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MESSAGE FROM THE MANAGING DIRECTOR

To raise new questions, new possibilities, to regard old problems from a new angle, require creative imagination and marks real advance in science.

Albert Einstein

Time to rejoice as another issue of our Journal being published. With more and more number of articles pouring in from different colleges all over, I am extremely happy in the direction in which our Journal is progressing. I am sure it will achieve newer heights in near future. I whole heartedly appreciate the hard work of the Editor and his team in continuously working hard in the prospect of the quality of the Journal.



Imbesat Shaukat
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MESSAGE FROM THE EDITOR

Your work is going to fill a large part of your life, and the only way to be truly satisfied is to do what you believe is great work. And the only way to do great work is to love what you do. If you haven't found it yet, keep looking. Don't settle. As with all matters of the heart, you'll know when you find it.

Steve Jobs

Greetings from the editorial desk. It is indeed a great pleasure to publish yet another new issue of our Journal. I sincerely thank all contributors and acknowledge their sincere efforts in complying with in various stages of query addressal. I highly appreciate the fact that in this issue we have original articles along with case reports and review articles. With increasing number of original articles we look forward for your continuous support in reaching new heights. As nothing is impeccable, we always open to suggestions and try to incorporate your constructive valuable opinions to strive better.



Prof (Dr) Dipto De
Editor
Journal of Oral & Dental Health

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Impact of a Tobacco Cessation Training Program for Dental Professionals in Kanpur, India: A Quasi Experimental Study

Abstract

Introduction: Developing health professional's knowledge and skills in tobacco cessation is a potentially powerful and far-reaching strategy to shift professional and societal norms toward cessation and promote comprehensive tobacco control in developing countries where tobacco use is normative and tobacco control is not well-established. **Materials & Methods:** Using a quasi-experimental pre-post-test study design, seventy six participants who attended a one-day tobacco cessation workshop organized by Tobacco Intervention Initiative- Indian Dental Association (T.I.I- I.D.A.) were assessed through a questionnaire survey for the impact of training on their knowledge, perceived role and tobacco cessation practices. Statistical analysis: Student's paired t-test, Wilcoxon signed Ranks test and Chi square tests were used. Level of significance was considered at $p \leq 0.05$. **Results:** Mean scores for knowledge, attitude, practices and barriers were significantly improved at six-months post training ($p < 0.001$). Knowledge was particularly high for use of behavioural and pharmacological interventions (Mean difference= 0.68), and use of 'Cold Tukey' method to quit (Mean difference= 0.59). All dentists (100.0%) were able to ask, 99% were able to motivate patients six months after the workshop. Nevertheless, dentists' skill in assisting and arranging follow up were poorer with 48.7% able to assist on a regular basis, i.e., often and always, and 34.2% able to arrange follow-up visits more often. **Conclusion:** Skills-based training workshops are needed to promote significant behaviour changes among dental professionals to integrate these practices into routine patient-care.

Key words: Tobacco cessation, Dental professionals, Training, Attitude, Practices

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INTRODUCTION

Tobacco use is a leading cause of preventable deaths all over the world. According to the World Health Organization (WHO), there are 1100 million smokers worldwide. This constitutes one-third of the global population aged 15 years and above. About 73% (800 million) of these are in developing countries and 27% (300 million) in developed countries. It has been estimated that without urgent interventions mortality due to tobacco use will rise to 10 million every year over the next 30-40 years, of which 70% will occur in developing countries.¹

Presently, rates of quitting smoking vary greatly between high-income developed countries and low- and middle-income countries. Despite the growing epidemic, tobacco control programs, including cessation programs, are underdeveloped or non-existent in many developing countries. The Global Adult Tobacco Survey India (GATS) 2009-10 revealed that more than one-third of adults use tobacco in one form or the other. Nearly two in five smokers and smokeless tobacco users made attempts to quit the habit in the past 12 months.²

Only 5% of the world's population has access to comprehensive tobacco cessation services.³ It is sad that the biggest cause of preventable death and disease has the least amount of effective intervention available.

According to WHO guidelines (South East Asian Regional Organization- SEARO), it is envisaged that the prevention of tobacco use and treatment of its addiction follow the TEACH paradigm:⁴

Training – Train all health-care providers to be familiar with the health, social and economic risks from tobacco use and how to provide help to users to quit.

Education – Educate people in the community as well as persons who access health-care services on the harm from tobacco use and thus decrease initiation and encourage cessation.

Advice – Advise all persons using tobacco to quit.

Counselling and care – Counsel persons regarding the benefits and ways of quitting and provide help to prevent relapse and care, both psychosocial and pharmacological, as needed.

