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“DENTAL LAMINA”

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Oral diseases are closely linked to lifestyle. Dental health encompasses the likelihood of making healthy choices in relation to diet, smoking, tobacco, oral hygiene and utilization of dental health services.³ A rise in the use of sugary diet, especially bakery products and carbonated drinks increase prevalence of Dental caries.

Making choices that support and care for your body everyday and making them part of your lifestyle will help you to have a healthy life and a healthy mouth. Unfortunately more and more people living busy lifestyles are relying on caffeine and sugar to keep them going and then turning to food and alcohol to help them relax. With modern technology and the need to get more done people are staying up later, not getting enough sleep or quality sleep and feeling exceedingly stressed on a daily basis.

No amount of good oral hygiene practices can make up for the affects of poor lifestyle habits. This would be like thinking that you can stay up really late every night then thinking you can make up the lost sleep hours by sleeping late on the weekends. The damage has already been done.

Balancing stress, diet/nutrition, sleep quality, hydration, tooth brushing and flossing are the keys to dental health. It has to be a total body package, aimed at achieving balance and harmony throughout the body as a whole.

Improving your health and in turn preventing dental problems may mean making some big changes to your lifestyle. It comes back to making a commitment to caring for yourself and adhering to it.

Make small manageable changes and take things step by step and in this way you will be on your way to a healthier life and have a healthier mouth before you know it.

Dr. Shveta Sood
Editor In Chief



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SIGNIFICANCE AND RELEVANCE OF ORIENTATION PROGRAM FOR FIRST YEAR STUDENTS IN DENTAL COLLEGES – A REPORT

Abstract

Students face a very difficult phase in their life during their transition from school to college due to the fear of unknown elements and anxiety prevailing in their mind of change of environment, place, people etc. To top it all, a medical or dental college life is by far the most hectic, challenging and strenuous one due to its heavy study load, practical exposure and altered examination pattern from the school life. This report attempts to explain and emphasize the importance of orientation for medical and dental students for the foundation making of their college life and meet the following objectives in Manav Rachna Dental College (MRDC):

- i) To facilitate activities among students to know each other and also the faculty
- ii) To empower students to know the culture and values of Manav Rachna Educational Institution
- iii) To enlighten the students with the resources available in the campus
- iv) To evaluate the effectiveness of orientation program in MRDC

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Keywords: Orientation, feedback, sessions, review, first year medical and dental students, significance.

Introduction

In a paradigm shift from school to college life, almost all the students undoubtedly need a support or helping hand in getting adjusted to their new environment and set foundation at their new home. Orientation program and mentor-mentee relationship are a few tools to accomplish these objectives. Orientation program is normally adopted in the beginning of the session, however the mentor-mentee coordination continues throughout the year.

A student orientation program plays the exact role of that helping hand. It is turning out to be a necessity in colleges these days due to the high number of out-of-state students who are plagued by personal fears, home sickness and peer pressure as they have never lived on their own before. Besides that in college life the working systems, the teaching methods and administrative rules and regulations are vastly altered and students require guidance in the initial time period to understand, accept and get adjusted to the variations in the lifestyle of college.

Orientation helps students to get acquainted with this new world in a systemized way under supervision in the form of sessions, tours etc. without which the students being new comers might feel completely lost in the fast moving campus life which can greatly impact their academics and their social life in the college.

The basic motive of an orientation program is to introduce students to the various facets of their future home like the basic academic details of their course, the educational opportunities available to them, the values and functions of the university, the central objective of this university as an academic enterprise, various cultural and sports activities and clubs which they can join according to their fields of interest 1, the campus area and physical locations of important places both on and off campus all the while taking care not to overwhelm them with overload of information 2 so that they can start to feel at home. Along with all this the program also aims to familiarize students with the faculty which will be teaching them, the student welfare coordinators whom the students can approach for any non-academic queries or guidance, various clubs or

organization's heads who will direct the students in extra-curricular fields and of course with each other as they will become each other's classmates and friends in the near future. Increased quality of orientation programs and peer involvement in orientation programs have been shown to improve retention.³

The additional aspects which are included in the program for the medical and dental students is their orientation towards their future work, its ethics and importance in the community, their career development and direction and also the emphasis is given on the need for personality and soft skills development, health being a purely public oriented sector requiring continuous one-to-one doctor-patient interactions. The practice of medicine is an art and not a trade or business, a calling in which your heart gets exercised regularly along with your head⁴. Keeping this noble sentiment in mind a need for orientation and induction training has been perceived by medical educationalists worldwide.

Objective

To assess the significance and relevance of student orientation and induction training for the medical and dental students in getting acquainted with the multiple arenas of dental curriculum and to study the impact of orientation program in the change from the school's perceptual learning into college's experimental learning.

Methodology

The orientation was a 6 day long program in which all the necessary orientation activities and sessions were held. It was conducted from 30th August 2017 to 6th September 2017 for the first year students of Manav Rachna Dental College.

All the sessions were interactive and the students played a proactive role in them. Noteworthy efforts of the CDC (Career development centre) team, MRCFL (Manav Rachna centre for foreign languages) team, the clan leaders, the clubs and organization's heads and the HODs of various departments along with the orientation team were also seen. Orientation saw the cooperation of the entire campus community and its resources.

An extra feature of power point presentations was also added in almost all the sessions to give a professional feel to the program, to make the session livelier and easier to understand and also to provide digital help to the conveners.

The evaluation of the orientation program was done through the feedback forms filled by the students after the completion of the program.

Significance of Major Sessions

1. Welcome Address :

Some say that the first impression is the last impression. The welcome address is the first greeting which the students receive when they take the first step in the outside world towards their future. A warm welcome gives a sense of security when they enter the unknown showing them that their presence is desired and pleasing thus dispelling some of their fears.

2. MRDC Rounds and Campus Tours :

In new place directions are required to navigate the area and without proper guidance it can take a long time for many students to get familiarized with the campus grounds. Thus, this activity is one of the "must have" activities in any program as it helps in increasing the comfort level and proficiency of the new students in and around the campus also helps them feel at home faster.

3. Introduction of Subjects :

Academics may not be the sole aspect of college life but it surely has the highest weightage in terms of priority in a student's life and keeping it in view an orientation program should not be purely fun and games but should also provide an introduction to the students of their subjects which they will be studying in immediate future and also the major changes which they will be facing in regard to the teaching methods, examination systems and the college lecture systems.

The medical and dental students also have another feature of practical learning attached with the general theoretical side of studies and the major variation is the shifting of weightage from the theoretical part to the practical work in the medical field. The orientation session shall help them accept these alterations and give them a platform to clear up any confusion or dubiety that they might have in mind.

4. Anti-ragging :

Since long ragging has been a serious issue in the institutes of higher education especially in India and over the years the government has taken a number of initiatives and measures to eradicate this

problem. Nowadays all the students whether of medical field or some other streams are required to produce affidavits for anti-ragging and the educational institutions have been given strict guidelines by the MCI and DCI (Medical and Dental Council of India) regarding the anti-ragging measures which need to be followed to prevent the occurrence of any act of ragging in their campus.

A seminar was conducted on Anti-ragging issues by member of Dental Council of India (DCI) to explain the prevalent policies, latest announcements by Government of India, ill-effects of ragging.

This session emphasized on what constitutes ragging, what anti-ragging measures have been taken by the university to safeguard the students against this offence, publicity of the names of anti-ragging committee members and what will be administrative actions in case any instance of ragging gets reported or is caught in and around campus.

5. Ice Breaking :

This session's main objective is to reduce stress among commencing students, allay anxiety and encourage students to be an active member of the group and to foster a sense of belonging with the formation of strong peer and academic support networks.^{3,5,6}

It was a very chatty and loud sitting that students responded well to and enjoyed thoroughly. It aimed to loosen up the interaction among the freshmen, promote positive attitudes and stimulate an excitement for the beginning of college life. It provided the students with an opportunity to get acquainted with their classmates and make new friends.

6. Stalwart of Dentistry :

Every discipline, every institution has their own group of stalwarts who have shown their commitment, dedication and unfaltering and staunch support towards their domain of practice or establishment.

Such personages of dentistry were invited to the program to elaborate on the future exploits, quests and ventures of the discipline which may transpire during the prospective professional lifetime of the students. They expounded on the importance of the medical and dental fields in the society and its

advantages over other professions. They motivated the early medical learners to inculcate the basic foundation requirements of professionalism, accountability and humanism to ease their journey in the medical world.¹⁴

7. Experience Sharing and Panel Discussion :

Giving the beginners a peak in their future life this session was a synergistic effect of the panel and the attendees. Professionals and post graduates were invited to this session to share their experiences and knowledge with the fresher, to give them pointers regarding their career and future endeavors that students might take up. This was a give-and-take session in which the students played an instrumental role through their questions, curiosity and interest which they displayed.

The panel too appreciated the response and was very proficient in providing prompt answers and allaying the curiosity of the students.

8. Other Activities :

Besides these major sessions numerous other activities were also conducted to increase the level of efficiency of the program. These included:-

- **Mentorship Program** – An introduction was given about the mentor system where the class is divided in groups and a mentor is assigned to each group. The students can go to the mentor in case of any query, doubt, complaint or other issues either academic or non-academic.
- **Clan System** – This is the system of division of the whole university randomly into four clans each representing an element of nature namely air falcons, water sharks, forest rhinos and wild cats. The clans conduct different activities of sports, nature conservation, quizzes etc. and helps students in making friends and acquaintances with students of other courses and colleges along with supporting a noble cause. The introduction to this system was given by clan leaders.
- **Soft Skills and Foreign Language Courses Introduction** – In these sessions', officials from the MRCFL team and CDC team were invited to elaborate on the importance of soft skills and advantages of learning a foreign language in today's competitive markets and medical industry and to give a brief overview of the courses offered by the university in these domains.

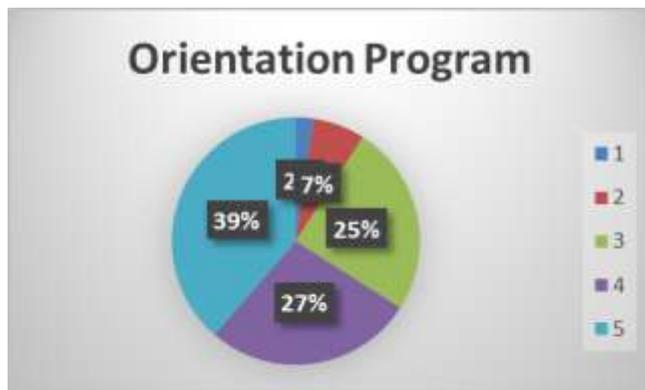
- **White Coat Ceremony** – This is a portentous ceremony in which the toppers of the batch were felicitated by the Vice Chancellor of MRIU and Managing Director of MREI.

9. Result

i. Evaluation of Orientation Program Feedback of students

There were 88 students who participated in orientation program. They were given a feedback form to get the information on its usefulness and furnish suggestions for improvement of the program.

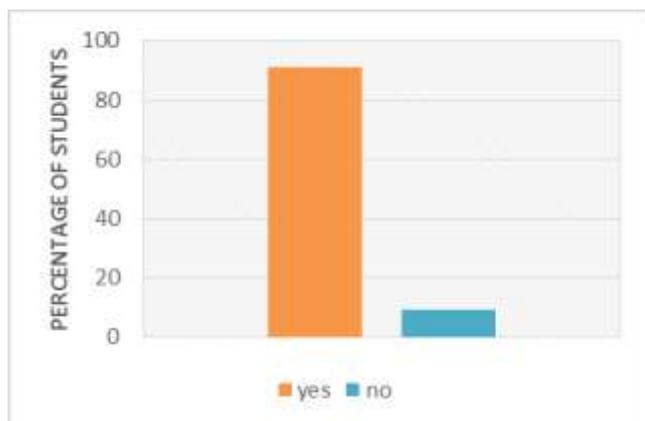
| rating | no. of students | percentage |
|--------|-----------------|------------|
| 1 | 2 | 2.27 |
| 2 | 6 | 6.82 |
| 3 | 22 | 25.00 |
| 4 | 24 | 27.27 |
| 5 | 34 | 38.64 |



As seen from the table, 66% of the students have rated the program as very good/ excellent and only 2% of the students were not satisfied with the orientation program.

