditions.<sup>11</sup> Most cutaneous disorders like pemphigous were eliminated from consideration by the lack of skin lesions and a negative Nikolsky sign.<sup>16</sup> The histopathological picture shows population of cells predominantly made up of plasma cells thus indicating the diagnosis. However, the patient's failure to respond appropriately to initial periodontal therapy necessitated a surgical excision of the remaining gingival enlargement.

### Case summary and conclusion

The case presented here is of a plasma cell gingivitis which is found to be caused due to long term use of herbal tooth paste. The 39 year old male complained about the enlarged gingiva in upper anterior region and noted bleeding while brushing. After non surgical periodontal therapy there was only a slight resolution of the lesion, which necessitated a surgical intervention. Surgical periodontal therapy along with avoidance the possible allergen brought about good treatment outcome along with patient satisfaction. As plasma cell gingivitis mimics lesions associated with other serious conditions like myeloma and leukemia

an early diagnosis is mandatory.

This was a case of plasma cell gingivitis associated with use of herbal toothpaste. The need for a detailed case history, examination, use of appropriate diagnostic tests to arrive a correct diagnosis and treatment plan is emphasized in this case report.

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# The Timeline in Understanding Periodontitis

K Harikumar <sup>1</sup>

## ABSTRACT

On the basis of emergence of concepts regarding etiology, pathogenesis and clinical course, knowledge about periodontal diseases kept changing. To understand periodontal diseases better, there were a lot of classification systems developed from time to time. A new classification scheme for periodontal diseases and conditions has been designed jointly by American Academy of Periodontology and European Federation of Periodontology in 2017 to overcome the deficiencies of previous classification systems. This will throw more light in understanding and diagnosing Periodontitis better than what we practiced in the past and what we follow today.

**Key words:** periodontitis, classification systems, aggressive periodontitis, early onset periodontitis, rapidly progressing periodontitis

## Introduction

Medical work documentation of ancient world devoted a significant space to periodontal diseases since 3000 BC. Periodontology evolved with modern dentistry during 18th century. Since then over a timeline knowledge about periodontal diseases kept changing. These were on the basis of emergence of concepts regarding etiology, pathogenesis and clinical course of the disease.

**“It is said that to understand a disease properly, we should have sound knowledge regarding the etiology, pathogenesis, clinical course and clinical presentation of the disease”.**

**“It is also said that, in order to differentiate one disease entity from another it should have a distinct etiology, pathogenesis and clinical course. A difference in clinical presentation is not enough for the differentiation”.**<sup>1</sup>

This is very true in case of periodontitis even

today, especially when we try to differentiate Chronic Periodontitis and Aggressive Periodontitis. To understand periodontal diseases better there were a lot of classification systems developed from time to time. All these were based on the current thinking of researchers at the time when the classification system was proposed. As the knowledge base expanded from time to time, the thinking also changed paving way for emergence of better classification systems for periodontal diseases.

## Historical background

The major controversy existed for almost two centuries (18th and 19th) in the field of Periodontology was whether periodontitis is inflammatory or degenerative. Also clinicians struggled to differentiate between periodontitis in adolescents and periodontitis in adults. In the midst of all these controversies, Periodontology developed in France and England initially, then to central Europe (Germany and Austria) later to Scandinavian countries (Sweden, Denmark and Norway)

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and finally to United States before the first quarter of nineteenth century. As a result, there existed controversies and consensus in concepts between European and American school of thoughts regarding various aspects of periodontal diseases.<sup>2</sup>

Major paradigm shifts observed in Periodontology in Periodontal etiopathogenesis are-<sup>3</sup>

1870 – 1920 - Clinical characteristics paradigm (John M Riggs, G V Black)

1920 – 1970 - Classic Pathology paradigm (Gottlieb & Orban)

1970 – 1999 - Infections/host response paradigm

### Overview of the existing classification systems

American Academy of Periodontology (AAP) was formed in 1914 and Periodontics was recognized as a speciality by American Dental Association in 1947.<sup>2</sup>

AAP attempted to classify periodontal disease in 1966, 1977, 1986, 1989, 1999 and 2017 during the World Workshop of Periodontics. Periodontal disease classifications (Table 1) went from:<sup>4</sup>

- 1 category in 1966
- 2 categories in 1977 (Juvenile periodontitis)
- 4 categories in 1986 (Juvenile periodontitis)
- 5 categories in 1989 (Periodontitis associated with systemic disease was added in 1989, Early Onset Periodontitis (EOP), Rapidly Progressing Periodontitis (RPP))
- 8 categories in 1999 (Gingival diseases classified)

Thus Periodontitis of adolescents was given different names like Juvenile Periodontitis, Rapidly Progressing Periodontitis, Early Onset Periodontitis and Aggressive Periodontitis from time to time.

During 1980 – 1990, based on the wealth of evidence from literature almost ten different classification systems were proposed across the world to define periodontitis in adolescents. So until 1999, Periodontitis in adolescents were named as Prepubertal, Juvenile,

Post juvenile etc (1986). Some defined all these together as Early Onset Periodontitis (1989). Based on rate of progression another entity called Rapidly Progressing Periodontitis was also defined (1989).<sup>4</sup>

If we look into the 1989 classification there were two forms of Periodontitis – Early onset Periodontitis, that occurred before the age of 35 and Adult onset Periodontitis which occurred after the age of 35. The major problem in diagnosing periodontitis in adolescents from Adult periodontitis according to 1989 classification was that, it was heavily “age dependent” and hence diagnosis can change and there will be significant overlap of disease categories.<sup>3</sup>

To overcome this, AAP convened a world workshop in 1999. They removed the “age factor” and Early Onset Periodontitis was renamed as Aggressive Periodontitis. (table 1)

So from 1999 onwards we had two category, Chronic Periodontitis and Aggressive Periodontitis. Also 1999 classification considered Aggressive periodontitis as a separate disease because of the following reasons:<sup>5</sup>

- Aggressive in nature
- Location of lesions
- Familial tendencies
- Thinness of biofilms
- Aggressive Periodontitis provoked by specific bacteria
- Immune responsiveness influence manifestation and progression
- Age was not considered a distinguishing factor (unlike in EOPD)
- Local & Systemic factors proposed as risk modifiers

In spite of all these, it was difficult to differentiate Chronic and Aggressive Periodontitis due to the following reasons:<sup>6</sup>

- A gold standard case definition is lacking
- Broad definitions proposed in the past were

inconsistent

- Low number of individuals with this disease
- The disease was not studied in its early phase
- The disease was not studied at different time points (temporal)
- The disease was not studied at different locations (geographic & topographic)
- No evidence of specific pathophysiology that enables differentiation
- Although there are multiple interacting factors influencing disease phenotypes, there is little consistent evidence to differentiate
- On population basis, the mean rates of progression are consistent across all observed populations
- There is evidence that specific segments of population exhibit severe CAL in subset of each age cohort
- A classification system based only on CAL fails to explain other dimensions of the disease

- Stipulated criteria to define Aggressive Periodontitis (Lang et al) is difficult to apply in daily practice.

Thus, major deficiencies identified in 1999 classification were the following :

- Diagnostic dilemma between Chronic and Aggressive periodontitis
- Reduced periodontium resulted after treatment was not addressed
- Non inflammatory causes resulting in clinical attachment loss was not addressed<sup>7</sup>

Hence it was proposed that resolution of these controversies will emerge only after us:

- 1) Better define disease
- 2) Perform longitudinal studies documenting the early stages of disease
- 3) Examine suspected microbes in the context of the total flora relative to disease development
- 4) Use standardized methods for plaque collection, DNA extraction, microbiologic identification, and statistical interpretation of data in an unbiased manner.<sup>5</sup>

All these recommendations when coupled with the exponential growth in research with substantial evidence, advances in microbiology, immunology, genetics, genomics and proteomics, that happened after 1999, resulted in host factors gaining more importance in etiopathogenesis of periodontal diseases.

Concepts of Osteoimmunology, Keystone Pathogen Hypothesis (2012)(low abundance species), Polymicrobial Synergy and Dysbiosis (PSD) were proposed with significant influence on etiopathologic concepts.<sup>2</sup>

Considering all these factors and the inability to define aggressive periodontitis convincingly, in spite of the wealth of research evidence available AAP convened a World Workshop in 2017 to address problems associated with 1999 classification.<sup>7</sup>

**Highlights of 2017 classification - WWP Proceedings:<sup>7</sup>**

- Case definitions

1870 - 1920	Periodontoclasia & Alveolar Pyorrhoea Riggs disease
1920 - 1960	Diffuse atrophy of alveolar bone Deep Cementopathia Paradontitis Marginalis Progressiva Paradontosis and Periodontosis
1960 - 2017	Chronic marginal Periodontitis Juvenile Periodontitis and Adult Periodontitis Early Onset Periodontal Diseases and Adult Periodontitis Aggressive Periodontitis and Chronic Periodontitis
2017	Periodontitis

- Definition of Gingival/Periodontal health
- Re categorization of various forms of periodontitis
- AGGRESSIVE PERIODONTITIS category removed
- Development of a novel staging and grading system for periodontitis
- Inaugural classification of Periimplant diseases and conditions

Thus, as per the most recent recommendation regarding the classification of periodontitis, all types of periodontitis described earlier were pooled into a single category of PERIODONTITIS.<sup>7</sup>

**To facilitate treatment and assessment of Prognosis, Periodontitis is categorized into four stages, and three grades.<sup>6</sup>**

- Staging levels indicate the extend & severity of the disease at presentation and the complexity of disease management.
- Grading structure considers biologic characteristics of the patient in estimating rate of progression,

assessment of risk and treatment outcome and effect on the general health of the patient.

## Conclusions

Although 2017 classification apparently have many advantages, the practical problems associated with the use this new system will be a hot topic in periodontal literature in the coming years.

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# The Knowledge, Awareness and Attitude of Patients towards Dental Implants - A Pilot Study

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## ABSTRACT

**Background:** In developing nations like India awareness and education about dental implants as a treatment modality is still scanty.

**Aim:** The study was conducted to determine the Knowledge, awareness and attitude of patients toward dental implants as a treatment option for replacement of missing teeth.

**Materials and methods:** A Questionnaire based survey was conducted on 100 patients of more than 18 years of age who reported to the Department of Oral Medicine and Radiology, Department of Prosthodontics and Department of Periodontology, Annoor Dental College and Hospital, Muvattupuzha, Kerala, India

**Results:** Ninety nine percentage of patient's opinion was, there is a need in replacing the missing teeth. Only 36 % of patients were aware about different treatment options for replacing the missing teeth and only 14 % of patients were aware of implant as an alternative treatment. Dentist, followed by the media and friends were the main sources of information. Only one percentage of the patients were well informed about Dental implants. High cost was the main factor that prevented patients from selecting the Dental implant when needed to replace missing teeth

**Conclusion:** Majority of the study population were unaware of Dental implants. Hence there is a need of educating the patients regarding Dental implants.

**Keywords:** dental implants, knowledge, awareness, attitude, questionnaire based survey

## Introduction

Smile is a window into one's personality. Teeth plays a significant part in the maintenance of a healthy personality and an affirmative self-image. Tooth loss is psychologically a very traumatizing and upsetting experience, it's considered to be a serious event in the life of a person, requiring significant psychological readjustment. Teeth replacement with dental implants provides greater stability, improved biting and chewing forces, and higher patient satisfaction than a conventional denture. Despite of the new available restorative options, it is observed that there are substantial barriers

between both need and demand and between demand and utilization. This is possibly due to the lack of information and awareness among the people. Also the financial cost lays a question mark in the people who are aware about implants.

## Materials and methods

A Questionnaire based survey was conducted on 100 patients of more than 18 years of age who reported to the Department of Oral Medicine and Radiology, Department of Prosthodontics and De-

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The questionnaire was provided to all the patients in general to assess their knowledge, awareness, and attitude about implants.

## Data analysis

Table 1 : Questionnaire

Sl no.	Questions		Frequency	Percentage (%)
1.	Age(in years)	Below 35	44	44
		Between 35 to 55	40	40
		Greater than 55	16	16
2.	Gender	Male (M)	53	53
		Female (F)	47	47
3.	Opinion regarding the need of replacement of missing teeth	It should be replaced	99	99
		It should not be replaced	01	01
4.	Awareness of different treatment options for replacing the missing teeth	No	64	64
		Yes	36	36
5.	Awareness of implant as an alternative treatment for missing teeth	No	86	86
		Yes	14	14
6.	Knowledge about implant treatment obtained from:	From your Dentist	7 (3 M,4 F)	7
		Books, Magazines, Internet	5 (4 M,1 F)	5
		Friends	1 (1M,0 F)	1
		Heard from other patients who have had undergone treatment	1 (0 M,1 F)	1
7.	How well Informed about implants	Poorly	2 (1M,1F)	2
		Moderately well	10 (5M,5F)	10
		Well	1(1M,0F)	1
		Very well	1(1M,0F)	1
8.	Knowledge about specific surgical procedure carried out during implant placement	No	10	10
		Yes	4	4
9.	Awareness of unexpected complications regarding the implant treatment	No	13	13
		Yes	1	1
10.	Expectation about the cost for a single tooth replacement by implant	About 7000 - 10000 Rs	2	2
		About 10000 – 20000 Rs	5	5
		About 20000 – 30000 Rs	5	5
		About 30000 – 40000Rs	2	2
11.	If you have a tooth missing, are you willing to replace it with an implant	No	7	7
		Yes	7	7
12.	If not willing to replace the missing tooth with an implant, then what is the reason	Phobia regarding the treatment	1(1M,0F)	1
		Cost of the treatment	3(1M,2F)	3
		Any other reasons	3(2M,1F)	3

A validated questionnaire was distributed among all the patients participating in the study.

This included total of 10 questions about the awareness of dental implants, the patient's knowledge of dental implants and how they learnt about it. The questions were based on simple answers that the subjects could readily answer by selecting any of the appropriate options. The data extracted were tabulated and statistically analysed.

## Results

The collected data were analysed and are tabulated. Out of these 100 patients, 53 males and 47 females were participated in this survey (Table 1). Opinion regarding replacing the missing teeth, majority of the patients that is about 99 patients opinion is missing tooth should be replaced. Only one patient is opposed to this. 36 patients were aware about the different treatment options for replacing the missing teeth. Among these 36 patients, only 14 patients were aware about the implant as an alternative treatment option for missing teeth. From 14 patients 7 obtained the knowledge through dentist followed by 5 obtained from books, magazines, internet, friends and other patients. 10 patients were moderately informed and only one patients got well knowledge about implant. Majority of the patients were unaware about the specific surgical procedure carried out during implant placement and unexpected complications. They are expecting the cost of about 10000 to 30000 rupees. Among these 14 patients 7 have showed a positive attitude to get their missing teeth replaced with implants in future. High cost is the main reason for their unwillingness followed by phobia and other reasons.

## Discussion

The present survey gives information about subjects' knowledge, awareness and attitude related to dental implants as an, option in replacing missing teeth. However, information which is available to the patients regarding the procedure and its success, is often fragmentary. This problem is more compounded in developing nations. In the present study it was found that out of these 100 patients only 14 patients were aware about implant treatment., that dentists were the main source of information regarding implants which

was similar to the findings of Johany SA et al. (2010),<sup>1</sup> Chowdhary R et al (2010),<sup>2</sup> Pommer et al (2011),<sup>3</sup> Satpathy et al. (2011),<sup>4</sup> Mukatash et al (2010),<sup>5</sup> and Ravi Kumar et al (2011)<sup>6</sup> while studies conducted by Zimmer et al (1992),<sup>7</sup> showed that media was found to be the main source of information about dental implants, while the dentists were the source for such information in not more than 17% of the cases. Berge (2000)<sup>8</sup> and Best (1993)<sup>9</sup> also found that, the media was the main source of information; while dentists played a secondary role at best. Akagawa et al. (1988)<sup>10</sup> in their study concluded that, dentists provided not more than 20% of the information. This clearly indicates the lack of efforts by dentists and the governing bodies regarding taking necessary steps for creating awareness amongst the people. They were moderately informed by them. Out of these 14 patients only 4 patients were aware about the specific surgical procedure and unexpected complications. Many of the patients are expecting the implant costs range from 10000 to 30000 Indian rupees. In the present study, majority of the patients reported high cost of implants as a major barrier in their use. Similar findings were reported Suprakash et al. (2013)<sup>11</sup> Zimmer CM et al. (1992)<sup>7</sup> and S A Johany et al. (2010)<sup>1</sup> wherein they found high cost as major factor in preventing the patients from the use of implants.

## Conclusion

This study shows limited knowledge and awareness about dental implants among the patients attending dental college seeking dental treatment. This survey underlines the need for providing correct information through various means to the patients to improve awareness about this treatment modality. Besides this, efforts should be made to reduce the cost of dental implants to a more affordable rate. As this survey was conducted in a limited group of people, further studies are required to be conducted amongst a larger group.

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### Achievement

DR PRIYA JOSE secured second rank for certificate program in bio psycho social health counselling



# Periodontal ligament stem cells: A review of the past, present and future

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## ABSTRACT

Teeth has a unique and complex developmental origin making it a fascinating area of study in regenerative medicine. Various types of mesenchymal stem cells have been isolated from the oral cavity and those from the periodontal ligament cells was in 2005. They can be easily recovered by non-invasive procedures and also culture, thus facilitating its use in regeneration.

The present review summarizes themorphofunctional features, surface markers and multilenage capacity of periodontal ligament mesenchymal stem cells. These cells also have an added advantage in possessing angiogenetic, immunoregulatory as well as anti-inflammatory properties, thus widening its use in periodontal regeneration arena.