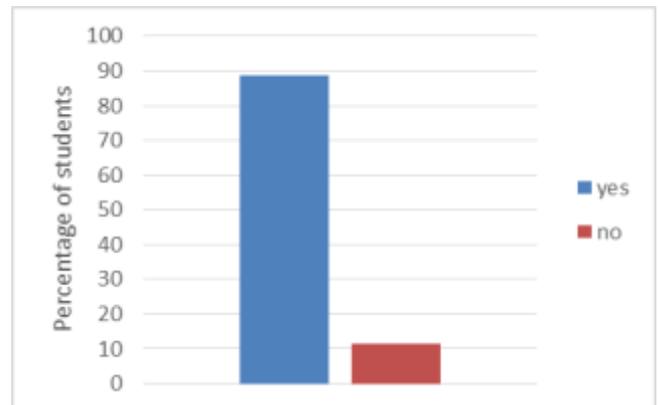
ii. Were the PowerPoint presentations informative/useful?

| Response | No. of students | Percentage |
|----------|-----------------|------------|
| yes | 80 | 91% |
| no | 8 | 9% |



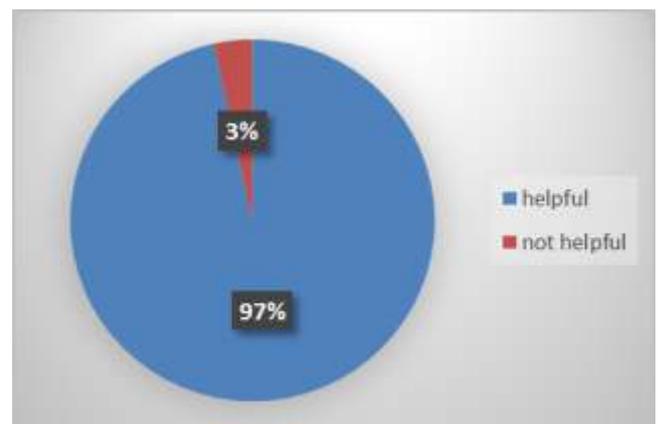
iii. Orientation should happen every year

| | no. of students | percentage |
|-----|-----------------|------------|
| yes | 78 | 89% |
| no | 10 | 11% |



iv. Helpful in coping with the year ahead

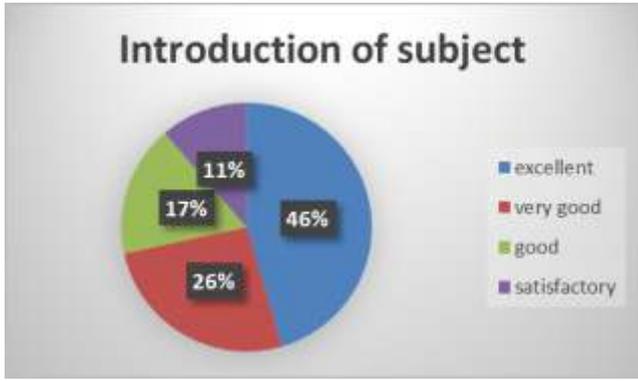
| 1. | no. of students | percentage |
|-------------|-----------------|------------|
| helpful | 85 | 97% |
| Not helpful | 3 | 3% |



v. Evaluation of various attributes of orientation program by students

A. Introduction of subject

| CATEGORY | NO. OF STUDENTS |
|--------------|-----------------|
| excellent | 40 |
| very good | 23 |
| good | 15 |
| satisfactory | 10 |



46% of the students have rated 'introduction by departments' as excellent and 26% have rated very good. Only 11% have rated satisfactory.

B. Mentorship

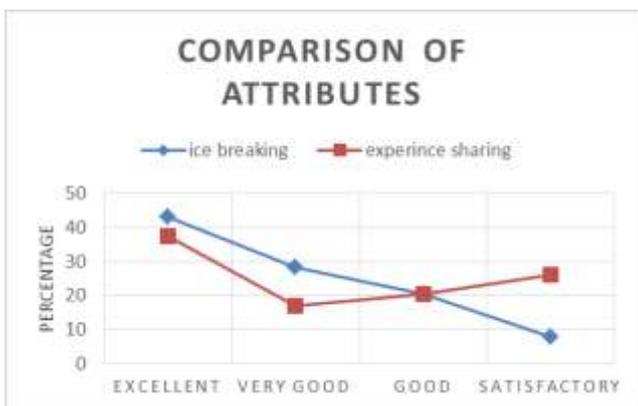
| CATEGORY | NO. OF STUDENTS |
|--------------|-----------------|
| excellent | 29 |
| very good | 25 |
| good | 23 |
| satisfactory | 11 |



33% of the students have rated 'mentorship' as excellent and 28% have rated very good. Only 13% have rated satisfactory.

C. Ice breaking and experience sharing in terms of number of students

| | Ice breaking (No of students) | Experience sharing (No of students) |
|--------------|-------------------------------|-------------------------------------|
| excellent | 38 | 33 |
| very good | 25 | 15 |
| good | 18 | 18 |
| satisfactory | 7 | 23 |



Ice breaking activity was rated excellent by approximately 45% students and experience sharing-Stalwart of dentistry was rated excellent by approximately 40% students.

D. Suggestions by students

- 23% of the students have suggested that more professionals should participate to share their expertise.
- 12% of the students suggested that more alumni should be invited to the program to give an insight of the institute.
- 10% students have felt the necessity of more interaction with faculty.
- 15% of students that more technical topics should be covered.

10. Discussion

Medicine is a profession that requires not only the mastery of a large body of knowledge and the acquisition of clinical skills but also high standards of behavior and appropriate attitudes⁷. It is found to be more effective to teach and assess professionalism in early medical learners who have just entered medical school with great expectations and ideals.

Previous studies on orientation training for first year medical and dental students have concentrated on the assessment of the student's knowledge, attitudes and perceptions about selected subject areas immediately before and after the orientation program and they revealed that the average knowledge and attitude scores increased after the program.⁸ In another study in Hyderabad, the students were given a pre and post orientation test and the post test showed an improvement of 37.3% over the pre test.⁹

Studies were also done to evaluate the orientation program from the student's perspective¹⁰ and to recommend the revised orientation program¹¹ as per the gaps. But not many studies were done to evaluate the long term effectiveness of orientation program. In the present study, the actual internalization of the skills taught during the program in day-to-day studies of dental students has been assessed.

A consensus is emerging that role modelling is an effective means of teaching professionalism.¹² In this context the faculty members and orientation team acted as facilitators of the various interactive sessions. The follow-up of the feedback forms showed that the orientation was well received by the students and 66%

of them rated it as very good or excellent and 89% agreed that it should happen every year.

The entire structure of the new orientation program was successful however the elements that had the most impact included introduction by departments and ice breaking session. This was expected from the fresher since the initial phase of the first year is always like a jump into the unknown and the above two sessions played a major role in easing that fear and helping in increasing familiarity of the students with their subjects and their classmates and these two play the key roles in a student's life.

11. Conclusion

This study makes it clear that there is a definite and lasting advantage of orientation program for students entering the medical or dental courses. 97% of the students stated that the program was helpful in coping with the year ahead.

The interactive and responsive sessions of the program were highly appreciated by the majority of the students who recommended further such programs every year on a regular basis. It has been proposed by many renowned educationalists and other studies that teaching of scientific research competencies should start early in graduate medical education and continue throughout the preclinical and clinical years as it helps in the research oriented or even practice oriented career in the future.¹³

In conclusion, orientation will help in priming the students to cope with the multiple demands of medical education. In the long run it will bring about the "harmonious development of the hand, heart and hand" to shape a model doctor as an effective health care provider.

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DENTAL ANXIETY: ITS VICIOUS CIRCLE AND MANAGEMENT

Abstract

This review attempts to explain the vicious circle of dental anxiety and its implications. It also outlines the various strategies to manage and treat dental anxiety. More attention from dentists could help apprehensive patients to utilize the dental services based on their needs.

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Keywords: dental anxiety, oral health, psychological health, psychological treatment

Introduction

Dental anxiety (DA) relates to the psychological and physiological variations of a non pathological fear response to a dentist's appointment or treatment.¹ The problem of DA is of paramount importance for several reasons: (a) avoidance causes worse dental health; (b) anxiety and phobia has negative effect on the dentist/patient relationship, may prevent proper dental treatment, and can be a reason for failure or complications of dental procedures; and (c) higher level of anxiety results in stress, such as syncope, hypertension, tachycardia, and cardiovascular accidents.

Vicious circle of Dental Anxiety

In order to synthesize different findings regarding dental anxiety, oral health and psychosocial aspects in a model, Berggren, as well as other researchers, have proposed a vicious circle of DA.^{2,3} The vicious circle shows how oral health and psychosocial aspects act together over time in the maintenance and elevation of DA and some of its consequences. The vicious circle has had a substantial impact on the research field and has been used as a conceptual model.² The first step in the vicious circle is avoidance of dental care. Avoidance is central to the many health related and psychosocial consequences of DA, and individuals with high DA who do not avoid dental care seem to be in a better position concerning oral health and psychosocial aspects.² The second step of the vicious circle is the deterioration of oral status that comes with avoidance of dental care. Armfield then argues that the deterioration of oral status may lead to invasive and acute treatments which make dental visits for an existing problem the third step in the vicious circle.^{2,4} Berggren, on the other hand, focuses on psychosocial

consequences and describes feelings of shame and inferiority caused by deterioration of oral status as the third step.⁵ Both problem-triggered visits to the dentist and feelings of shame and inferiority are then assumed to increase the existing DA. Although the relationship between DA, avoidance of dental care and oral health has not been thoroughly investigated until recent years, it has long been anticipated and is included in Coriat's previously mentioned article from 1946.⁶

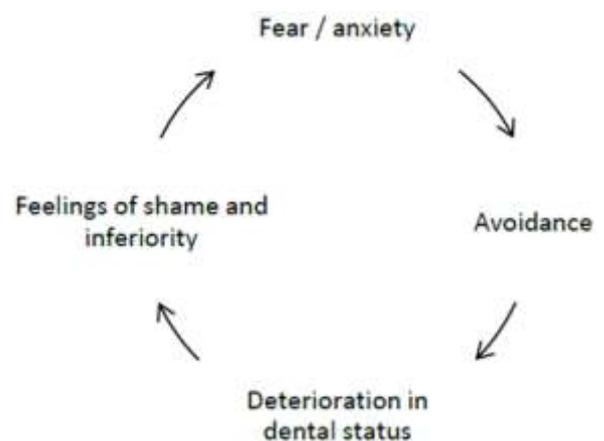


Figure 1. The vicious circle of Dental Anxiety

As a means to validate the vicious circle model, Armfield investigated the patterns of avoidance of dental care, treatment need and seeking dental care for an existing problem and found that 38.5 % of individuals with DA in a general population sample seemed to follow the course implied by the vicious circle.² Results from Jongh et al. also indicate that poorer oral health mediate the relationship between avoidance of dental care and fear of being negatively evaluated by others, which further supports the model.³

Management of dental anxiety

In reviewing the associations between DA and oral health psychosocial aspects, DA is recognized as a health-related condition that may have serious implications for health and well-being. Effective ways to manage DA are therefore of significant importance. As shown in Table 1, there are a variety of potential strategies that have been used to manage anxiety in the dental setting.⁷

Some psychological aspects of dental treatment are the cause of a patient's nervousness. The psychological treatment method was based on behavior therapy (BT) using the systematic desensitization technique developed by Wolpe.⁸ Today, a range of treatment methods, both pharmacological⁹ and behavioral¹⁰, are used to make dental care possible in patients with DA. In some cases, these methods are used only as a means to get through dental treatment, while, in other cases, there is also the explicit goal to reduce DA in the long term and to normalize the patient's dental care attendance patterns and ability to cope with conventional dental care routines. Pharmacological methods consist of dental treatment under different kinds of sedation and general anesthesia.

Behavioral interventions usually consist of anxiety reduction and coping techniques delivered by the dental team, or more comprehensive psychological treatments delivered by the dental team or a psychologist. Of the comprehensive psychological treatments, interventions based on BT or cognitive behavior therapy (CBT) are the most common, but other types of intervention also exist, with hypnotherapy probably being the best known.¹⁰

Behavior therapy was first developed in the mid-20th century and was based on learning theory, as developed by the behaviorist approach to psychology. Later, cognitive therapy was developed with its focus on cognition, and the two traditions were combined into what is now called CBT. The term CBT thus includes a variety of interventions from behavioral to cognitive. Hereafter, the term CBT will be used for all treatment approaches that build on these types of intervention, although the content may vary substantially between treatments. In the treatment of specific phobias, and anxiety disorders in general, CBT has been established as an effective form of treatment.¹¹ In a meta-analysis of behavioral interventions for DA and dental phobia in adults, Kvale and colleagues reported medium to large effect sizes, despite extensive heterogeneity between studies.¹⁰

| Strategy | Evidence of Efficacy |
|--------------------------------|--|
| Communication | Effective communication between the dental staff and the patient is essential for building trust in the relationship and putting the patient at ease. ¹² |
| Sedation or General Anesthesia | Sedation can lower a patient's current state of pain and recalled pain. It can also lower predicted and recalled anxiety. ¹³ |
| Relaxation | When patients were given instructions on functional relaxation and performed it during their treatment, it significantly lowered their anxiety. ¹⁴ |
| Distraction | Virtual reality was tested to determine if distraction from the dental treatment reduced anxiety. Patients' self-evaluation and physiological measures showed that distraction helps reduce anxiety in a dental setting. ¹⁵ |
| Hypnosis | Patients who were hypnotized reported having lower levels of anxiety during treatment than those who were not. ¹⁶ |
| Aromatherapy | Patients in the aromatherapy groups reported less anxiety and a greater feeling of calmness. ¹⁷ |

In evaluating the effects of interventions aiming to reduce DA, several types of outcome measures are important. The subjective experience of reduced DA is often used as the main outcome and is measured on self-rating scales. Although the experience of reduced DA is an important outcome it does not by itself measure the effect of treatment on dental care utilization. Therefore, this type of data needs to be complemented by measures of whether regular dental care can be maintained after treatment for DA. Dentists' ratings of the treatability of patients may be used to indicate whether dental treatment is possible, but follow-up data regarding the actual frequency and content of dental care visits are also considered important. Other outcomes, such as quality of life and Oral health related quality of life, as well as adverse effects, are important in order to establish the effect and drawbacks of interventions aiming to reduce DA.