**Keywords:** Periodontal ligament stem cells, stem cell markers, multipotency, immunomodulation, periodontal regeneration

## Introduction

Rudolf Virchow (1821-1902) postulated that all cells of the human body derive from a single cell and so started regenerative medicine studies. With this concept, the modern medicine, and in particular the regenerative medicine, focused its attention on stem cells located in specific niches.

A stem cell is defined as a cell that can continuously produce unaltered daughter cells and has the ability to generate cells with different and more restricted properties.<sup>1</sup> Stem cells can be categorized into two groups- embryonic and adult. Though embryonic stem cells are totipotent, regulatory issues concerning their procurement and use have caused current attention to be directed toward stem cells derived from adult tissues adult postnatal stem cells. These cells are slow cycling, and are 'self- renewing' cells or can generate large numbers of progeny. They are multipotent and differentiate into intermediate cell types, called precu-

ror or progenitor cells with clonogenic potential<sup>2</sup> the differentiating ability into cell types of the tissue in which they reside.<sup>3</sup> Having more restricted differentiation potential than totipotent embryonic stem cells, postnatal stem cells can thus be classified depending on their origin and differentiation potential. Common examples are hematopoietic and mesenchymal stem cells [MSC].

Friedenstein et al. 1970<sup>4</sup> first described MSC in bone marrow. They described MSC as fibroblast - like cells with the ability to assume an osteogenic phenotype in diffusion chamber cell suspensions when iso-transplanted in to mice. Although MSC have recently been isolated from a variety of adult and embryonic tissues,<sup>5</sup> presently, bone marrow represents the major source of postnatal MSC and is the most studied. However, bone marrow aspiration is an invasive procedure and, therefore, the search for alternative sources

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of MSC, and research regarding their potency is of significant value.

### Stem Cells in Dental Tissues

As tooth development occurs through mutually inductive signalling between oral epithelium and ectomesenchyme, they make stem cells derived from oral cavity interesting. The migrating neural crest cells have their own specific cells that represent a multipotent cell population that are derived from the lateral ridges of the neural plate during craniofacial development.<sup>4</sup>

Neural crest cells can be considered as the fourth germ layer as their specific features of stemness and multipotency, play a strategic role in tooth organ development thus contributing to craniofacial bone formation.<sup>5</sup> Six different human dental stem cells have been reported in literature: dental pulp stem cells (DPSCs), exfoliated deciduous teeth stem cells (SHED), periodontal ligament stem cells (PDLSCs), apical papilla stem cells, dental follicle stem cells (DFSCs), and gingiva stem cells (hGSCs).<sup>6-10</sup>

In comparison to others, periodontal ligament consists a peculiar population of multipotent postnatal stem cells known as Periodontal Ligament Stem Cells (PDLSCs) was described by Seo BM, (2004)<sup>11</sup> and Trubiani (2005).<sup>12</sup> As it can be expanded in a xeno-free medium preserving morphological features, markers associated with pluripotency and a normal karyotype, it can be used for human clinical regeneration therapy. PDLSCs are easily accessible from periodontal tissue with noninvasive procedure during standard dental scaling and root planning.<sup>13,14</sup>

The periodontal ligament (PDL) is a highly vascular and cellular connective tissue present between the cementum and alveolar bone socket. They play important role in sustaining and supporting the teeth within the jaw, tooth nutrition, homeostasis, and repair of damaged tissue and contains progenitors cells other than Malassez residual epithelial sheet.<sup>11</sup>

As stated earlier, PDL can be expanded *ex vivo* thus providing autologous stem cells with phenotypic profile same as bone marrow derived stem cells (BMMSCs), but with a higher cell growth.<sup>15</sup> PDLSCs cultured until 15 passages did not show signs of senescence.<sup>7</sup>

### Morphology and Stem Cell-Related Marker Expression of Periodontal Ligament Stem Cells

Human PDLSC were first isolated by Seo et al. in 2004. Primary cultures of PDLSCs showed colonies of bipolar fibroblastoid cells with oval nuclei containing two or three nucleoli.

On Ultrastructural analysis, PDLSCs showed cells with a large cytoplasm, extensive rough endoplasmic reticulum, abundant mitochondria, some residual lysosomal bodies containing electron-dense material and bundles of filaments and the nuclei had a dispersed chromatin indicative of an active gene transcription status.

Flow cytometry analysis revealed the homogeneous expression of the mesenchymal-related antigens CD13, CD29, CD44, CD73, CD90, CD105, CD146, CD166, other than OCT3/4, Sox2, and SSEA4 intracellular antigens, p75, Nestin, CD49, SLACS, SOX10 neural crest related markers.<sup>16,17</sup>

They also express the following proteins like CLPP, NQO1, SCOT1, a new isoform of TBB5 and DDAH1 that are not present in BMMSCs, implicated in the cell cycle regulation and stress reaction, homing, and detoxification.<sup>18</sup> Cells denoted as PDLSC have been shown as lacking hematopoietic markers, CD14, CD45, and CD31.

### Multipotency of PDLSCs

PDLSCs have the ability to differentiate into several cells (Fig. 1) under defined culture conditions thus showed a cell population able to differentiate into neural and mesodermal tissue.<sup>19,20</sup> It has already been demonstrated that PDLSCs can differentiate into osteoblast/cementoblast-like cells, adipocytes and chondrogenic cells.<sup>11,13,21</sup>

Xeno-free PDLSCs express neural protein markers as Nestin and GAP-43 according with their neural crest origin. GAP-43 is expressed in the nervous system, in glial cells and has action in mechanisms which control pathfinding and branching during development and regeneration.<sup>22,23</sup> This protein present in the periodontal Ruffini endings has an important role in nerve regeneration/development processes.<sup>24</sup> It has been also evidenced that during PDLSCs neurogenic

differentiation occur a cytoskeleton rearrangement, the cytoskeleton actin, is localized at the periphery with a typical epithelial arrangement and cells showed a very small and rounded cell body with thin neurite-like processes.<sup>25,26</sup>

In addition, PDLSCs could differentiate into Schwann cells via the ERK1/2 signalling pathway.<sup>27</sup> Okubo reported the differentiation ability of PDLSCs toward endothelial cells<sup>28</sup> and Pizzicannella demonstrated that LPS-G stimulus in endothelial cells obtained from PDLSCs causes a slowdown of cell growth and the release of IL6, IL8 and MCP1 molecules with the involvement of TLR4/NFkB/ERK1/2/p-ERK1/2 signalling.<sup>29-31</sup> PDLSCs can be induced to differentiate into cardiac myocytes expressing cardiac cell markers as sarcomeric actin and cardiac troponin T.<sup>32</sup> Other authors reported the possibility to generate islet-like cells from PDLSCs expressing endoderm- and pancreas-related genes.<sup>33</sup>

Also the differentiation into retinal ganglion-like cells has been demonstrated in PDLSCs.<sup>34</sup>

Numerous experiments have been demonstrated that the PDLSCs are the master regulator of osteogenic differentiation. In fact, when used in combination with different biomaterials, PDLSCs were able to promote a bone-regeneration process for the treatment of bony defects.<sup>35</sup> Interestingly, the upregulation of Mir-2861 and Mir-210 offers a novel regulatory pathway in the early steps of the bone-regeneration process related to the angiogenesis and osteogenesis processes.<sup>36,37</sup>

### Immunomodulatory Properties of PDLSC

There is much in vitro evidence indicating that various MSC are hypoimmunogenic, and also modulate the T cell response, independent of major histocompatibility complex (MHC) expression.<sup>38-42</sup> In vitro, human MSCs express intermediate levels of human leukocyte antigen (HLA), MHC class I molecules, are

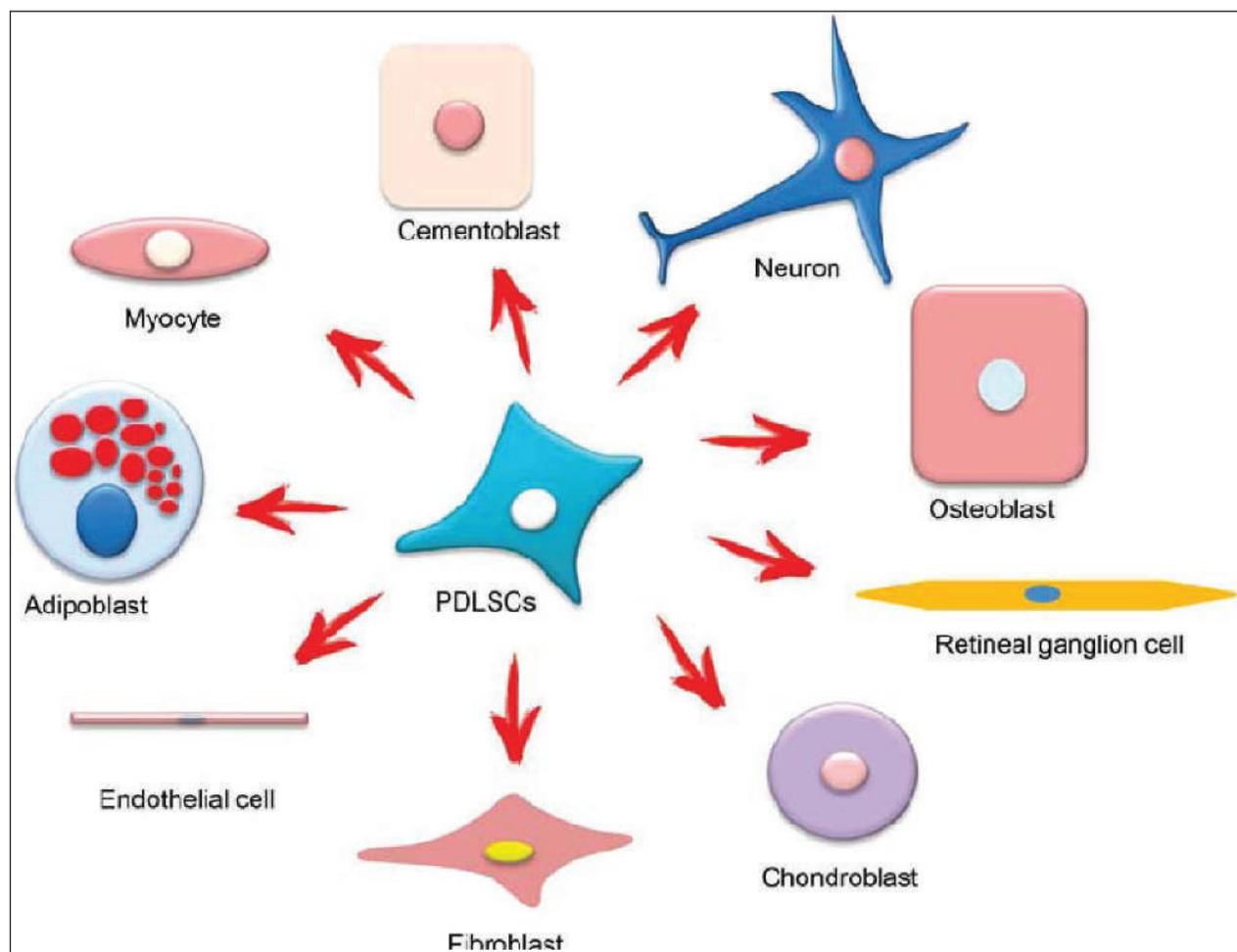


Figure 1: PDLSCs multipotency: PDLSCs have demonstrated the capacity to differentiate into several cytotypes.

negative for MHC class II molecules, but can be induced to express MHC class II by interferon gamma, and lack co-stimulatory molecules B7-1, B7-2, CD40, and CD40 ligand.<sup>43-47</sup> Consequently, these cells may escape recognition by alloreactive T cells.<sup>45,46</sup> In agreement, Wada et al. in 2009 showed that ex vivo expanded PDLSCs demonstrated *in vitro* immunosuppressive ability by inhibiting the proliferation of mononuclear cells, partly attributed to induced soluble factors such as hepatocyte growth factor and indoleamine 2, 3-dioxygenase (IDO) production.

However, very significantly, contradictory *in vivo* findings have been noted, showing a strong cellular immune response to transplanted MSC, indicating a possible alteration of antigen expression *in vivo*.<sup>48,49</sup> Hence, the *in vivo* utility of allogeneic PDLSC remains highly questionable, in line with earlier reports showing that human allogeneic tooth transplantations cause rejection due to immune-mediated osteoclast activation.<sup>50</sup>

Although a recent animal study showed evidence that, after allogeneic tooth transplantation, the donor periodontal tissue was replaced and regenerated by host cells without exhibiting a MHC-mediated host immune response,<sup>51</sup> findings from *in vitro* and inbred animal studies need to be considered with caution and validated in appropriate preclinical trials. Further studies are needed to investigate any potential value of PDLSC purported immunomodulatory activity in actual clinical settings.

### Periodontal Regeneration by PDLSC

PDLSC represent a novel stem cell population, in terms of *in vivo* capacity to develop into cementoblast like cells, and cementum, periodontal ligament like tissue, as evidenced positively in preclinical studies.<sup>38</sup> Seo et al.,<sup>38</sup> using a rodent model, demonstrated a cementum-PDL like complex generated in surgically created periodontal defects by transplanting *in vitro* expanded human PDLSCs in a ceramic particle scaffold. There is a similar report of histologic periodontal regeneration *in vivo* by expanded autologous PDLSC in a swine model.<sup>39</sup> Another porcine model study reports transplanting autologous swine PDLSCs, which lead to the generation of a root-periodontal complex capable of supporting a porcelain crown, resulting in normal tooth function.<sup>40</sup>

Besides periodontal regeneration, another potential application of PDLSCs is in the area of hybrid 'tooth engineering' in combination with other stem and progenitor cell populations and scaffolds. BMSC have been shown to form *de novo* organized dental tissue with a regenerated periodontal complex when used in an animal model.<sup>41</sup> In a recent study, Ma et al.<sup>41</sup> cell differentiation along the cementoblast lineage, denoting a potential inductive role of root surface in the activation of PDLSC differentiation, which can be utilized for bio-engineering applications. Periodontal tissue engineering using PDLSC conventionally needs 3-D biomaterial scaffold technology that can closely mimic the effect of extracellular matrix (ECM) derived signals for optimal differentiation however, there are inherent shortages in current scaffold technology. This has led to the development scaffold-free methodology for PDLSC transplantation, such as cell sheets<sup>42</sup> and recently, a promising novel 3D human PDLSC cell pellet, which self-secretes ECM and has favorable fabrication and handling, demonstrated the formation of a cementum-PDL like complex on transplantation into immune compromised mice.<sup>43</sup>

Cryopreserved PDLSC may be collected and saved for future use through preservation techniques such as freezing in liquid nitrogen. Seo et al.<sup>44</sup> reported that periodontal ligament, preserved frozen in liquid nitrogen, generated high proliferative PDLSC, although the number of PDLSC colonies derived was decreased in comparison with freshly isolated tissue samples. Thus, use of cryopreserved PDLSC could widen the application arena.

### Conclusion

Recent findings demonstrate that periodontal ligament contains a population of multipotent post-natal stem cells that can be isolated and expanded *in vitro*, providing a unique reservoir of stem cells. Hence, it can be concluded that human PDLSC may hold promise as the basis of practical cellular-based treatment for periodontal regeneration. Challenges for periodontal regeneration using PDLSC include the inflammatory environment, intrinsically associated with periodontal disease and difficulties in obtaining histological evidence in human clinical trials. Other issues yet to be assessed adequately are proteomic profiling, optimal cell density for implantation, op-

timal scaffolds for cell delivery, assessment of tissue regeneration by image analysis, and the development of bioreactor technologies that can more efficiently address the clinical need for largescale production of MSC, including PDLSC.

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## Awards and Achievements



Dr Rosamma Joseph Vadakkekuttal  
Professor & HOD(Periodontics), Govt.  
Dental College, Kozhikode has secured  
second rank in the certificate programme

in Research Methodology conducted under  
the Kerala University of Health Sciences  
School for Health Policy and Planning Studies,  
Thiruvananthapuram (2018 batch).

# Platform Switching –Put A Stop To Crestal Bone Loss???

Mahshook KP<sup>1</sup>, Shibu Godfrey Pereira<sup>2</sup>

## ABSTRACT

The peri-implant bone level has been used as one of the criteria to assess the success of dental implants. It is an important prerequisite for preserving the integrity of gingival margins and interdental papillae. Traditionally, a radiographic marginal bone loss of 1.5 mm during the first year followed by a radiographic marginal bone loss of 0.2 mm during each succeeding year is an important parameter for the assessment of implant success. Purpose of this review is to assess survival rates and clarify their influence both on marginal bone loss around the cervical region of the implant and on soft tissue aesthetics.