Because of the substantial health-related and psychosocial effects of severe DA and dental phobia, it is important to establish effective treatments. Since CBT is the major treatment approach in DA and dental phobia, a new systematic review and meta-analysis of its treatment effect in adults, according to established standards of quality assessment, are needed.

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DIABETES MELLITUS AND NEW WAYS TO TEST BLOOD GLUCOSE

Abstract

Diabetes mellitus is a complex multisystemic metabolic disorder characterized by a relative or absolute deficiency insulin secretion and/or concomitant resistant to the metabolic action of insulin on target tissues(1). Diabetes mellitus is therefore, a group of metabolic disorders that share the common underlying feature of hyperglycemia. Chronic hyperglycemia and the attendant metabolic dysregulation may be associated with secondary damage in multiple organ system, especially the kidney, eyes, nerves and blood vessels (2).

Data indicates that in year 2011, 366 million people worldwide were affected by diabetes and the number is continuing to climb steeply (3). By 2030, predictions suggest that the number of people with diabetes will reach 552 millions (4). Currently, India is in the second position in the chart, after the people republic of China (3).

It is well known that currently, a diagnosis of diabetes is achieved only by analyzing blood glucose levels (random, fasting and postprandial (5)), However monitoring of glycated hemoglobin (HbA1c) levels has become more common and frequent, providing an accurate measure of average glycemic control over the past three months (6,7). These are invasive methods that are physically and psychologically traumatic to the patient. There are 6 current areas of research in alternative technology that will hopefully avoid those prickly finger sticks.

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Saliva

We know that glucose is present in the saliva of normal individuals, however, the mechanism of its secretion is still obscure. Both para-cellular and intercellular pathways have been proposed (8). Many authors have tried to explain the increased glucose content in the salivary secretion of diabetic patients. Lopez et al (9) have tried to show that the salivary glands act as filters of blood glucose that are altered by hormonal or neural regulation. According to Qureshi et al (10) persistent hyperglycemia leads to microvascular changes in the blood vessels, as well as basement membrane alteration in the salivary glands. This leads to increased leakage of glucose from the ductal cells of the salivary gland, thereby increasing the glucose content in saliva. Sreedevi et al (11) quoting the works of Harrison, commented that glucose is a small molecule that easily diffuses through semipermeable membranes. Thus large amounts of glucose become available to saliva when blood glucose levels are elevated, as in diabetes.

It is well established that the complications of diabetes are due to microvascular changes (2). Many theories

have been put forth to explain the microvascular alterations. According to theories, hyperglycemia leads to increased advanced glycosylation end products, commonly known as AGEs. These AGEs crosslink proteins such as collagen and extracellular matrix proteins, leading to basement membrane alterations and hence, endothelial dysfunction. This alters the microvascular structure and makes it more permeable. Other products, such as sorbitol, diacylglycerol, and fructose 6 alteration takes place by altering the extracellular matrix proteins. The end result is leaky microvascular and a leaky basement membrane (2). This explains the increased passage of glucose from the blood in to saliva in diabetes mellitus. Belazi et al (12) proposed that the increased permeability of basement membrane in IDDM may lead to enhanced leakage of serum-derived components into whole saliva via gingival cervices.

Technique using saliva to test blood sugar uses a meter and instead of blood on a test strip and is captured on the single use wick.

Acetone in the breath

Researchers in Israel are developing a testing device which is a single use capsule to measure the amount of acetone in an exhaled breath. Based on the principle when acetone in the breath is mixed with a certain chemical compound, a reaction happens which correlates to blood glucose amounts (13).

Earlobe

The gluco-track is a device that clips to the earlobe for measuring blood glucose levels. It uses ultrasonic, electromagnetic and thermal technologies. A personal ear clip is attached through a small cable to a main unit (MU). The MU provides the blood glucose measurements. The main unit has a memory capacity of 1000 reading per user(13).

Light through the skin

German researchers are devising a glucometer that uses infrared laser light to measure glucose through the skin. This device will send a pulse of light that is absorbed by the molecules of glucose which creates a sound that is correlated to blood glucose levels (13).

Coil between the eyelid and eye

The Noviosense glucose sensor uses a small metal coil covered with a special gel that is placed between the lower eyelid and the eye. The gel makes contact between eye fluid and the coil. An enzyme on the coil generates a small current which is measured by the coil. The data is sent to a small device that the person holds in front of the eye through which the blood sugar reading is displayed (13).

Tears

A device which is worn as a contact lens but is a monitor that tests blood glucose with tears every second using wireless technology.

Several workers have studied the glucose level in tears in normal subjects Ridley (14)-65 mg/100 ml, Borsellino(18) -27 mg/100 ml, Giardini and Roberts (15)-26 mg/100 ml, Gasset et al.(16) -1 mg/100 ml, and Motoji(19) 2 mg/100 ml.

Michail et al(20) first demonstrated in 1937 the rise of tear glucose during hyperglycemia (alimentary and diabetic). Lewis and Stephens (17) and Giardini (15) studied the level of tear glucose in diabetic patients and found it to be often raised, though the increase bore no relationship to blood glucose. Gasset et al(16) and

Motoji(19) found a definite relationship of tear glucose and blood glucose and concluded that hyperglycemia could be detected by measuring tear glucose level.

Gasset et al (16) measured changes in the tear glucose level following oral glucose load and found an increase in the tear glucose level in diabetic patients but no significant rise in the tear glucose level in normal subjects. Motoji (19) also studied the glucose level in tears in normal subjects and in diabetics before and after peroral glucose load. He found that, while the glucose level in the tears tended to run parallel with the blood glucose level, the former tended to be higher for the same blood glucose level after the peroral glucose load. Since it was found that, after the glucose load, tear glucose level at 11 mg/100 ml was a reliable guide for classifying a person as diabetic, tear glucose levels in the postprandial phase or after giving oral glucose load can be used as a screening device for picking up diabetic cases. Subjects with values higher than 12 mg/100 ml could be labelled as diabetics. Subjects with levels between 9 mg/100 ml and 12 mg/100 ml could be considered suspicious and subjected to detailed blood glucose analysis.

This finding can lead advantage in surveying the prevalence of diabetes in a population.

Persons without diabetic symptoms would be less reluctant to give samples of tears than of blood. Thus, a fairly accurate estimate of the prevalence of diabetics could be made with less resistance from the public.

Conclusion

Researchers' team around the world are working on ways to test blood glucose using methods that do not use a blood sample and are pain free. It is hoped that in near future many of these devices will be able to go through the testing needed for safety and reliability along with ease in collection.

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PLASTINATION – AN ART OF PRESERVING TISSUE SPECIMEN

Abstract

Plastination is a process of preserving anatomical specimens by forced impregnation with curable polymers like silicone, epoxy or polyester resins. In this process, water and lipids in biological tissues are replaced by curable polymers (silicone, epoxy, polyester) which are hardened, resulting in dry, odorless and durable specimens. It has gained wide acceptance in medical and dental fields of study as they are easy to handle, odorless, non-hazardous and stable. It proved to be a successful admixture of science and art which can be used as an excellent museum technique for preserving specimens.

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Keywords: Plastination, Impregnation, plastinated specimens, silicon, curable polymers

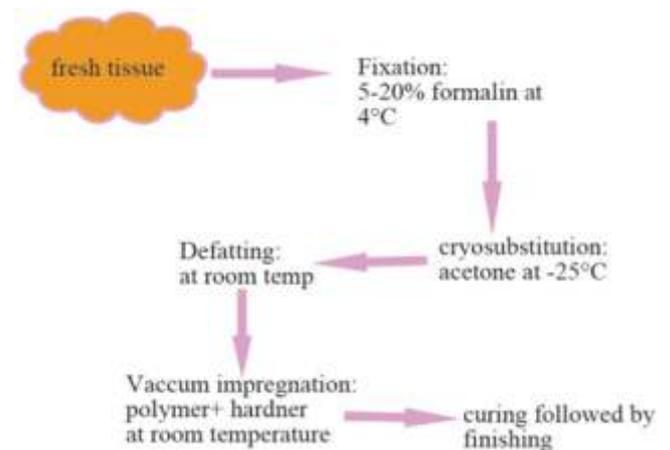
Introduction

The word "Plastination" is derived from the Greek word "plassein" which means to shape or to form, Professor Gunther von Hagen is a German born Physician & Anatomist who^{1st} preserved human bodies through 'plastination'. He discovered this process in 1977 in a laboratory at the German University of Heidelberg. He was experimenting with kidney slices and plastic polymers when he came across the technique, whereby blood, fat, water and other fluids were replaced by plastic, enabling corpse tissue to be preserved for centuries.¹

This technique preserves the specimens in a physical state approaching that of the living condition, keeping it fulsome, lifelike, indefinitely antiseptic without surface morphological modification.² Although it is difficult to prepare a well plastinated specimen, but it is considered as a good method to preserve the specimens as an alternative to formalin preservation. Under this technique, the water and fat of the body are replaced by certain plastic yielding specimens that can be touched, do not smell or decompose, and even retain most properties of the original sample.³

Basic Procedures: There are four integrated basic steps utilized in the process of the plastination technique: 1) specimen preparation and fixation, 2) dehydration, 3) forced impregnation in a vacuum and

4) hardening. In this technique, water and lipid tissues are replaced by curable polymers like silicone, epoxy and polyester-copolymer.⁴



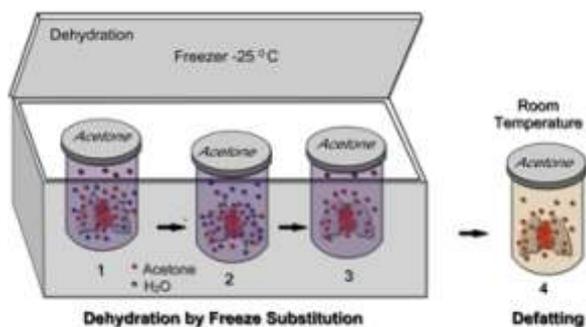
Flow diagram depicting the steps in plastination process

Source: –J Oral Maxillofac Pathol. 2011 May-Aug;15(2): 133137.

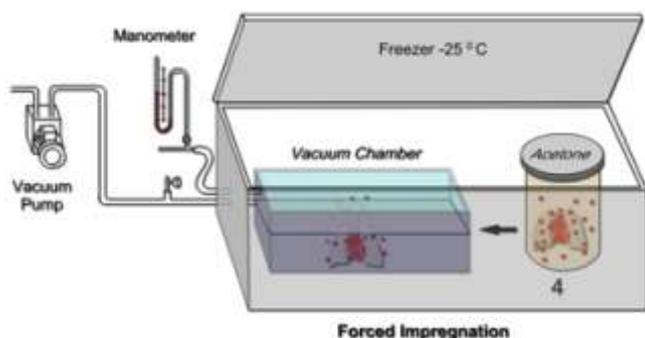
(A) Specimen Preparation and Fixation: It is necessary to prepare high quality dissected specimen to produce plastinates. Under fixation, the body is embalmed, usually in a formaldehyde solution in order to prevent the decomposition of the body. Specimens may be fixed prior to or after prosection. However, to minimize exposure to formalin vapors and to assure final specimen shape and desired position, fixation should be done after prosection. Usually 10 %

formaldehyde solution may be used as a fixative, lower percentage formalin solutions may produce less bleaching of the specimen. However, brain should be fixed with high (10-20) percentage formalin for several months in order to prevent the shrinkage during impregnation. Minimal fixation with low percentage of formalin and short time duration (1-2 days) will yield a specimen which is more flexible and more natural looking. Fixation of hollow organs is necessary to maintain the shape and lumen of the organ. It is beneficial to keep the specimen in its normal anatomical position during both, fixation as well as in the first dehydration bath.⁵

(B) Dehydration: All biological specimens, generally, have a high water content which needs to be removed for plastination procedure. This is achieved by a process known as dehydration, where the specimens are placed into cold (-25 degree centigrade) solvent, usually acetone for four to five weeks. Over a period of four to five weeks, the tissue water is slowly replaced by the acetone. It would be easy to dilate maximally the body organs in freezing acetone during the initial exposure to acetone. This freezes the organ in a dilated state and ensures maximal dilation of the organ later on in the plastination process.⁶



© **Impregnation:** In the third step, the dehydrated specimen is then placed in a bath of liquid polymer, such as silicone rubber, polyester or epoxy resin. By creating a vacuum, the acetone is made to boil at a low temperature. The vacuum draws out the acetone from the specimen and the polymer, takes its place inside the tissues and vessels.⁶



(D) Hardening: The impregnated specimen is cured with gas, heat, or ultraviolet light, in order to harden it. The polymer filled specimen is placed into a sealed chamber where it comes in contact with a curing gas. This gas will harden the polymer throughout the specimen, making the specimen dry to touch within 48 hours. In a few months, curing procedure is completed and the specimen can be stored indefinitely at room temperature.