**Keywords:** Platform switching, crestal bone loss, bone implant contact (BIC), Osseo integration of dental implants

## Introduction

The goal of modern implant therapy is focused on more than just the successful osseo-integration of the implant. A successful result must also provide an esthetic and functional restoration surrounded by sound peri-implant tissues that are in harmony with the existing dentition. Stable level of peri-implant bone is one set parameter of implant success. As a process to improve long-term bone maintenance around implants, a new implant-to-abutment connection referred to as “platform switching” was proposed.<sup>1</sup> The resulting crestal bone levels around dental implants after the restoration has been a topic of discussion and used as a reference for evaluation of implant success for many years. In the late 1980s, wide-diameter implants were commercially introduced.<sup>2</sup> Contrary to what was expected, post-loading radiographic evaluations showed no changes in the crestal bone levels around platform switched implants. This serendipitous finding led to the introduction of the concept of platform switching.<sup>3</sup>

## Crestal bone loss

Adel et al (1981) were the first to qualify and report marginal bone loss. Their study indicated greater magnitude and occurrence of bone loss during the

1st year of prosthetic loading. A loss of between approximately 1.5 and 2 mm down to the first thread during the first year of loading of submerged implants followed by 0.2 mm in subsequent years.<sup>4</sup> So crestal bone preservation should always be considered while planning for implant placement. Apart from this, resorption of marginal bone will affect the gingival contours and may result in loss of inter proximal papilla. The crestal bone around dental implants could be a fulcrum for lever action when a bending moment is applied, suggesting that implants could be more susceptible to crestal bone loss by mechanical force.<sup>5</sup>

## Factors contributing to marginal bone loss around implants

The remodeling process involves marginal bone resorption that is affected by one or more of the following factors: (1) infectious process; (2) excessive loading conditions; (3) the location, shape, and size of the implant-abutment microgap and its microbial contamination; (4) biologic width geometry and implant surface roughness; (5) peri-implant inflammatory infiltrate; (6) micro-movements of the implant and prosthetic components; (7) repeated screwing

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and unscrewing; (8) implant-neck; and (9) traumatic surgical technique.<sup>6</sup>

### The implant abutment interface-microgap

The connection between implant fixture and its restorative abutment is termed the implant abutment interface (IAI) or “microgap”. In most cases, it is susceptible to micromovements during clinical function and also permits micro-leakage of fluids. This infiltration results in the permanent presence of an area of abutment inflammatory cell infiltrate. The sustained state of inflammation promotes osteoclast formation and activation, which contributes to bone loss. Platform-switching concept requires that this microcrack be placed away from the implant shoulder and closer toward the axis in order to increase the distance of this microcrack from the bone as a protective measure.

### Concept of platform switching

In 1991, Implant Innovations introduced 5 mm and 6 mm diameter implants. They were intended to

increase the bone to implant contact, when placing shorter implants in areas of limited bone height. At that time, prosthetic components of similar dimension were not easily available; hence clinicians restored them with standard 4.1 mm diameter components, which created a 0.45-0.95 mm circumferential horizontal difference in dimension between the implant seating surface and the attached component. After a 5-year period, the typical pattern of crestal bone resorption was not observed in platform switched implants.<sup>8</sup> Thus, the discovery of the concept was a coincidence. Platform switching concept was introduced in the literature by Lazaro, Various biologic and mechanical theories have been proposed to justify this phenomenon.<sup>6</sup> It was suggested that the inward positioning of the implant-abutment interface allowed the biologic width to be established horizontally, as an additional horizontal surface area is created for soft tissue attachment hence, less vertical bone resorption is required to compensate for the biologic width. Furthermore, this design increases the distance between the inflam-

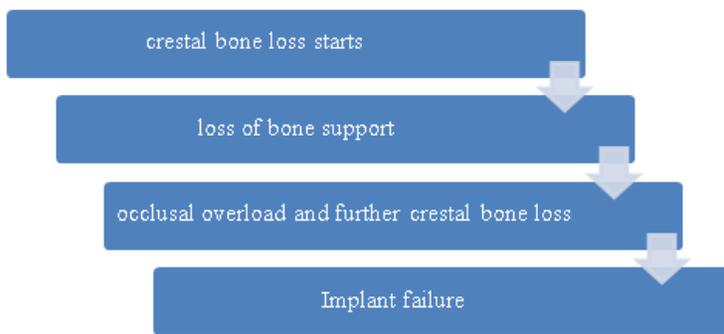


Figure 1: The pathway for implant failure

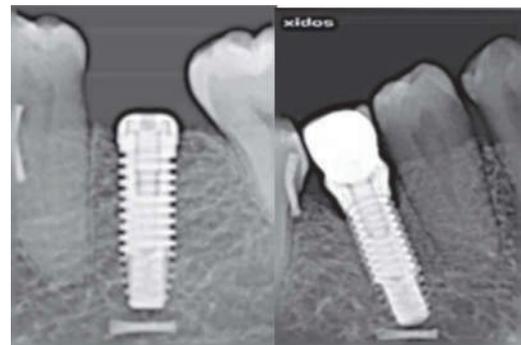


Figure 2: Crestal bone resorption

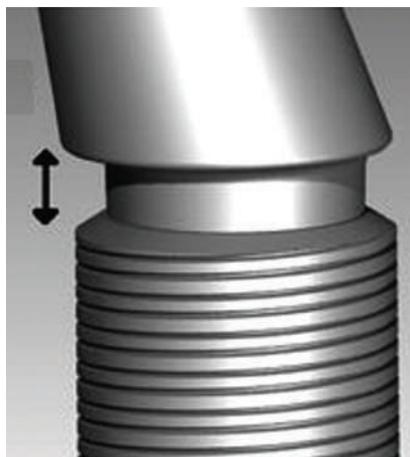


Figure 3: Platform switching

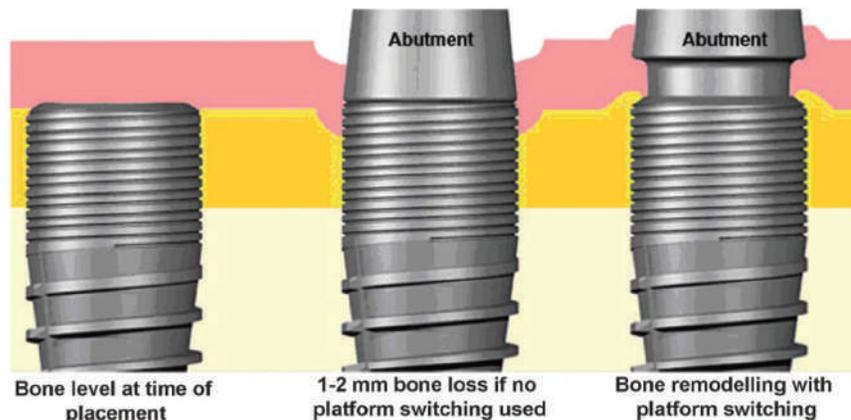


Figure 4 : Mechanism by which platform switching reduces crestal bone loss

matory cell infiltrate at the microcap and the crestal bone, thereby minimizing the effect of inflammation on marginal bone remodelling.<sup>10</sup> Another theory supported by finite element analysis, reports reduction in stresses, especially in the crestal region by shifting the stresses away from the bone implant interface.<sup>9</sup>

The mechanism by which platform switching can contribute to reduce the crestal bone loss could be due to following reasons.

1. Shifting of the inflammatory cell infiltrate inwards and away from the adjacent crestal bone.
2. Maintenance of biological width and increased distance of IAJ from the crestal bone level in the horizontal way.
3. The influence of microcap on the crestal bone is reduced.
4. The stress levels in the per implant bone are decreased.

### Influence of platform switching on stress distribution on bone-implant biomechanical system

According to Rodrigo et al osseointegrated implants with internal connections showed less marginal bone loss as compared to external connection implants.<sup>10</sup> This is mainly due to presence of platform switching present in internal connection implants. This is because in platform switching the implant abutment connection is far away from the margin, which causes decreased load concentration, decreased micromovements, and also the bacterial colonization takes place at a farther region of bone. When crestal bone geometry is modeled by platform switching configurations and subcrestal positioning the best stress based performance for compact bone was obtained, together with acceptable stress values at cancellous interface. Recent studies<sup>11</sup> have also shown that the biomechanical performance in platform switched implants is better as it changes the stress distribution from the abutment to the implant and from the implant to the bone when occlusal loading occurs.

### The response of soft-tissue to platform switching

The most widely studied theory proposed to explain maxillary bone remodelling after dental implant

placement has been the formation of a new biological space. The creation of this mechanical barrier serves as a defence mechanism, preventing the penetration of bacteria from the oral environment. According to Lazaro and Porter, the deliberate creation of a space for the mentioned physiological barrier minimizes the space for repositioning of the fibers by displacing the junction with the abutment to a more medial position with respect to the axis, an increased surface area of the implant is freed. Thus favouring controlled repositioning of the biological space.<sup>13</sup> The space is created in the horizontal plane one millimetre from the IAJ, supported over the external margin of the platform. In addition, this procedure keeps the inflammatory infiltrate away from the crestal bone margin, with a 50% reduction in occupation surface.

### Advantages

- The inflammatory cell infiltrate, which surrounds the IAJ in a collar like fashion, is contained within the angle formed at the interface and thus prevented from spreading further apically along the implant where it would otherwise result in inflammatory changes to the bone crest
- The horizontal dimension of the step allows for an additional area where biologic attachment may take place, thus limiting the extent of physiologic remodeling of the bone crest needed to accommodate the biological zone
- Optimal management of restorative space with the crestal bone preserved both horizontally and vertically, support is thus retained for the interdental papillae. Maintenance of midfacial bone height helps to maintain facial gingival tissues.<sup>14</sup>
- Improved bone support for shorter implants
- The possible influence of the microgap on bone resorption may be diminished by moving the junction inwards from the bone crest.