Other methods used in modern times include the Silicone S-10 Standard Procedure, the Cor-Tech Room temperature procedure, the Epoxy E-12 procedure, and the Polyester P-35 (P-40) procedure. The Silicone S-10 is the procedure, most often used in plastination and it provides opaque, natural-looking specimen. Cor -Tech Room Temperature Procedure is designed to allow plastination of specimen at room temperature to various degrees of flexibility using three combinations of polymer, cross linker and catalyst. According to the International Society for Plastination, the Epoxy E-12 procedure is utilized for thin, transparent, and firm body and organ slices, while the Polyester P-5 or P -40 preserves semi-transparent and firm brain slices.⁷

Dental Implications:

The study of gross specimens is an integral part in learning oral pathology. They provide an illustrative and explanatory adjunct in understanding the disease. They also have a useful role in postgraduate oral pathology training. Decay of biological specimens is a vital process in nature but an impediment to morphological studies, teaching, and research.⁸

Any student or even a pathologist always desires for a “real” or “ideal” specimen which is dry, odorless, durable, and nontoxic and which can be used in class rooms and in laboratory without protective equipment such as gloves. Whole specimen paraffinization and infiltration with high-molecular weight polyethylene glycols have been tried in the past but are proved unsatisfactory due to excess specimen shrinkage, poor color preservation as specimens tend to get charred when paraffinized, and improper glycol impregnation occurs if clearing of the paraffin is not done perfectly, as paraffin is immiscible with glycols. However, plastination to a large extent yields the “ideal” specimen.⁹

Histologic Examination of Specimens:

One of the most interesting, important and potentially useful qualities of tissue plastination by silicone is that its microscopic structure remains intact. This implies

that the specimen can be preserved almost indefinitely in a form that is easily stored while still retaining full potential for histologic examination. The key to this is “deplastination.” This takes advantage of the unusual ability of sodium ion to depolymerize silicone rubber. Tissue samples to be deplastinated are exposed to a saturated solution of sodium methylate in anhydrous methanol until free of polymerized silicone rubber and then subjected to standard histologic techniques. Although some staining procedures are slightly prolonged, the results are comparable to those obtained with more conventional methods.¹⁰

Plastinated specimens as teaching aids:⁸

- Preservation of autopsy or surgical tissue samples in a form useful for teaching.
- Plastinated specimens are individually superior to their counterparts both in terms of esthetic superiority and in their demonstration of specific features.
- Plastinated specimens are generally easier to interpret than the usual “pots”, so students are more interested in examining plastinated specimens than those preserved in formalin jars.
- Can be easily carried to class rooms during lectures and can be easily passed to each student without gloves to appreciate the features which is impossible in jar specimens.
- Long-term storage of autopsy or surgical specimens for later histologic examination.
- They can be easily used as spotters in undergraduate practical examinations.
- They probably will not undergo significant deterioration over many years of continuous use. Thus, rare or unusual specimens can be made available for study when they are no longer seen in clinical practice.
- They can be used as an adjunct to problem-based type of curriculum in postgraduate training.
- Plastinated specimens may be pinned and/or photographed and labeled to highlight salient landmarks which should make student to identify easily.
- They also act as patient educative tools; a doctor can explain to a patient the anomaly or pathology he is suffering from with the help of plastinated specimen of such anomaly.

Uses/Advantages of Plastination in Anatomic Pathology and Forensic include the Following:⁸

- They are non-toxic, non-infectious, and do not exude fumes or fluids.
- It aids in preparation of tissue sample which are used as evidence.
- In preparations of unusual or historically important material for museum display.
- Preparation of surgically removed facial organs (nose and ear) for use as their own prosthetic replacement.
- They can be stored in plastic bags, along with appropriate documentation.
- Preservation of whole organism such as parasites, insects, snakes, or plants for instructional use.
- Plastinated specimens require little storage and no maintenance. Thus, the time saved can be utilized in expanding the collection rather than just maintaining it.

Limitations/Disadvantages of Plastination:⁸

- Process is technique sensitive, time consuming and hence a dedicated pathologist is required.
- Beginner has to do a lot of trial and error during the process to achieve the desired outcome leading to consumption/wastage of rare and unusual specimens.
- Slightly more expensive and needs more equipment than the conventional laboratory methods.
- To obtain a good specimen display the process needs lot of postcuring works such as trimming, polishing, coloring, and mounting.
- Learning anatomy on only plastinated specimens is a compromise because of its limitations in terms of tactile and emotional experience that is provided by wet cadavers.

Conclusion:

Plastination is a beautiful admixture of the modern science and skillful technique. Plastinated oral pathology museum specimens are superior to those preserved in formalin, both in terms of user acceptance and ease of maintenance.

The plastinated specimens will bring tridimensionality to teaching in the form of clean, touchable, authentic,

non-smelly, non-toxic, non-bio-hazardous specimens. With expanding popularity of this procedure, a day might come when plastination will be a standard part of the museum, classroom, and research activity. Commercial display should be discouraged on ethical and legal grounds. The advantages are many with the only hindrance being the high initial cost of equipment. Advantages and disadvantages over other methods, along with legal and moral aspects must be kept in front of society for integrating with medical education of the nation.

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Abstract

Long treatment times have been a factor of inconvenience for patients seeking orthodontic correction of teeth, posing added problems such as inability to maintain proper oral hygiene, high predisposition to caries and periodontal problems. In such a scenario, treatment modalities decreasing treatment time would be of great benefit. Various methods such as low level laser therapy, pulsed electromagnetic fields, corticotomy, distraction osteogenesis, and mechanical vibration, have shown to decrease treatment duration. Together they are referred as Accelerated Orthodontics.

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Keywords: .

Introduction

Research in the field of orthodontic tooth movement (OTM) has evolved rapidly and changed considerably since the work of Reitan et al in the 1950s.¹ Moreover, the importance of all tissues, be it alveolar bone, periodontal ligament (PDL), root cementum, and associated vascular and neural networks, has been investigated to delineate the role played by them.² This growing attention given to the biological basis of Orthodontics expands current knowledge and augments understanding of the effects produced by mechanical loading over living tissues.³

Today, a major part of the population undergoes orthodontics treatment in order to bring about better occlusion, improved oral function as well as harmonized facial appearance.⁴ The prolonged treatment duration is one of the main deterrents in orthodontics. Lengthy orthodontic treatment prompts many patients, especially adults, to either avoid treatment or to seek shorter alternative solutions with compromised results. Therefore, the treatment modalities that decrease treatment time without compromising the treatment outcome is an active area of research in orthodontics today.⁵ Unfortunately, long orthodontic treatment time possess several disadvantages like higher predisposition to dental caries, gingival recession and root resorption.⁶ Therefore this increases the demand to find the best method to

increase rate of tooth movement with the least possible disadvantages.

The success of orthodontic treatment is influenced by a number of factors, including periodontal health, oral hygiene, and orthodontic forces.⁹ The development of new methods to accelerate orthodontic tooth movement (OTM) has been sought by clinicians as a way to shorten treatment times, reduce adverse effects such as pain, discomfort, dental caries, and periodontal diseases, and minimize iatrogenic damages such as root resorption and the subsequent development of nonvital teeth.¹⁰

Thus, accelerating orthodontic tooth movement and the resulting shortening of the treatment duration would be quite beneficial. Till date, several novel modalities have been reported such as, low-level laser therapy,^{11,12} pulsed electromagnetic fields,¹³ electrical currents,¹⁴ corticotomy,¹⁵⁻¹⁶ distraction osteogenesis¹⁷⁻¹⁹ and mechanical vibration.²⁰

Changes at Cellular and Tissue level during Orthodontic Tooth Movement :

Orthodontic treatment is based on the premise that when force is delivered to a tooth and thereby transmitted to the adjacent investing tissues, certain mechanical, chemical, and cellular events take place within these tissues, which allow for structural alterations and contribute to the movement of that

tooth. Conventionally, this process is slow and orthodontic treatment times can range anywhere between 12-48 months. By enhancing the body's response to these forces, tooth movement can be accelerated.²¹

Tooth movement induced by orthodontic force application is characterised by remodelling changes in the dental and periodontal tissues.²² Two interrelated processes involved in OTM are deflection, or bending of the alveolar bone and remodelling of the periodontal tissues, including the dental pulp, periodontal ligament (PDL), alveolar bone, and gingiva. The applied force causes the compression of the alveolar bone and the PDL on one side, while on the opposite side the PDL is stretched.²³ This happens via induction of osteoclasts via the RANK-RANKL pathway and presence of various inflammatory mediators such as IL-1, IL-8, TNF-alpha etc.²⁴⁻²⁷

Bone Modeling, Remodeling and Orthodontic Tooth Movement

Bone modeling is the uncoupled process of activation-resorption (catabolic) or activation-formation (anabolic) on bone surfaces, resulting in changes of the shape, size, or position of the bone.²⁸ Bone remodeling or turnover on the other hand, is a tightly coupled local process, which starts with bone resorption, followed by reversal and bone formation phases, resulting in the replacement of old bone with new bone.^{29,30}

Both bone modeling and remodeling are determinants for the rate of orthodontic tooth movement.³¹

As orthodontic forces are applied to teeth, the compression region shows an elevation in osteoclastic activity. Meanwhile, in the tension region, osteoblasts begin to proliferate and mineralise the extracellular matrix.

This orchestra results in alveolar bone remodelling.³² Chemokines may contribute to differential bone remodelling in response to orthodontic forces through the establishment of distinct microenvironments in the sites of both compression and tension.³³ The principal trigger for Orthodontic tooth movement is most likely the strain experienced by the PDL cells, bone-related cells and the extracellular matrix. This strain leads to changes in gene expression in the cells via interactions between the cells and the extracellular matrix.³⁴

Both bone modeling and remodeling are controlled by the cellular activities of osteoclasts, osteoblasts, and osteocytes. Apparently, osteoclasts carry out resorption,

whereas osteoblasts carry out bone formation during bone modeling. The resorption-formation sequence of the bone remodeling process is performed by basic multicellular units, which are organized osteoclasts and osteoblasts.²⁸ Both biochemical and mechanical factors regulate the rates of bone modeling and remodeling.^{30,35,36}

Previous studies have shown that orthodontic treatment stimulates alveolar bone modeling,³¹ as well as bone remodeling that resembles RAP (Regional Acceleratory Phenomena)³⁷ with increased number and function of osteoclasts and osteoblasts, and more active bone resorption-formation cycles.

Methods to accelerate orthodontic tooth movement can be broadly studied under the following categories²¹ :

1. Biological Approach.
2. Surgical Approach.
3. Physical Approach.

Biological Approach

This includes : Prostaglandin E (PGE2), cytokines which includes lymphocytes and monocytes-derived factors, receptor activator of nuclear factor kappa B ligand (RANKL), and macrophage colony-stimulating factor (MCSF).⁴¹⁻⁴³

Prostaglandins- Remodeling activities associated with inflammatory reactions induced by mechanical stimuli form the biological basis for orthodontic tooth movement. This led researchers to inject PGs at the site where orthodontic tooth movement is needed, to intensify the bone remodeling process, and thereby augment the rate of orthodontic tooth movement.⁶

Effect of cytokines on tooth movement: High concentration of cytokines such as interleukins IL-1, IL-2, IL-3, IL-6, IL-8 and tumour necrosis factor alpha (TNF) were found to play a major role in bone remodeling. Moreover, interleukin-1 (IL-1) stimulates osteoclast function through its receptor on osteoclasts. It was also found that mechanical stresses due to orthodontic treatment increased the production of prostaglandin PGE and IL-1 beta in the periodontal ligament.⁴³ Other cytokines which are also involved in the acceleration of tooth movement are RANKL, which is a membrane-bound protein on the osteoclasts that bind to the RANK on the osteoclasts and causes osteoclastogenesis.⁴⁴⁻⁴⁶

Effect of vitamin D3 on tooth movement: Vitamin D3 has also attracted the attention of scientists to its role in the acceleration of tooth movement; 1,25

dihydroxycholecalciferol is a hormonal form of vitamin D and plays an important role in calcium homeostasis with calcitonin and parathyroid hormone (PTH). A comparison between local injection of vitamin D and PGEs on two different groups of rats was also done. It was found that there is no significant difference in acceleration between the two groups. However, the number of osteoclasts on the pressure side which was injected by vitamin D was greater than on the PGE2 side. This indicates that vitamin D may be more effective in bone turnover.⁴

PTH effect on tooth movement: PTH has shown to accelerate orthodontic tooth movement in rats, which was studied by continuous infusion of PTH (1 to 10µg/100g of body weight/day) implantation in the dorsocervical region which made the molars move 2 to 3 fold faster mesially by orthodontic coil spring.⁴⁷ Locally injected PTH induces local bone resorption and hence it is more advantageous to give PTH locally rather than systemically.⁴

Surgical Approach :

It is a clinically effective technique used for adult patients, where duration of orthodontic treatment may be critical in selective groups of patients. Several surgical approaches to accelerate tooth movement are interseptal alveolar surgery, osteotomy, corticotomy, and Piezocision technique.⁴⁸