### Disadvantages

- If normal sized abutments are to be used, implants of larger size need to be placed. This might not be possible clinically always
- If normal implants are to be used, smaller diameter abutments may compromise the emergence profile in aesthetic areas
- Around 3 mm of soft tissue should be pres-

ent to place platform switched implants or else bone resorption is likely to occur

- For platform switching to be effective, the under sizing of the components must be carried out during all phases of the implant treatment.<sup>15</sup>

### Conclusion

Crestal bone loss has been documented as one of the important factors that affect the long term prognosis of a dental implant platform switching is capable of reducing or eliminating crestal bone loss. It also contributes to maintaining the width and height of crestal bone and the crestal peak between adjacent implants and it also limits the circumferential bone loss. We conclude that the inward shift of IAJ platform switching can be considered a desirable morphologic feature that may prevent the horizontal saucerization and preserve the vertical crestal bone levels. Despite the obvious potential these facts convey, the platform-switching procedure is a subject that needs extensive investigation. Further studies including modified 3D finite element models and longitudinal clinical observations.

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### Achievement

Dr Deepak Thomas secured First rank in certificate course in family health care and health humanities conducted by KUHS



# “Ushering in a new role for Periodontists as Forensic Odontologists!”

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## ABSTRACT

The science of using oral structures for human identification, better known as forensic odontology, is a special branch of forensic medicine while Periodontics is a specialized field of dentistry that deals with the diseases of the Periodontium.

Every individual has a unique dental identity. Dental identifications have always played a key role in natural and man made disasters. Records of gingival & periodontal ligament morphology and pathology, alveolar process & lamina dura, case history, photographs & cast documentation, age and gender determination, implant recognition software etc, have been used for identification of individuals.

This article provides futuristic eyesight into how periodontal records can play an important role in identifying the deceased.

**Keywords:** Gingiva, periodontists, periodontal tissues, forensic odontology, post mortem, ante mortem.

## Introduction

A genuine and dedicated criminal investigation requires the combined efforts of a multidisciplinary team. The science of using oral structures for human identification, better known as forensic odontology, is a special branch of forensic medicine. It is performed by a comparative evaluation of the antemortem and postmortem records.<sup>1</sup> Since Forensic odontology is a field of dentistry involved in analysing the dental evidence in the interest of justice,<sup>2</sup> the application of these forensic techniques in the identification, criminal justice and dental liability is being practiced worldwide.

In mass disaster events, notably large commercial aircraft crashes, the traumatic forces are such that fragmentation and conflagration results in only the most durable of human tissues ie; dentition surviving and becoming a potential source of identification.<sup>3</sup> Here comes the most important role of the forensic dentist in the identification of the deceased individuals.<sup>4</sup>

## History

History has witnessed many incidents wherein forensic odontology was used in investigations. The first ever evidence of the use of forensic odontology to identify a dead subject was in the late 60's AD when King Nero recognized a lady through her peculiar teeth setting.<sup>5</sup> The first ever case that recorded the use of dental identification was that of John Talbot, who fell in the Battle of Castillon in 1453. Dr. Paul Revere, who identified the body of Dr. Joseph Warren, a revolutionary in 1775 did so by identifying the silver and ivory bridge he had constructed for the latter two years prior to the event. These were the first forensic Odontologists. The first comprehensive text on forensic odontology entitled, “L' Art Dentaire en Medicine Leagale” was published by Dr. Oscar Amoedo, who is also known as the father of forensic odontology.<sup>1</sup> The late President of Pakistan, General Zia-ul-Haq who died in a plane crash and the late Indian Prime Minister, Mr. Rajiv Gandhi who was assassinated in a terrorist

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attack in 1991 were identified from their dentition.<sup>6</sup>

### Case record maintenance

The innovation of electronic software for dental record maintenance has certainly enhanced the quality and the safety of the patients, and in the future it is likely to increase as more dental clinics and hospitals have become computerized.<sup>7</sup> A proper ante mortem periodontal case record & history of the patient will enable the forensic specialist in the accurate identification of the deceased by matching it with the post-mortem record.<sup>8</sup> The ability of clinical practitioners to produce and maintain accurate dental records is essential for good quality patient care and it is as well a legal obligation. The dental record provides the continuity of care for the patient and is critical in the event of a fraud insurance claim.<sup>9</sup> For Forensic odontology to be practical in the easy identification of each victim or culprit; comparison of the antemortem records that was recorded by each Periodontists in detail and the postmortem records can be done.

It is important for the Periodontist to note and record the various disease factors (patient's case history, photographs & casts documentation) and that would definitely serve as an important tool in the diagnosis of the deceased. Keeping in mind that the death of the soft tissues occurs after the clinical death of the deceased in 48 hours, the maintenance of the clinical photographs prove to be of utmost importance in evidence.<sup>10</sup> Dental identification involves two main forms; by using antemortem dental records and post-mortem dental profile.

### Comparative dental identification: Both antemortem and postmortem records comparison

The central theory of dental identification is that postmortem dental remains can be compared with

antemortem dental records, including written notes, study casts, radiographs and so on to confirm identity. Clearly, individuals with numerous and complex dental treatments are often easier to identify than those individuals with little or no restorative treatment.<sup>11</sup> The forensic dentist produces the postmortem record by careful charting and written descriptions of the dental structures and radiographs.

### Ante mortem

If the antemortem records are available at this time; postmortem radiographs should be taken to replicate the type and angle of these.<sup>6</sup> Structures which are examined during oral examination are:

#### a. Gingival morphology and pathology

- ★ Contour, recession, focal/diffuse enlargements, interproximal craters
- ★ Colour: inflammatory changes, physiological (racial) or pathological pigmentations
- ★ Calculus deposits

#### b. Periodontal ligament morphology and pathology

- ★ Thickness
- ★ Widening
- ★ Lateral periodontal cysts

#### c. Alveolar process and lamina dura

- ★ Height, contour, density of crestal bone
- ★ Thickness of interradicular bone
- ★ Exostoses, tori
- ★ Pattern of lamina dura
- ★ Bone loss (horizontal/vertical)
- ★ Trabecular bone pattern of bone
- ★ Residual root fragments



Figure 1: Clinical picture of periodontitis<sup>22</sup>



Figure 2: Post mortem record of periodontitis<sup>22</sup>

It is important for the Periodontist to note & record various disease factors (patient's case history, photographs & casts documentation) in order to facilitate the effective diagnosis of the deceased.<sup>12</sup>

### Postmortem

**Human identification by deoxyribonucleic acid:** Human identification by deoxyribonucleic acid (DNA) isolation from several biological contents of saliva has come into the limelight in the present years. Saliva, an abundantly available oral fluid, can be procured from bite marks, edibles, cigarette butts, and other objects and easily stored in most different conditions. Moreover, 1 ml of saliva has been proved to include a DNA typing strength equivalent to 10  $\mu$ l of whole blood making it a reliable source for human identification.<sup>1</sup>

**Assessments of gingival epithelium:** Assessments of gingival epithelium vary among individuals and these can be precisely studied through cellular changes under the microscope. Histological examination of gingival tissues procured from postmortem and antemortem samples at different time intervals revealed that decomposition process is initiated within 10 h after death and other cellular changes occur subsequently.<sup>1</sup>

**Gender identification:** The determination of sex and ancestry can be assessed from the skull shape and form. Apart from using skull shape, microscopic examination of teeth can be used to confirm sex by checking for the presence or absence of Y-chromatin. DNA analysis can also reveal sex. Currently, DNA comparisons may very well prove to be the most reliable and useful method of identification. DNA is a stable molecule and can survive decomposition when contained within bones and teeth. Dental calculus is also used for determination of sex by the PCR method using primers, which recognize DYZ3 region of Y-chromosome and DXZ1 of X-chromosome. Sex determination using DNA in dental calculus will be quite useful for forensic application because it can be done without destruction of morphological characteristics of the teeth.<sup>12, 13</sup>

### Age determination

**Cementum Incremental Lines:** Determination of age from cemental incremental lines was evaluated

in intact teeth.<sup>14,15</sup> Cemental annulations are not always easy to count. Mineralized 100 $\mu$  thick cross-sections were subjected to one of the following three treatments: unstained, stained with Villanueva's blood stain and stained with acridine orange.<sup>15,16</sup> Cresyl fast violet, Toluidine blue, hematoxylin or periodic acid Schiff (PAS) can also be used for staining. Ideal areas were selected by light microscopy and photographed. Countability of incremental lines from photographic enlargements were evaluated. The average number of years required for the eruption of a particular tooth was added to the incremental lines count to estimate the age of the individual. Results obtained from unstained mineralized 100 $\mu$  thick cross-sections using differential interference microscopy (Nomarsky) provided the most countable lines. The accuracy and replicability of the method is not dependent on tooth type or location, but on the average obtained from making as many counts as possible. Incremental lines in human dental cementum could be observed best using decalcified sections stained with cresyl violet excited by green light; since incremental lines are not destroyed by acids and stains.<sup>17</sup> In another study demineralized stained sections of canines and single-rooted premolars were viewed in a fluorescence microscope. Non-fluorescent lines, seen against a fluorescent background were counted directly and computed this on the total width of the cementum. The correlation coefficient between tooth age and the number of lines for the whole material was 0.84 when counted and 0.73 when calculated. The coefficient was only significant in teeth from individuals below the age of 50 years.<sup>18</sup>