Wilcko et al showed a transient demineralization-remineralization process taking place after corticotomy.⁴⁹ This was termed as PAOO (Periodontally Accelerated Osteogenic Orthodontics). This concept was earlier described by Frost in 1983, and was called as RAP (Regional Acceleratory Phenomenon).³⁷ Regional Acceleratory Phenomena (RAP) is local response to a noxious stimulus, which describes a process by which tissue forms faster than the normal regional regeneration process. By enhancing the various healing stages, this phenomenon makes healing occur 2–10 times faster than normal physiologic healing (Frost, 1983).³⁷

1. Interseptal Alveolar Surgery (Distraction Osteogenesis)

It is divided into distraction of PDL or distraction of the dentoalveolar bone. The common example for both of them is canine distraction.⁴⁸ In the rapid canine distraction of PDL, the interseptal bone distal to the canine is undermined 1 to 1.5mm surgically at the same time of extraction of the first

premolars and the socket is deepened by a round bur to the length of the canine(fig.1). In this technique, the compact bone is replaced by the woven bone and tooth movement is easier and quicker due to reduced resistance of the bone.⁵⁰



Fig. 1



Fig. 2

2. Corticotomy and Osteotomy:

A corticotomy is defined as a surgical procedure where only the outer cortical bone is cut, perforated or modified. The medullar bone is left intact. This is in contrast to osteotomy, where the surgical cut perforates both cortical and medullar bone. This technique is reported to have postoperative stability and improved retention. The only pitfall of these surgical techniques is their invasive nature and the fact that acceleration was seen only in the first 3 to 4 months after which it declines with time.⁴



Fig. 3



Fig. 5

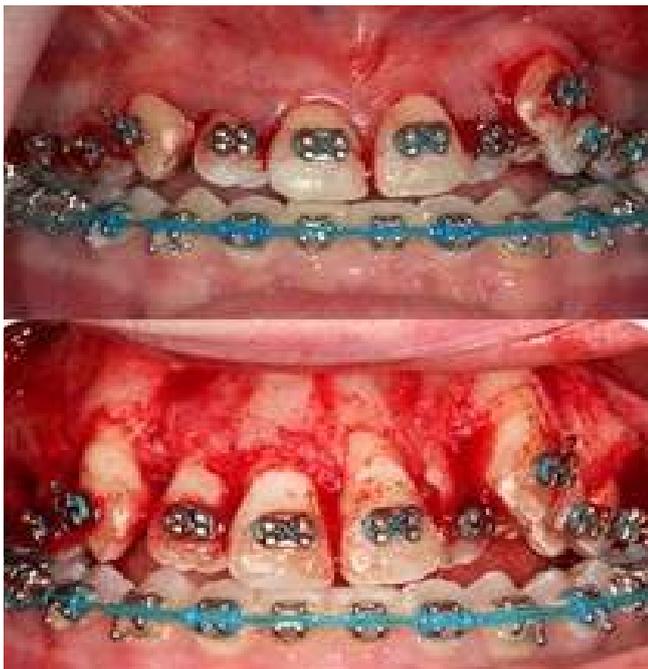


Fig. 4

3. Piezocision Technique

Dibart⁵¹ was among the first to apply the piezocision technique. In this the primary incision is placed on the buccal gingiva followed by incisions by Piezosurgical knife to the buccal cortex.⁵² This technique did not cause any periodontal damage.⁵³ It can be used with Invisalign, which gives a better aesthetic appearance and less treatment time.⁵⁴

Physical Approach

The concept of using physical approaches came from the idea that applying orthodontic forces causes bone bending (bone bending theory) and bioelectrical potential develops. The bioelectrical potential is created when there is application of discontinuous forces, which leads to the idea of trying cyclic forces and vibrations.⁴

These modalities include⁴ :

- lasers, vibrations & direct electric current

1. Low Level Laser Therapy :

Its stimulatory effects can accelerate bone regeneration in mid palatal suture, during rapid palatal expansion and stimulate synthesis of collagen, which is a major matrix protein in bone.⁶ Laser light has been seen to stimulate the proliferation of osteoclast and fibroblasts, and thereby affects bone remodelling and accelerates tooth movement. The mechanism involved in the acceleration of tooth movement is by the production of ATP and activation of cytochrome C, which was seen when low-energy laser irradiation enhanced the velocity of tooth movement via RANK/RANKL and the macrophage colony-stimulating factor and its receptor expression.⁴



Fig. 6

In 2004, Cruz et al. were the first to start a human study on the effects of low-intensity laser therapy in orthodontic tooth movement. They showed that the irradiated canines were retracted at a greater rate than the control canines by 34% over 60 days.⁷

In 2015, Kazem Dalaie et al. concluded that laser enhanced orthodontic tooth movement in the upper jaw, but they failed to provide solid evidence to support the efficacy of laser for expediting tooth movement or reducing the associated pain.⁸

2. Direct Electric Current Effect :

This technique was tested only on animals by applying direct current to the anode at the pressure sites and cathode at the tension sites (by 7V) thus generating local responses and acceleration of bone remodeling. This technique was tested only on animals by applying direct current to the anode at the pressure sites and cathode at the tension sites (by 7V) thus generating local responses and acceleration of bone remodelling as shown by group of investigators⁵⁵. Their studies were more successful than the previous attempts because electrodes were placed as close as possible to the moving tooth. The bulkiness of the devices and the source of electricity made it difficult to be tested clinically.

3. Vibrations

Nishimura et al. in 2008, used a Ni-Ti expansion spring on Wistar rats and applied a vibration of 60 Hz, 1 m/s². The rats that received vibration showed increased tooth movement. In the sectioned samples of vibration received rats showed increased RANKL expression in the fibroblasts and osteoclasts of the periodontal ligament of rats.²⁰

More recently, a product by name *AcceleDent* has arrived, which makes use of this technique. *AcceleDent*

consists of an activator, which is the active part of the appliance.⁵⁶ Activator delivers the vibration impulses through a mouthpiece that contacts the teeth. It can also be connected to a computer with a USB interface to review the patient usage of the appliance.

AcceleDent System- It is a simple, removable and non-invasive appliance that complements the orthodontic force applied by braces and works through the application of electromechanical vibrations. Just 20 minutes of daily use enhances the orthodontic force applied by braces or aligners to accelerate the rate of orthodontic tooth movement. It is designed to deliver gentle micro vibrations, in a way that is comfortable and easy to use. The benefit is shortened orthodontic treatment time and all of the benefits associated with the fast track to correct malocclusion and a great smile.⁶

Conclusion

Since long, orthodontic patients have been asking for shorter treatment times, and today, we do have methods that can accelerate orthodontic tooth movement safely. The current methods such as piezocision, lasers, vibration and biological methods have reduced or eliminated the invasive nature of previous procedures used to achieve the Regional Acceleratory Phenomenon. These methods have advantages such as reduced rates of relapse, less orthodontic pain and less root resorption. These techniques are a step closer to quicker orthodontic treatment making them the next frontier for orthodontics and its success.

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Abstract

Free radicals, Reactive oxygen species (ROS) and reactive nitrogen species (RNS) play a major role as both toxic and beneficial compounds, since they can be either harmful or helpful to the body. Overproduction of ROS (arising either from mitochondrial electron-transport chain or excessive stimulation of NAD(P)H results in oxidative stress, a deleterious process that can damage cell structures, including lipids and membranes proteins, and DNA. At moderate concentrations, however, nitric oxide (NO), superoxide anion, and related reactive oxygen species (ROS) play an important role as regulatory mediators in signalling processes. Ironically, various ROS-mediated actions protect cells against ROS-induced oxidative stress and maintain "redox balance" or "redox homeostasis". Oxidative stress plays a major part in the development of chronic and degenerative illness such as cancer, autoimmune disorders, ageing, cataract, rheumatoid arthritis, cardiovascular and neurodegenerative diseases. This review examines the chemistry, formation and sources of free radicals and its involvement in various diseases. Attention is focussed on the ROS/RNS-linked pathogenesis of cancer, cardiovascular disease (CVD), atherosclerosis, hypertension, diabetes mellitus (DM), neurodegenerative diseases (Alzheimer's disease) and ageing.

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Keywords: Free radicals, Oxidative stress, Antioxidants, Reactive oxygen species (ROS), Reactive nitrogen species.

Introduction

A free radical can be defined as an uncharged molecule containing one or more unpaired electrons in valency shell or outer orbit and is capable of independent existence. The odd number of electron(s) of a free radicals are short lived and highly reactive. Because of their high reactivity, they can abstract electrons from other compounds to attain stability. Thus the attacked molecule loses its electron and becomes a free radical itself, beginning a chain reaction cascade which finally damages the living cell [1]. Both ROS and RNS collectively constitute the free radicals and other non-radical species. The most important oxygen-containing free radicals in many disease states are hydroxyl radical, superoxide anion radical, hydrogen peroxide, oxygen singlet, hypochlorite, nitric oxide radical, and peroxynitrite radical. Reactive nitrogen species (RNS), include nitric oxide (NO), which is relatively unreactive, and its derivative the peroxynitrite (ONOO⁻) is a powerful oxidant. All these are highly reactive species, capable in the nucleus, and in the membranes of cells of damaging biologically relevant molecules such as DNA, proteins, carbohydrates, and lipids [2]. The ROS/RNS play a dual role as both beneficial and toxic compounds

to the living system. At the cellular level, ROS regulate growth, apoptosis, and other signalling pathways while, at the system level, they contribute to complex functions, including blood pressure regulation, cognitive function, and immune function [3,4,5].

Nitric oxide, early identified as a signalling molecule in blood vessel modulation [6] and now known as a regulator of important physiological processes [7], can mediate cellular toxicity, damaging metabolic enzymes and generating, by reaction with superoxide, peroxynitrite [8]. In short, ROS/RNS at low or moderate levels are vital to human health but when produced in excess, it can generate oxidative stress which can damage the cell membrane structure and other biomolecules.

Generation of Free radicals

Formation of ROS and RNS can occur in the cells by two ways: enzymatic and non-enzymatic reactions. Enzymatic reactions generating free radicals include those involved in the respiratory chain, phagocytosis, prostaglandin synthesis and in the cytochrome P450 system [9-17]. For example, the superoxide anion radical (O₂⁻) is generated via several cellular oxidase

systems such as NADPH oxidase, xanthine oxidase, peroxidases. Once formed, it participates in several reactions yielding various ROS and RNS such as hydrogen peroxide, hydroxyl radical (OH), peroxyxynitrite (ONOO⁻), hypochlorous acid (HOCl), etc. H₂O₂ (a non radical) is produced by the action of several oxidase enzymes, including amino acid oxidase and xanthine oxidase. Hydroxyl radical (OH), the most reactive free radical *in vivo*, is formed by the reaction of O₂⁻ with H₂O₂ in the presence of Fe²⁺ or Cu⁺ (catalyst). This reaction is known as the Fenton reaction [11-16].

Free radicals can also be produced from non-enzymatic reactions of oxygen with organic compounds as well as those initiated by ionizing radiations. The non-enzymatic process can also occur during oxidative phosphorylation (i.e. aerobic respiration) in the mitochondria [12, 13, 15].

ROS and RNS are generated from either endogenous or exogenous sources. Endogenous free radicals are generated from immune cell activation, inflammation, mental stress, excessive exercise, ischemia, infection, cancer, ageing etc. Exogenous ROS/RNS result from air and water pollution, cigarette smoke, alcohol, heavy or transition metals (Cd, Hg, Pb, Fe, As), certain drugs (cyclosporine, tacrolimus, gentamycin, bleomycin), industrial solvents, cooking (smoked meat, used oil, fat), radiation etc. [12-17]. After penetration into the body by different routes, these exogenous compounds are decomposed or metabolized into free radicals.

Deleterious activities of free radicals and oxidants and Pathogenesis

When produced in excess, free radicals and oxidants generate a phenomenon called oxidative stress, a deleterious process that can seriously alter the cell membranes and other structures such as proteins, lipids, lipoproteins, and deoxyribonucleic acid (DNA) [12-18]. Oxidative stress results from an imbalance between formation and neutralization of ROS/RNS. For example, hydroxyl radical and peroxyxynitrite in excess can damage cell membranes and lipoproteins by a process called lipid peroxidation. This reaction leads to the formation of malondialdehyde (MDA) and conjugated diene compounds, which are cytotoxic and mutagenic. Lipid peroxidation occurs by a radical chain reaction, i.e. once started, it spreads rapidly and affects a great number of lipid molecules [19]. Proteins may also be damaged by ROS/RNS, leading to structural changes and loss of enzyme activity [17, 19]. Oxidative damage to DNA leads to the formation of different oxidative DNA lesions which can cause mutations. The

body has several mechanisms to counteract these attacks by using DNA repair enzymes and/or antioxidants [14-17]. If this is not regulated properly, oxidative stress can induce a variety of chronic and degenerative diseases as well as the ageing process and some acute pathologies (trauma, stroke).

Antioxidants

'Antioxidants' are substances that neutralize free radicals or their actions [20]. Nature has gifted each cell with adequate protective mechanisms against any harmful effects of free radicals: superoxide dismutase (SOD), glutathione peroxidase, glutathione reductase, thioredoxin, thiols and disulfide bonding and buffering systems are present in every cell. α -Tocopherol (vitamin E) is an essential nutrient which functions as a chain-breaking antioxidant which prevents the propagation of free radical reactions in all cell membranes in the human body. Ascorbic acid (vitamin C) is also a good antioxidant. Other non-enzymatic antioxidants include carotenoids, flavonoids and related polyphenols, α -lipoic acid, glutathione etc. Antioxidants act at the levels of prevention, interception and repair. Preventive antioxidant attempt to stop the formation of ROS which include superoxide dismutase (SOD) that catalyses the dismutation of superoxide to H₂O₂ and catalase that breaks it down to water [20, 21]. Interception of free radicals is mainly by radical scavenging, while at the secondary level scavenging of peroxy radicals are affected. The effectors include various antioxidants like vitamins C and E, glutathione, other thiol compounds, carotenoids, flavonoids, etc. Mainly repair enzymes are involved at the repair and reconstitution level [20, 21, 22].

Oxidative stress

Oxidative stress arises as a result of an imbalance between free radical production and antioxidant defences, associated with damage to various molecular species including lipids, proteins, and nucleic acids [23,24]. Short-term oxidative stress may occur in tissues injured by trauma, infection, heat injury, hypertoxia, toxins, and excessive exercise. These injured tissues produce increased radical generating enzymes (e.g; xanthine oxidase, lipogenase, cyclooxygenase) activation of phagocytes, release of free iron, copper ions, or a disruption of the electron transport chains of oxidative phosphorylation, producing excess ROS. The initiation, promotion, and progression of cancer, as well as the side-effects of radiation and chemotherapy, have been linked to the imbalance between ROS and the

antioxidant defence system. ROS have been implicated in the induction and complications of diabetes mellitus, age-related eye disease, and neurodegenerative diseases such as Parkinson's disease [25].

Oxidative stress can lead to metabolic imbalances and to various diseases [Fig.1]

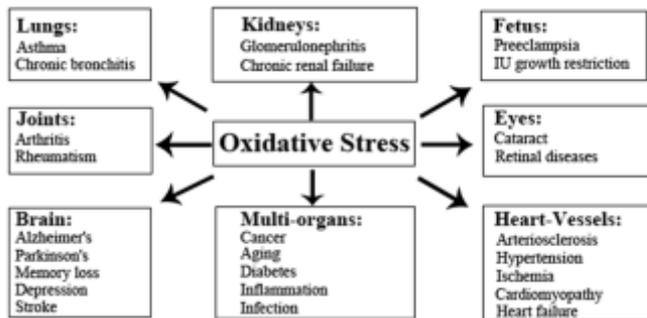


Figure 1

Role of free radicals in various diseases

The role of free radicals and oxidative stress has been postulated in many conditions, including atherosclerosis, inflammatory condition, cancers, diabetes mellitus, neurodegenerative diseases and the process of aging.

Cancer

The development of cancer in humans is a complex process including cellular and molecular changes mediated by diverse endogenous and exogenous stimuli. ROS induce DNA damage, as the reaction of free radicals with DNA includes strand break base modification and DNA protein cross-links. Several researchers have proposed participation of free radicals in carcinogenesis, mutation, and transformation. The presence of free radicals in the bio system could lead to mutation, transformation, and ultimately cancer. Induction of mutagenesis, the biological effect of radiation, occurs mainly through damage of DNA by the HO. radical and other species are produced by the radiolysis, and also by direct radiation effect on DNA. The reaction of HO. radicals is mainly addition to double bond of pyrimidine bases and abstraction of hydrogen from the sugar moiety resulting in chain reaction of DNA. These effects cause cell mutagenesis and carcinogenesis. Lipid peroxides are also responsible for the activation of carcinogens. [11, 12, 26]. Certain antioxidant supplements like vitamin C and E can prevent much oxidative damage to DNA and can reduce the ability of the oxidants to induce cancer [27,28]. Supplements like resveratrol (a flavonoid) to cancer patients may have some beneficial effect for a

more successful radiotherapy [29]. Dietary deficiencies in zinc can contribute to single- and double-strand DNA breaks and oxidative modifications to DNA that increase risk for cancer development [30].

Cardiovascular disease

Oxidative damage and the production of free radicals in the endothelium are two main factors involved in the pathogenesis of the atherosclerotic process that causes CVD. Poly unsaturated fatty acids occur as a major part of the low density lipoproteins (LDL) in blood and oxidation of these lipid components in LDL play a vital role in atherosclerosis [30]. The three most important cell types in the vessel wall are endothelial cells, smooth muscle cell and macrophage can release free radical, which affect lipid peroxidation [31]. With continued high level of oxidized lipids, blood vessel damage and can lead to generation of foam cells and plaque the symptoms of atherosclerosis. Oxidized LDL is atherogenic and is thought to be important in the formation of atherosclerotic plaques. Furthermore, oxidized LDL is cytotoxic and can directly damage endothelial cells. Antioxidants like β -carotene or vitamin E play an important role in the prevention of various cardiovascular diseases.

Researchers have shown that persons who consume large amounts of fruit and vegetables have lower incidences of cardiovascular diseases, stroke, and tumours, although the precise mechanisms for this protective effect are Elusive. Possible explanations include (a) increased consumption of dietary fiber, (b) reduced consumption of dietary cholesterol and other lipids, and (c) increased intake of the antioxidant vitamins (A, C, and E) [32,33].

Many studies showed that intake of vitamin E over an extended period was associated with decreased risk of cardiovascular events [34]. Tea and wine, rich in flavonoids, seem to have beneficial effects on multiple mechanisms involved in atherosclerosis [35].

Free radicals and ageing

One of the most popular theories of ageing is the "Free Radical Theory of Ageing." This theory was first proposed by Dr. Denham Harman [36], and postulates that aging results from an accumulation of changes caused by reactions in the body initiated by highly reactive molecules known as "free radicals." The review on 'Free radical and ageing 'by Barja [37] emphasizes that caloric restriction (CR) is the only known experimental manipulation that decreases the rate of mammalian ageing and it has many beneficial effects on

the brain of rodents and possibly of human. Calorie restricted mitochondria, similar to those of long lived animal species, avoid generation of ROS effectively at complex 1 with pyruvate and malate. The mitochondrial oxygen consumption remains unchanged, but the free radical leak from electron transport chain is decreased in CR.

Hypertension

Increased oxidative stress in hypertensive patients reduces activity of SOD. Vitamin E supplementation provides protection against oxidative stress by restoring the enzyme activity and preventing further damage caused by lipid peroxidation. Inclusion of vitamin E in antihypertensive therapy in post reperfusion hypertensive patients results in better management of blood pressure. So the consumption of diet rich in vitamin E should be increased in hypertension [43, 44]

Diabetes Mellitus

Oxidative stress plays a major role in the pathogenesis of diabetes mellitus and its underlying complications [45]. Both mitochondrial and non mitochondrial derived ROS contribute to oxidative stress during DM. Under normal conditions, the electron transport chain complexes I and III are the key sites of superoxide anion production [41]. Increased glucose level in DM leads to increased glycolysis resulting in the augmented generation of pyruvate, thus rising in the inner mitochondrial membrane potential upwards, followed by mitochondrial dysfunction and increased ROS production at electron transport chain complex III [42].

Persistent hyperglycaemia in the diabetic patients leads to generation of oxidative stress due to a) auto oxidation of glucose; b) non-enzymatic glycosylation and c) polyol pathway. Auto-oxidation of glucose involves spontaneous reduction of molecular oxygen to superoxide and hydroxyl radicals, which are highly reactive and interact with all biomolecules. They also accelerate formation of advanced glycation end products (AGEs). AGEs such as pyrroles and imidazoles tend to accumulate in the tissue. Cross linking AGE-protein with other macromolecules in tissues results in abnormalities in the cell and tissue function. Polyol pathway is the third mechanism by which free radicals are generated in the tissues [38,39]. Long-lived structural proteins, collagen and elastin, undergo continual non-enzymatic cross linking during ageing and in diabetic individuals [40].

ROS level elevation in diabetes may be due to decrease in destruction or/and increase in the production by

catalase (CAT—enzymatic/non-enzymatic), superoxide dismutase (SOD) and glutathione peroxidase (GSH-Px) antioxidants. The variation in the levels of these enzymes makes the tissues susceptible to oxidative stress leading to the development of diabetic complications [46]. According to epidemiological studies, diabetic mortalities can be explained notably by an increase in vascular diseases other than hyperglycemia [47]. Free radical formation in diabetes by non-enzymatic glycation of proteins, glucose oxidation and increased lipid peroxidation leads to damage of enzymes, cellular machinery and also increased insulin resistance due to oxidative stress [46]. According to latest research, the apolipoprotein component of LDL forms insoluble aggregates due to hydroxyl radical-induced cross-linkage between Apo-B monomers that is responsible for oxidative damage in diabetic complications [47]. In diabetes mellitus, main sources of oxidative stress are mitochondria. During oxidative metabolism in mitochondria, a component of the utilized oxygen is reduced to water, and the remaining oxygen is transformed to oxygen free radical which is an important ROS that is converted to other RS such as ONOO⁻, OH and H₂O₂ [49]. Insulin signalling is modulated by ROS/RNS by two ways. On one side, in response to insulin, the ROS/RNS are produced to exert its full physiological function and on the other side, the ROS and RNS have got negative regulation on insulin signalling, interpreting them to develop insulin resistance which is a risk factor for diabetes type 2 [50].

Neurodegenerative Disorders

Nervous tissue including brain is highly susceptible for free radical damage due to high content of lipids especially polyunsaturated fatty acids. Biochemical and histological studies have shown that increased levels of oxidative stress and membrane lipid peroxidation (LP) occurs in Alzheimer's disease (AD). Alterations in levels of antioxidant enzymes such as catalase and CuZn- and Mn-SOD in neurons in AD patients are consistent with their being under increased stress. Increased protein oxidation, protein nitration and LP occur in neurofibrillary tangles and neuritic plaques. Lipid peroxidation is quite extensive as indicated by increased levels of peroxidation products such as 4-hydroxynonenal (4-HNE) in the cerebrospinal fluid of AD patients which plays a central role in the neurotoxic actions of amyloid β peptide [51]. Lipid peroxidation may also promote neuronal death in AD by multiple mechanisms.

Novel approaches to reduce free radical damage

There are several novel approaches in the study of free radicals/antioxidants for the improvement of human health. A number of neuronal and behavioural changes occur with ageing, even in the absence of degenerative diseases. Several recent studies have found associations between the decline of memory performance and lower status of dietary antioxidants. The totality of evidence from experimental, clinical, and epidemiological studies support that consumption of foods obtaining high levels of dietary antioxidants, in addition to exerting several health benefits, may prevent or reduce the risk of cognitive deterioration.

Development of genetically engineered plants, to yield vegetables with higher level of certain compounds is another approach to increase antioxidant availability. Tomatoes with up to 3 times lycopene concentration as well as with longer shelf life were developed. 'Orange cauliflower' is found to be rich in β -carotene. One way of checking the antioxidant ability of vegetables and fruits is measuring its ORAC value or oxygen radical absorbance capacity. Some fruits/vegetables with their ORAC values/100 g are: raisins (2830), black berries (2036), strawberries (1540), oranges (750), grapes (739), cherries (670), spinach (1260), beets (840), onion (450) and eggplant (390).

Intake of fruits and vegetables with ORAC values between 3000 and 5000 per day is recommended to have significant impact of the beneficial effect of antioxidants [52].

Conclusion

Oxidative stress can cause cellular damage by oxidizing nucleic acids, proteins, and membrane lipids. ROSs have been implicated in the pathogenesis of many diseases and important biological processes including carcinogenesis and inflammatory disorders. Antioxidants plays a major role in the prevention/reduction of free radical formation. Further sources of free radical production and newer methods of production of antioxidants to supplement the naturally occurring defense mechanisms need to be explored.

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Abstract

Stress and oral health often go hand-in-hand, but stress also takes indirect paths to affect your dental health. In the past, there has been a tendency for many physicians and other health care providers to overlook or only give superficial consideration to psychological stress. Stress, anxiety, and depression were the three important factors affecting academic performance of the students. An increasing trend is observed in the prevalence of severe psychological problems in postsecondary students over the past years. Clinical dental teaching is in a unique position as the student is expected to learn both academic and clinical skills. Studies have shown that both clinical and academic factors contribute to stress among the dental students. This paper provides review of relationship between stress and the physiology and pathology of the major organ systems of the body, stress in dental and medical students as well as its management.

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Introduction

Stress is often described as a feeling of being overloaded, wound up tight, tense and worried. We all experience stress at times. It can sometimes help to motivate us to get a task finished, or perform well. But stress can also be harmful if we become over-stressed and it interferes with our ability to get on with our normal life for too long.

Webster's Third New International Dictionary defines stress "a physical, chemical, or emotional factor (as trauma, histamine, or fear) to which a individual fails to make a satisfactory adaptation, and which causes physiologic tensions that may be a contributory cause of disease..."

Signs of stress - When we face a stressful event, our bodies respond by activating the nervous system and releasing hormones such as adrenalin and cortisol¹. These hormones cause physical changes in the body which help us to react quickly and effectively to get through the stressful situation. This is sometimes called the 'fight or flight' response. Three types of stress are there¹:-

Acute stress - Sometimes stress can be brief, and specific to the demands and pressures of a particular situation, such as a deadline, a performance or facing up to a difficult challenge or traumatic event. This type of stress often gets called acute stress.