**Langerhans cells:** Modified adenosine triphosphatase (ATPase) histochemistry was employed in the identification and counting of the Langerhans cells (LC) in autopsy tissues from 8 oral mucosal sites, 8-20 h postmortem. Nonkeratinized mucosae of the soft palate, ventral tongue, lip, and floor of the mouth had the highest counts (508  $\pm$  110 LC/mm<sup>2</sup>, n = 24), and keratinized mucosae of the hard palate and gingiva had the lowest counts (201  $\pm$  97 LC/mm<sup>2</sup>; n = 8). The frequency of oral mucosal langerhans cells varies inversely with the degree of keratinization. There are regions of the oral mucosa that have no langerhans cells.<sup>19</sup>

**Gingival tissue changes:** Gururaj and Sivapathasundharam<sup>20</sup> who examined and analysed

postmortem changes in gingival tissues found that the gingival sections from dead individuals clearly depicted vacuolation of the nuclei in the spinous layers of epithelium and this suggests autolysis. Although Gingival sections from living individuals showed no changes at all, sections that were fixed after 24 and 48 hours showed changes throughout the epithelium similar to those in the dead individuals.

The marginal tissue recession of the periodontium has been used as one of the several indicators of age in methods of age estimation. Periodontal recession though not an accurate indicator of age, has been recorded to be more rapid in males than in females.<sup>21</sup>

**Implants:** Though usual dental implants have a melting point above 1650°C, there are other conventional restorative materials like dental amalgam, composite resin, and gold which might melt or distort in high temperatures. Therefore, complete details of implant manufacturing process and materials involved being revealed can aid in case recognition and this would simplify the job of a Forensic Odontologist. An Implant Recognition Software has been developed by G. Michelinakis and this software uses aspects like design, properties, and attachment mechanism for identification.

## Conclusion

Effective criminal investigation thus requires a joint effort from multiple disciplines. Detailed records of gingival morphology & pathology, periodontal ligament morphology and pathology, alveolar process and lamina dura, case history, photographs and cast documentation should be recorded (ante mortem) in detail and maintained in order to facilitate the smooth and easy diagnosis by the Forensic Specialist as a Periodontal-Forensic Approach might require a lot of information.<sup>22</sup> Post mortem records of human identification through deoxyribonucleic acid and the assessment of gingival epithelium vary among individuals and this holds extreme importance in terms of diagnosis in forensic odontology. The aforementioned

details highlight the importance of Periodontists as Forensic Odontologist.

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# Evaluation of salivary pH levels in periodontitis patients- a pilot study

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## ABSTRACT

**Objectives:** The incorporation of salivary diagnostics into dental practice is now becoming a reality and will be of diagnostic value in the future. It contains a variety of mucosal host defense factors. Salivary pH is one of the essential factors in the determination of periodontal diseases and dental caries. The aim of this study was to evaluate and compare the salivary pH levels in periodontally healthy subjects and patients with chronic generalized gingivitis and chronic generalized periodontitis. **Study Design:** The study population consisted of 48 patients. They were divided into three groups of 16 patients each: Group A with periodontally healthy subjects, Group B with chronic generalized gingivitis, and Group C with chronic generalized periodontitis. Unstimulated saliva was collected from each patient and pH was analysed. The mean and standard salivary pH for all the three groups was calculated. The multiple group comparison was done with Post Hoc analysis using Tukey HSD (honestly significant difference). **Results:** The salivary pH was slightly acidic for patients with chronic generalized periodontitis as compared to the periodontally healthy subjects ( $p=0.001$ ) and patients with chronic generalized gingivitis ( $p=0.001$ ). **Conclusion:** Based on our results, salivary pH may be an important predictor of oral health status. Any change in the salivary pH can cause dental and periodontal disease. Future prospective studies with large samples are recommended to confirm these results.

**Key words:** Salivary pH, digital pH meter, chronic generalized gingivitis, chronic generalized periodontitis

## Introduction

Saliva is complex fluid that maintains oral hygiene and microbiological flora. The saliva that circulates in the mouth at any given time is known as whole saliva and it consists of a mixture of secretions from the major and minor salivary glands and traces from the gingival crevicular fluid.<sup>1</sup> The wide range of molecules present in the salivary secretions makes saliva a potential source of disease biomarkers. Biochemical composition of saliva, its pH and enzymatic contents determine oral health and onset of diseases inside the oral cavity.<sup>2</sup>

Periodontitis is the second most prevalent oral

disease next to dental caries that affects 5-30% of adult population. It follows a discontinuous pattern of exacerbation and remission characterized by disease activity and inactivity. Periodontal disease are associated with Gram-negative anaerobic organisms that colonize at the tooth surfaces and just below the gingival margin. There is a strong evidence exists that *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis* and *Tannerella forsythia* are the main etiological agents. A study by Takahashi et al. on the effect of pH on the growth of microorganisms showed that *P. intermedia* grows at a pH of 5.0-7.0, *P. gingivalis* grows at a pH of 6.5-7.0 and *E. nucleatum* grows at a pH of 5.5-7.0.<sup>3,4</sup>

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Diagnosing active stages of periodontal disease and identifying patients at risk for active disease pose a challenge to both researchers and clinicians. In general, clinical parameters like probing depth, clinical attachment loss, bleeding on probing and radiographic bone loss are used to assess the severity of disease.

Occasionally, monitoring of the microbial infection<sup>5</sup> and analysis of the host response in gingival crevicular fluid (GCF) are utilized in an attempt to identify individuals at risk for future breakdown.<sup>6,7</sup>

Salivary sample has many benefits over serum like low cost, ease of collection, storing, transport and reduces the anxiety of patients due to the non-invasive collection techniques. Saliva has a major impact on the initiation, maturation and metabolism of plaque. So salivary pH may be tried to be used as a quick chair side test. There is scanty evidence in the literature regarding the use of salivary pH as a diagnostic marker in periodontal disease.

### Aim

To evaluate and compare the salivary pH levels in periodontally healthy subjects and patients with chronic generalized gingivitis and chronic generalized periodontitis.

### Materials and methods

The study was conducted among out patients who attended the Department of Oral Medicine and

Radiology and Department of Periodontics. Salivary analysis was done in the Department of Oral Pathology and Microbiology at Anoor Dental College & Hospital, Muvattupuzha. All patients were verbally explained the nature of the study and an informed written consent was obtained.

### Sampling

The study consists of 48 subjects including both male and female patients aged between 20 to 45 years who were divided into three groups and each group consists of 16 individuals.

Group A-Periodontally healthy subjects

Group B-Patients with chronic generalized gingivitis

Group C- Patients with chronic generalized Periodontitis

### Inclusion criteria

#### For Group A

- Subjects with a minimum number of 28 teeth.
- Sulcus depth  $\leq 3$ mm with no clinical attachment loss and no bleeding on probing (as per gingival index by Loe and Sillness in 19638).

#### For Group B

- Subjects with a minimum number of 28 teeth.
- Sulcus depth  $\leq 3$ mm with no clinical attachment loss but presence of bleeding on probing (as per



Figure 1: Single electrode digital pH meter (Model EI-111)

gingival index by Loe and Sillness in 1963).<sup>8</sup>

**For Group C**

- Subjects with a minimum number of 20 teeth.
- 10 teeth having clinical attachment loss with a pocket depth of ≥5 mm.

**Exclusion criteria**

- Patients with history of systemic diseases or conditions.
- Patients who were completely edentulous patients and smokers.
- Patients giving history of hospitalization or intake of medications in a period of 6 months.
- Patients with dental caries.
- Patients with malocclusion, mouth breathing and local pathological factors that lead to periodontal disease.

**Assessment of Gingival Index**

Gingival Index was assessed by using Gingival Index developed by Loe H and Silness J in 1963.<sup>8</sup>

**Assessment of Clinical attachment loss**

The clinical attachment level and periodontal pocket was measured by using University of Michigan ‘O’ probe, with William’s markings.

**Saliva Sampling**

Saliva was collected in accordance with protocol derived from the World Health Organization/International

Agency for Research on Cancer guideline “Common Minimal Technical Standards and Protocols”.<sup>9</sup> After an overnight fast, saliva samples were collected in the morning, during which subjects were asked not to drink any beverages except water. Drinking water (bottled) was provided and they were requested to rinse their mouth out well (without drinking water). The subjects were requested to refrain from speaking and let the saliva flow to the front of the mouth naturally. The subjects were also advised to spit the saliva and not to cough up mucus. 3 ml of saliva was collected in sterile 10 ml beakers. The salivary sample was obtained between 9:00 am and 11:00 am. The pH of the saliva was assessed instantly to avoid any sample deterioration.