Episodic acute stress - Some people seem to experience acute stress over and over. This is sometimes referred to as episodic acute stress. These kind of repetitive stress episodes may be due to a series of very real stressful challenges, for example, losing a job, then developing health problems, followed by difficulties for a child in the school setting.

For some people, episodic acute stress is a combination of real challenges and a tendency to operate like a 'stress machine'. Some people tend to worry endlessly about bad things that could happen, are frequently in a rush and impatient with too many demands.

Chronic stress - The third type of stress is called chronic stress. This involves ongoing demands, pressures and worries that seem to go on forever, with little hope of letting up. Chronic stress is very harmful to people's health and happiness. Even though people can sometimes get used to chronic stress, and may feel they do not notice it so much, it continues to wear people down and has a negative effect on their relationships and health.

Measurement of Stress

1. Psychological questionnaires

It is the measurement of abstract concepts, such as language, cognition, personality and emotions, to name a few. To this end psychologists developed

questionnaires that cover a wide range of psychological symptoms that can be induced by exposure to chronic stress².

2. Physiological measures

The interpretation of a situation as being stressful leads to the activation of the hypothalamic-pituitary-adrenal (HPA) axis, and to the ultimate secretion of cortisol and catecholamines in humans². The end products are easily measurable in blood, urine and saliva.

3. Autonomic measures

Blood pressure - It is a measure of the force that blood exerts on the walls of blood vessels

Vagal tone - It represents the parasympathetic impulse that would apply a brake to decrease heart rate during both resting and reactive conditions.

Stress and General Health

Effect on Hemodynamic - The nervous system consists of central (CNS) and peripheral (PNS) nervous components. The PNS consists of both sympathetic and parasympathetic components. The sympathetic nervous system (SNS) responds rapidly to acute stress to mobilize the body's defense mechanisms. This emergency system plays an important role in the stress response such as increases in heart rate, blood pressure, cardiac blood flow, cardiac output, pupil dilation, perspiration, bronchial dilation, mobilization of glucose, lipolysis, and muscle strength³. Except for certain conditions, such as normal developmental processes, the body generally attempts to maintain a steady state. So, if a stressor alters the physiology of an organ system, the body appears to stimulate counteracting processes to resist change. Disruption of homeostasis occurs in the emotional and biological status of the person.

Effect on Endocrine System

The general adaptation syndrome¹ - The three stages of the G.A.S. include :

Alarm Stage — In the initial ALARM stage, the classical fight or flight reaction ensues. A stressor (physical or emotional) disrupts homeostasis of the subject. Adrenal catecholamine secretion and other biologic responses occur and the individual experiences heightened arousal, increased heart rate and blood pressure, and the psychological urge to attack or flee from the stressor event.

Stage of Resistance — In this stage, the body attempts to calm and better control the changes started in the

alarm reaction. For example, adrenal glucocorticoid hormones and other physiological processes lead to decreased inflammation, enhancement of anabolic processes, and hemodilution. The individual settles into a psychological mode of coping and possibly co-existing with the stressor, if the stressor cannot be eliminated.

Stage of Exhaustion — In this stage, a stressor persists despite attempts to either remove exposure to it, or to peacefully coexist with it. The individual basically “gives in” due to resource/energy depletion. Diminished functional capacity, sleep, rest, or even death, are forced upon the person.

Effect on GIT

Stress can lead to alterations in gastrointestinal motility, increase in visceral perception. It causes changes in gastrointestinal secretion and negative effects on regenerative capacity of gastrointestinal mucosa and mucosal blood flow. It also leads to esophageal Motility Disorders and negative effects on intestinal microflora. All these can further lead to various diseases such as gastro esophageal reflux, peptic ulcer disease, non-ulcer dyspepsia, irritable bowel syndrome and idiopathic constipation.¹

Effect on Respiratory System

Stress can increase the chances of lung cancer, bronchial asthma, acute respiratory infections and COPD (Chronic obstructive pulmonary disease). It increase the risk of hyperventillatory syndrome (Chest pain, anxiety, paraesthesias, weakness of extremities, muscular irritability, lightheadedness, blurred vision, and inability to concentrate)

Effect on Immune System

Stress has been shown to alter the immune system and often increase susceptibility to infection and possibly to certain forms of cancer. It alters cellular immune function, numbers and percents of white blood cells, and immunoglobulin levels.¹²⁶ These mechanisms may be important in respiratory infections, asthma and lung cancers. It has become increasingly clear that glucocorticoid secretion is a consequence of stress and that glucocorticoids are powerful immunosuppressors¹.

Stress and Oral Health

We all encounter stress in our lives, and some more than others. You're probably aware of what stress does to our bodies -- it can cause anxiety disorders and panic attacks, and a lack of sleep can lead to grogginess and

irritability. But stress and oral health is an entirely new ballgame for most people.

Unfortunately, our mouths have just as much of a chance of being affected by stressful situations as our bodies and minds do. Researchers have found a significant link between stress and oral health, helping us better understand what part anxiety and depression take in the development of dental problems. We now know that stress is a contributing factor to the conditions like bruxism, canker sores, dry mouth, burning mouth syndrome, TMJ disorders, lichen planus, oral cancer and dental caries.

In the study done by Jain M et al, it was found that the correlation between perceived stress score and DMFT scores in the sample was weak ($r=0.389$) but highly significant ($p<0.001$). The correlation between perceived stress score and DMFT scores in males was found to be moderate ($r=0.579$) and highly significant ($p<0.001$). The correlation between perceived stress score and DMFT scores in females was found to be very weak ($r=0.242$) but statistically significant ($p<0.05$)⁴.

Stress and oral health often go hand-in-hand, but stress also takes indirect paths to affect your dental health. Patients who are under stress tend to neglect their oral hygiene routines. So, when you have so much going on, it's hard to remember to brush and floss correctly. Poor diet is also a result of stress -- sugary and carbohydrate-laden foods that promote tooth decay might be consumed on a more frequent basis when we are busy or depressed. There is yet another significant correlation between stress and oral health -- stress not only causes dental conditions, but painful dental problems can also increase our levels of stress and anxiety. Furthermore, our ability to tolerate pain is compromised as our bodies struggle to adapt to stressful situations. As a result, tooth pain can become more extreme during times of stress.

Stress at Work Place

Burnout generally occurs in employees and professions characterized by a high degree of personal investment in work and high performance expectations. It occurs most often in employees who have a strong emotional commitment to work.

Outline of the Burnout Syndrome

1. **Initial Stages** – It is related to work performance which includes loss of efficiency, loss of initiative, inability to control work performance during stressful situations, declining interest in work. Also there can be some physical/medical condition

including shortness of breath, sleep disorders, loss of weight/appetite, headaches, fatigue and exhaustion, gastrointestinal disorders. It may be related to behavioral symptoms which includes lack of interest in fellow employees, temper tantrums, risky behavior, low tolerance level and mood swings.

2. **Late Stages** – It includes substance abuse such as alcohol, drugs, excessive smoking and increased use of caffeinated drinks. The person starts rigid and negative thinking. He lack of faith in the abilities of co-workers, management, organization and self. There will be lower return of productivity at work.

Stress in Dental and Medical Students

Student-teacher relationship contributes immensely to both intrinsic and extrinsic motivation of a learner. Teachers hold an important position in identifying psychological weakness in the students. Tutor related behavior also has an important role to play in learning. Psychological health of the tutor in clinical dental education system, therefore, becomes important part of an effective learning system. This has been a neglected part of the dental education system and many remains unknown about tutor's mental health^{5,6}.

A cross-sectional, questionnaire based study was conducted among clinical dental students and faculty of a dental college in Faridabad, India by Jain M et al⁶. Depression Anxiety Stress scales-21 (DASS 21) which is a short version of the original 42-item DASS described was used. It was found that the stress scores were higher in trainees as compared to trainers. This difference was statistically significant with $P = 0.04$. Statistically, significant difference was seen in stress scores between graduate and postgraduate trainers ($P = 0.015$) as well as between undergraduates and postgraduate trainers ($P = 0.005$). There was a statistically significant difference in stress scores of postgraduate trainers and students ($P = 0.02$)⁷.

Lower level of stress in trainers may lead to more involvement with students and better learning environment that may be responsible for lesser percentage of students having stress. However, higher mean scores, particularly in undergraduates, indicate a need for introduction of psychological counseling in dental education and various practices for reduction of stress in clinical dental settings in teaching hospitals.

Stress due to academic performance:

Kumar et al (2009) reported the most important source of stress among Indian dental students was the academic component of the course, especially in regard to examinations and grading. For the preclinical students (first and second year students) examinations, grades and fear of failing a course or year are the greatest causes of stress because students have to focus on the completion of preclinical laboratory projects in addition to successful performance in demanding basic medical and dental sciences subjects which require a lot of study⁸. Senior students, on the other hand, generally experience stress related to difficulties in meeting clinical requirements before being allowed to sit for examination.

Student Relationships with Faculty as a Potential Stressor

Dental students reported high levels of stress due to unjustified criticism of their faculty on preclinical and clinical exercises. Sanders and Lushington found that students with higher levels of stress related to their relationships with faculty members tended to have lower grades in tests of clinical competence and basic understanding⁹.

Patient and Clinical Responsibilities as a Potential Stressor

Pau and Croucher conducted a study of British dental students and found that third- and fourth-year students had higher levels of stress than preclinical students. The most common stressors included patients arriving late or not showing up for appointments, needing to find one's own patients and difficulty finding suitable patients¹⁰.

Personal Life Issues

Acharya reported that Indian dental students were often stressed by the fear of facing their parents after failing academically. Researchers in both dental and medical education have reported student frustration due to loss of opportunities for social and recreational activities and inadequate amount of time for rest and relaxation¹¹.

Other personal life issues included being forced to postpone marriage or commitments, conflicts with partners over career decisions and discrimination against female dental students.

Financial obligations

Increasing costs of a professional education is a very significant stressor for both medical and dental

students. Along with this increasingly uncertain earning potential, has raised concerns about their long-term financial security among both medical and dental students.

Management of Stress

Stress perception and coping

Perception of the same stressor is often quite varied among different people. To one subject, the concept of riding on a roller coaster or singing before an audience may be very pleasurable, while provoking extreme anxiety in another. Thus, the expected emotional and somatic effects of the same stressor may differ. The ability of people to cope with the same stressor may be vastly different¹².

Differences in coping skills depend on a combination of many factors including genetics, training, religion, environment, education, perception of the stressor, coping skills, gender, age, experience, race, nationality, rest level, exercise frequency, family stability, social friendships and many others.

Aiding people in their ability to cope with stress more effectively is a major role of many psychiatric and family physicians, psychologists, and clinical counselors (such as some nurses and social workers). In addition, people learn a great deal about coping strategies informally from their parents, teachers, coaches, friends, and others. It is in the area of coping style that stress impacts on many other areas of life, such as alcoholism, drug abuse, interpersonal relationships, and others¹².

Identify warning signs

It is very helpful to be able to identify early warning signs in your body that tell you when you are getting stressed. These vary from person to person, but might include things like tensing your jaw, grinding your teeth, getting headaches, or feeling irritable and short tempered.

Identify triggers

There are often known triggers which raise our stress levels and make it more difficult for us to manage. If you know what the likely triggers are, you can aim to anticipate them and practice calming yourself down beforehand, or even find ways of removing the trigger. Triggers might include late nights, deadlines, seeing particular people, hunger or over-tired children.

Establish routines

Having predictable rhythms and routines in your day, or over a week, can be very calming and reassuring, and can

help you to manage your stress. Routines can include regular times for exercise and relaxation, regular meal times, waking and bedtimes, planning ahead to do particular jobs on set days of the week, spend time with people who care, spending time with people you care about, and who care about you, is an important part of managing ongoing stress in your life. Spend time with friends and family, especially those you find uplifting rather than people who place demands on you, share your thoughts and feelings with others when opportunities arise. Don't 'bottle up' your feelings, look after your health, make sure you are eating healthy food and getting regular exercise, take time to do activities you find calming or uplifting, such as listening to music, walking or dancing. Avoid using alcohol, tobacco or other drugs to cope¹².

Notice your 'self-talk'

When we are stressed we sometimes say things in our head, over and over, that just add to our stress. This unhelpful self-talk might include things like: 'I can't cope', or 'I'm too busy', or 'I'm so tired', or 'It's not fair'. While we might think that these are fairly truthful descriptions of what's going on, they are not always helpful to repeat, and can even make you feel worse.

Notice when you are using unhelpful self-talk, and instead try saying soothing, calming things to yourself to reduce your levels of stress. Try more helpful self-talk like 'I'm coping well given what's on my plate', or 'Calm down', or 'Breathe easy'. Keeping things in perspective is also important. When we are stressed, it's easy to see things as worse than they really are. Try self-talk such as 'This is not the end of the world' or 'In the overall scheme of things, this doesn't matter so much'.

Practice relaxation

Make time to practice relaxation. This will help your body and nervous system to settle and readjust.