**Salivary Analysis**

Salivary pH was measured with the help of a single electrode digital pH meter (Model EI-111) as shown in Figure 1. The digital pH meter was calibrated every day. The electrode was placed in 0.1N hydrochloric acid overnight. The digital pH meter was then calibrated using freshly prepared pH 7 and pH 4 buffers. The electrode was then kept in double distilled water. Before dipping the electrode into the sample, it was gently dried completely by using fresh sterile filter papers each time. The electrode tip was again washed with a gentle stream of distilled water after evaluating the pH and then dipped in the double distilled water. The liquids and chemicals were freshly prepared every day.

**Statistical Analysis**

The mean and standard salivary pH for all the three groups was calculated. The multiple group

Table 1: Average pH values for the three groups

Groups	Average pH
A	7.01 ± 0.26
B	7.10 ± 0.03
C	6.80 ± 0.04

Table 2: Average Gingival Index for the three groups

Groups	Average Gingival Index
A	0 (0.00)
B	1.27 (0.42)
C	2.56 (0.19)

Table 3: Multiple group comparisons

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
A	B	-0.085	0.05608	0.293
	C	0.21375	0.05608	0.001
B	A	0.085	0.05608	0.293
	C	0.29875	0.05608	0.001
C	A	-0.21375	0.05608	0.001
	B	-0.29875	0.05608	0.001

comparison was done with Post Hoc analysis using Tukey HSD (honestly significant difference) and was considered statistically significant if  $p$  value was  $< 0.05$ .

## Results

As shown in Table 1, the average salivary pH for periodontally healthy subjects was  $7.01 \pm 0.26$ . The average salivary pH of patients with chronic generalized gingivitis was  $7.10 \pm 0.03$  while average pH for patients with chronic generalized periodontitis was  $6.80 \pm 0.04$ .

The bar chart showing average pH values for the three groups is given below.

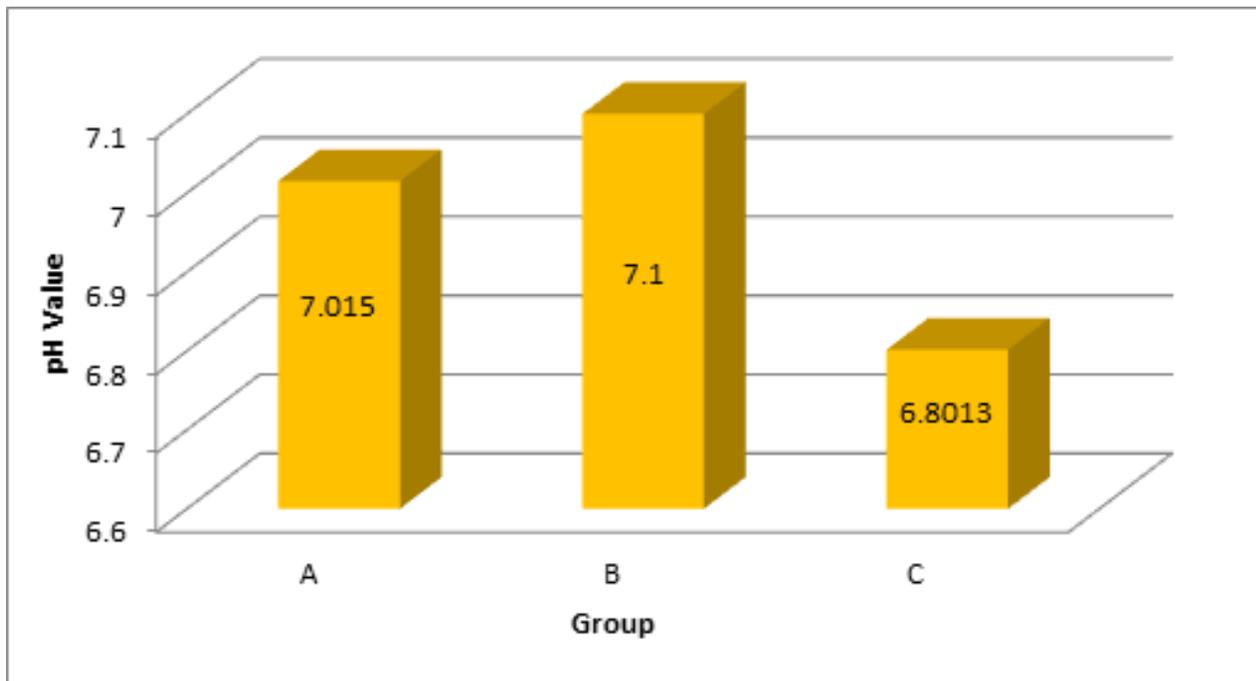
The mean gingival index for the three groups is shown in Table 2.

Multiple group comparisons was made with Post Hoc analysis using Tukey HSD (honestly significant difference). The difference in the pH value between A and B is not significant. The difference between A and C, B and C are significant because the  $p$  value is less than 0.05. It was found that pH of saliva from chronic generalized periodontitis patients was slightly acidic as compared to the periodontally healthy subjects ( $p=0.001$ ) and patients with chronic generalized gingivitis ( $p=0.001$ )[Table 3].

## Discussion

Approximately 500-700ml of saliva is secreted daily of which submandibular gland accounts for 70%, parotid gland accounts 25%, and sublingual gland accounts 5%. The saliva also contains desquamated oral epithelial cells, microorganisms and their products, leucocytes, serum constituents, fluid from gingival crevice and food remnants.<sup>10</sup> The pH of saliva is maintained near neutrality (6.2-7.6) by two mechanisms. First, saliva flow eliminates carbohydrates that can be metabolized by bacteria and removes acids produced by them.<sup>10</sup> Second, by the buffering activity of saliva, acidity from drinks and foods, as well as from bacterial activity, is neutralized.<sup>10</sup>

Periodontitis is highly prevalent all over the world and is an important health challenge in different countries.<sup>11, 12</sup> Periodontal disease is an inflammatory condition of the tooth-supporting structures caused by gram-negative subgingival anaerobic bacteria. It involves plaque accumulation, release of bacterial substances and host inflammatory response which results in periodontal pocket formation and loss of alveolar bone. The periodontal pathogens reside in these pockets and their products cause pathologic



Graph 1: Bar Chart showing average pH values for the three groups

tissue changes that deepens the gingival sulcus and progresses the disease.

Gingival crevicular fluid seeps into the gingival sulcus from the gingival connective tissue through the thin sulcular epithelium and contribute to the pH of saliva. For this reason whole unstimulated saliva was collected from the subjects.

According to Takahashi N, proteolytic bacteria like *Fusobacterium*, *Campylobacter*, *Prevotella* and *Porphyromonas* can degrade nitrogenous compounds into small peptides and amino acids by cell membrane-bound and/or extracellularly secreted proteases for subsequent use as metabolic substrates. *Fusobacterium* species use glutamic acid as source of nutrient and produce acetic acid and butyric acid. *P. gingivalis*, *P. intermedia* and *C. rectus* metabolizes aspartic acid to succinic acid but requires formic acid as a reducing agent. Oral Treponemal species are exclusively dependent on isobutyric acid for growth. Thus, most of the subgingival microbiota responsible for chronic periodontitis either use or produce mild to moderately acidic end products.<sup>13</sup> In acidic conditions the mouth is more prone to dental caries, halitosis and periodontitis.

Fujikawa et al. evaluated the correlation between the pH level and the microflora in periodontal pockets in the various stages of periodontal disease. A change in pH level was observed in deep pockets or severe gingival inflammation. The pH level was significantly related with the proportion of coccoid forms, but was negatively correlated with the proportion of motile organisms that are reported to be associated with periodontal disease.<sup>14</sup>

Baliga et al. reported that chronic generalized gingivitis patients had more alkaline pH as compared to control group whereas chronic generalized periodontitis patients had more acidic pH as compare to control group.<sup>10</sup>

Nabi T et al. in a case control study observed that saliva of patients suffering from chronic generalized gingivitis was alkaline in nature while that of patients with chronic generalized periodontitis was acidic when compared with health individuals.<sup>15</sup>

Umamaheshwari et al. observed that salivary pH was lower in individuals with periodontitis and diabetes

mellitus as compared to individuals with periodontitis without diabetes mellitus. They commented that salivary pH was more acidic among diabetic individuals due to metabolic processes.<sup>16</sup>

Galgut reported that there is no correlation between pH and gingivitis but significant correlations were evident between pH and periodontal pocket. This is in accordance to our result for pH and chronic periodontitis.<sup>17</sup>

## Conclusion

Saliva contains many locally derived and systemically derived markers for periodontal disease. It can be used an indicator of prognosis during periodontal treatment. Within the limitations of this study, it has been observed that the salivary pH in patients with chronic generalized periodontitis is slightly acidic as compared to chronic generalized gingivitis and subjects with clinically healthy gingiva. Further elaborate studies with larger sample size, microbiological analysis and ions in the salivary sample are required draw definite conclusions.

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