Consider trying some of the following things¹²:

1. Learn a formal technique such as progressive muscle relaxation, meditation or yoga.
2. Make time to absorb yourself in a relaxing activity such as gardening or listening to music.
3. Plan things to do each day that you look forward to and which give you a sense of pleasure, like reading a book.

Conclusion

If high levels of stress continue for a long period of time, or are interfering with you enjoying a healthy life, it

is advisable to seek professional help. Stress is a silent killer. So, a mental health professional, like a psychologist, can help you identify behaviors and situations that are contributing to high stress, and help you to make changes to the things that are within your control. Seeking help can be one way to manage your stress effectively. Stress discussed above will raise some new issues and reinforce some of the investigative and management strategies currently employed. Better management of work stress may help reduce the overall risk of stress-related medical problems discussed in this lecture.

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AN INDIRECT COMPOSITE VENEER TECHNIQUE FOR SIMPLE AND ESTHETIC TREATMENT OF FLUOROSIS

Abstract

This case report describes a technique for treating anterior teeth with fluorosis using indirect composite veneer restoration. The prime advantage of an indirect veneer technique is that it provides an esthetic and conservative result. One of the most frequent reasons that patients seek dental care is discolored anterior teeth. Although treatment options such as removal of surface stains, bleaching, microabrasion or macroabrasion, veneering, and placement of porcelain crowns are available, conservative approach such as veneer preserves the natural tooth as much as possible. Full veneers are recommended for the restoration of localized defects or areas of intrinsic discoloration, which are caused by deeper internal stains or enamel defects. Indirectly fabricated veneers are much less sensitive compared to a operator's technique and if multiple teeth are to be veneered, indirect veneers can be usually placed much more expeditiously. Indirect veneers last much longer than the direct veneers. Therefore, indirectly fabricated veneers are more advantageous than directly fabricated veneers in many cases.

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Introduction

The word esthetic implies beauty, naturalness, and youthful appearance relative to one's age. Esthetic dentistry created new dimensions in providing esthetics and functional rehabilitation.¹ Because of esthetic demands as well as patients' awareness have been increased over the period of years, it becomes imperative for clinicians to evolve better treatment modalities to deliver higher standard of therapies using new generation materials along with improved clinical procedure.^{2,3}

The aim of this study is to present a novel indirect restorative technique with composite in anterior teeth providing esthetic in order to restore the dental anatomy to hypoplastic teeth.

Case Report

An 18-year-old girl presented to the Department of Conservative Dentistry And Endodontics Dentistry of Manav Rachna Dental College, Faridabad, with a chief complaint of discoloured teeth. Clinical examination revealed generalized fluorosis. (Figure 1 & 2)



(Figure 1)



(Figure 2)

Following oral hygiene measure, it was decided to restore teeth with indirect composite veneer restoration.

Upper and lower anterior teeth were prepared by the removal of 0.5–0.75 mm enamel with a medium grit chamfer bur with proximo-incisal shoulder preparation.¹



(Figure 3)

Further, arch impression of the prepared teeth was made using an elastomeric impression material. The cast is prepared using die-stone. Separating medium applied on the cast. Te-Econom Plus (Ivoclar Vivadent) shade A1 was applied. Finishing and polishing of veneers were carried out with shofudisc and shofupolishing cup.⁴ (Figure 4 & 5) The veneers were then subjected to heat tempering in an oven. Cerinate® Oven (Den-Mat Corp) can be used at 110°C for 7 min.



(Figure 4)



(Figure 5)

Although a significant advantage exists over direct composite veneers, indirect veneers made of processed composite possess limited bond strength because of the reduced potential to form chemical bond with the bonding medium.⁵ After etching using 37% phosphoric acid, a thin layer of bonding agent was applied on the prepared tooth surface and light cured. Then luting composite was applied to the internal surface of the veneer and the prepared tooth and removed the excess composite resin with a brush dipped in bonding agent before curing. Other veneers were placed in same fashion. (Figure 6 & 7)



(Figure 6)



(Figure 7)

Discussion

Today's dentistry requires more conservative treatment options.⁶ Therefore, composite veneer restorations, which require minimal removal of tooth structure, are one of the best treatment choices. With the advantages such as only one appointment for the whole treatment time, very low costs compared with the ceramics and no need for long laboratory procedures, direct composite laminate veneers are popular in today's dentistry.⁶ However, direct composite laminate restorations have still less resistance against abrasions and fractures compared with indirect composite laminate veneers and ceramic laminates. Furthermore, indirect composite laminate veneer restorations due to polymerization outside of the oral cavity, and ceramic laminate veneers due to better color stability because of being less affected by the fluids of the oral cavity, are superior to direct composite veneers.⁷

In our case, in order to establish both functional and esthetic integrity, and considering more resistance and compressive strength than ceramics and similar abrasion rates compared with natural tooth structures, indirect composite veneer restorations were considered. Full ceramic crown restorations were not considered because they result in excessive tooth structure loss as well as their high costs. Framing the teeth, within the confines of the gingival architecture, has a tremendous impact on the aesthetics of the smile.⁷ The impact on the beauty of a smile from an uneven gingival contour height can be dramatic and although the position of the zenith of the gingival tissue seems like a small detail, it can greatly influence the axial inclination and emergence profile of the teeth.

These factors, some major and some minor, all add up to determine how pleasing the smile.⁸ The instructions given to the patient in our case for maintaining good oral hygiene were important for a long-lasting esthetic results (e.g. gingivitis-free situation). Though the final result was satisfying for the patient, a follow-up is highly recommended.

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ANTERIOR MARYLAND BRIDGE COMPENSATING THE SPACE : A CASE REPORT

Abstract

One of the basic principles of tooth preparation for fixed Prosthodontics is conservation of tooth structure. A resin-bonded bridge consists of a cast metal framework that is cemented with resin composite to abutments which have preparations confined entirely to enamel. The resin-retained bridge is considered good treatment option for missing teeth as it is relatively cheap when compared to alternatives such as dental implants, requires little or no damage to the surrounding teeth during preparation for placement, and it is well tolerated by patients. This case report deals with the successful replacement of space created anteriorly after orthodontic treatment by a Maryland bridge.

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Keywords: Resin- Bonded bridge, Rochette bridge, Maryland bridge, micromechanical bonding.

Introduction

Resin-Bonded fixed dental prosthesis require minimal removal of tooth structure and is appealing, particularly for abutment teeth that are intact and caries free.

The Glossary of Prosthodontic Terms¹ defines Resin-Bonded prosthesis as a fixed partial denture that is luted to tooth structures, primarily enamel, which has been etched to provide micro mechanical retention for the resin luting agent; early designs incorporated perforations on the lingual partial-coverage retainer (Rochette bridge) through which the resin luting agent passed to achieve a mechanical lock; subsequently, use of acid etching of the metal partial-coverage retainer (Maryland bridge or resin-bonded prosthesis) eliminated the need for perforations; recently, adhesive resins that bond to the metallic oxides of non-acid etched alloy or to the triborosilicate coated alloy have been used; also recently, the resin impregnated fiber-reinforced composite resin (FRC) retainer and framework has eliminated the metal alloy; glass, polyethylene, and carbon fibers are used in resin-bonded prostheses. The restoration is simple in concept and consists of one or more pontics supported by thin metal or porcelain retainers bonded lingually and proximally to the enamel of abutment teeth.² The primary goal of resin bonded partial FPD is the replacement of missing teeth and maximum conservation of tooth structure.

Case Report :

A 21 years old female reported to Department of Prosthodontics, Manav Rachna Dental College, Faridabad with a complaint of a gap between two teeth in upper, front tooth region. Dental history was recorded which revealed that three years back, she got her right canine disimpacted prior to the orthodontic treatment. A gap was created between 12 and 13 [Fig. 1].

Diagnostic impressions were made with alginate (Zelgan, Dentsply, India) and casts were poured in type III gypsum (Kalstone, Kalabhai, India) and the space of 7mm was measured between two teeth. Thus, a Maryland bridge was planned to compensate for the space created.



Fig. 1: Pre-operative photograph

Abutment teeth were prepared palatally by leaving margins about 1mm from the incisal edge and 1mm from gingival margin. Chamfer gingival margin was placed slight supragingival so as to delineate the gingival extension of the preparation. The finish line extended incisally through the distal marginal ridges of 12 and 13 so that mesial, distal and lingual planes were created. Finish line on proximal surface was placed as far facially as was possible, adjacent to the edentulous space to optimize esthetics. The proximal walls of abutment teeth were kept parallel [Fig. 2]. Occlusion was assessed to ensure at least 0.5 mm of interocclusal clearance for metal retainers in maximum intercuspation. Three flat countersinks were placed on palatal surface of incisor and cingulum rest was prepared on canine, acting as vertical stops.

Putty-light body impression was made with condensation silicone, Zetaplus (Zhermack) and Oranwash impression material, for the maxillary arch [Fig. 3] which was poured in type IV gypsum (Ultrarock, Kalabhai, India).

Wax pattern was fabricated [Fig. 4 (a)] with wings extending onto the palatal surfaces and pontic was carved out in the shape of canine. It was then casted [Fig. 4 (b)] and the retainers were seated palatally on abutment teeth. Pontic was built up in porcelain (Vita, Zahnfabrik, Germany), fired and contoured. The fit was evaluated in bisque trial and then finally glazed.



Fig. 2: Preparation of abutment teeth

The prosthesis was then bonded with resin cement, Calibra (Dentsply) [Fig. 4 (c)].

Discussion

Bonded pontics were the earliest resin bonded prosthesis which included extracted teeth or acrylic teeth as pontics that bonded to proximal and lingual surfaces of abutment teeth with composite resin.³ Such restorations should be presented to patients only as short term replacement as with time composite resin degrades to wire or mesh and subsequently can fracture.⁴ Splinting mandibular anterior teeth with a perforated metal casting was first described by Rochette in 1973.⁵



Fig. 3 : Putty-light body impression

The cast perforated resin-bonded fixed partial denture bonded mechanically. Despite the success, it showed limitations as perforations caused exposure to wear the resin, limited adhesion of metal and weakening of metal retainer by the perforations.⁶ A technique for electrolytic etching of cast base metal retainers was developed at the University of Maryland by Thompson and Livaditis.^{7,8}

Etched cast retainers have definite advantages over cast perforated restorations:

- a) Retention is improved because the resin-to-etched metal bond can be substantially stronger than the resin-to-etched enamel. The retainers can be thinner and still resist flexing.
- b) The oral surface of cast retainers is highly polished and resists plaque retention.

During the course of this work, the need for composite resin with low film thickness for luting the casting became apparent.⁹

Typical success rates are being quoted as high as 80% after 15 years in the anterior maxilla. Far lower success rates are seen in the posterior mandible.¹⁰ Thus, case

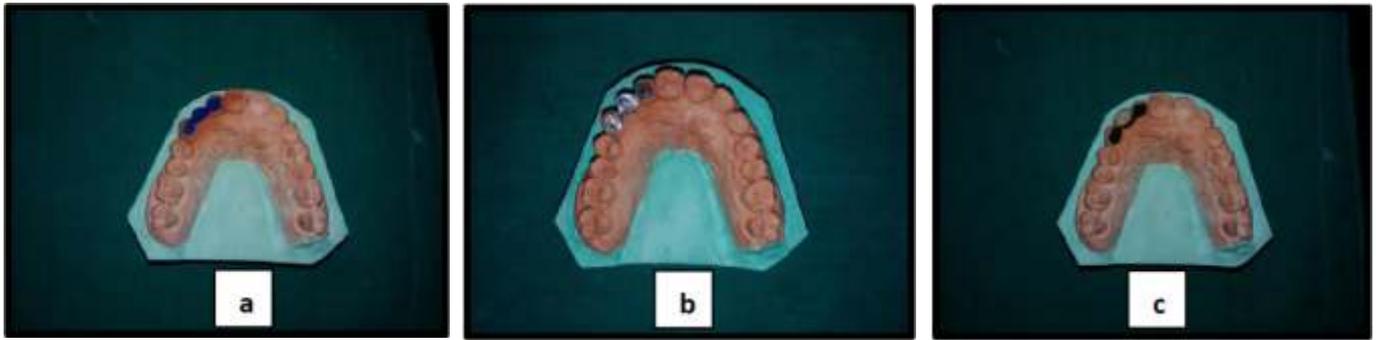


Fig. 4: (a) Wax pattern; (b) casted and (c) pontic built up in porcelain



Fig. 5: a) Pre-op photograph; b), c) & d) Post-op photograph of the patient

selection is important. As with any dental procedure, good oral hygiene is paramount for success.

Conclusion:

The resin-retained bridge is increasingly being used in modern dentistry as an alternative to more destructive treatments. This has been driven by the advent of evidence-based dentistry showing the benefits to patients of reduced tooth preparation and the importance of an intact enamel structure for the long-term health of the teeth. One major advantage of the resin-retained bridge over a conventional bridge is the failure mode is likely to be debonding of the retainer. In conventional bridges, the failure mode is likely to be complete fracture of the abutment tooth with difficult-to-manage sequelae, possibly requiring root canal treatment. With a resin-retained bridge the prosthesis can usually be cleaned off and rebonded in position with minimal inconvenience to the patient.

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I, Dr. Shveta Sood, hereby declare that the particulars given above are true to the best of my knowledge and belief.

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