Harm minimization – Harm minimization, both to those exposed to tobacco smoke and tobacco users themselves.

Tobacco dependence is a chronic condition characterized by susceptibility of relapse over years. It can be well handled by sustained professional support from health care providers mainly through behavioral counseling and pharmacotherapy. Dental professionals can play a pivotal role in diagnosing and effectively managing tobacco dependence.

For cessation training programs to be both successful and sustainable, countries need health care professionals with the knowledge and skills to both deliver and teach tobacco cessation. An essential first step in establishing sustainable tobacco cessation training programs for health care professionals is to train faculty with the requisite knowledge and skills to staff these programs.

Developing faculty knowledge and skills in tobacco cessation is a potentially powerful and far-reaching strategy to shift professional and societal norms toward cessation and promote comprehensive tobacco control in developing countries where tobacco use is normative and tobacco control is not well-established.⁵

Faculty development refers to those activities and programs which focus on assisting or enhancing the academic faculty members' ability to function in the diverse roles of teachers, scholars and professionals, and individuals with both work and personal lives.⁵

Amongst all health-care professionals, dentists particularly can take leadership role in tobacco cessation strategies. The effects of tobacco use on the population's oral health are alarming, and there is a clear link between tobacco use and oral health outcomes of the same. They are concerned about the adverse effects in the oropharyngeal region, they often have access to children, youths and their caregivers, thus providing opportunities to influence these individuals on the dangers of tobacco. They spend more time with their patients, treat patients of all age groups. Reports have suggested that simple patient counselling by dentists increases cessation rates as they can stimulate their smoking patients into quitting by showing the actual effects of tobacco on the mouth.⁴

India is witnessing a major growth in the health care and health education sector, with rapid growth of dental institutions in the last two decades. Empowering dental graduates, post graduates, faculty and practitioners thus seems to be a promising way ahead to carve the path for effective tobacco cessation programmes. Thus the present study was initiated with the aim of evaluating the impact of a tobacco cessation training program for dental students, faculty and practitioners on their knowledge, attitude and practices of tobacco cessation.

MATERIAL AND METHODS

Development of the Workshop

The program was designed as a one-day training workshop held by Tobacco Intervention Initiative (T.I.I.) in association with Indian Dental Association (I.D.A.). TII is a professionally-led "call to action" programme to eradicate tobacco addiction while striving for a 'tobacco free India' and thus improving the oral health of Indians by the year 2020. Aim of the workshop was to provide quality tobacco intervention training to dental professionals with a resultant reduction of oral cancer burden on the people and the nation. They empower the participants with Training, Advocacy, IDA-certified Tobacco Intervention Centres and Educational resources. The content of the workshop included providing basic knowledge on extent of the tobacco problem, effects on general health and oral health, and economy, and role of oral health professionals in tobacco control (module 1); pharmacology of nicotine addiction and behavioural therapies (module 2); brief intervention for tobacco use in the dental office - 5A's of tobacco cessation (module 3), pharmacotherapy (Nicotine replacement therapy - NRT/non-NRT)

and drug interactions (module 4); factors effecting relapse and prevention and treatment of relapse (module 5).

Study Population and Study Setting

BDS interns, post graduates, faculty and dental practitioners who attended a single day T.I.I.-I.D.A tobacco cessation training workshop at Faculty of Dental Sciences, Rama University, Kanpur, India were invited to participate in the study. The organizers contacted the participants before the start of the program and informed them about the study. A total of 80 participants attended the workshop and all agreed to participate in the study. A pre-test questionnaire for assessing knowledge, attitude, practices and perceived barriers was distributed to them before the start of the workshop and post-test questionnaire was administered during the group activity after the workshop for assessing post-workshop knowledge, attitude and perceived barriers. Assessment for tobacco cessation practices was done after 6 months by personally visiting all the participants (two extra attempts were made to visit those who were missing on first attempt).

Ethical Clearance

Ethical clearance to conduct the study was obtained from the Institutional Review Board of Faculty of Dental Sciences, Rama University.

Inclusion Criteria

All enrolled workshop participants, giving consent for participating in the study.

Exclusion Criteria

Those who had attended any training workshop in the past.

Study Design and Measures of Outcome

A quasi experimental pre-test post-test study design was used.

During the pretest and posttest, participants were assessed on their knowledge regarding tobacco use and tobacco cessation (18 yes/no questions), attitude - perceived role regarding the contribution in tobacco cessation (7 statements with 4-point likert scale, from strongly disagree to strongly agree), practices - performing cessation counselling and pharmacotherapy (11 statements 4-point likert scale, from never to always), and perceived barriers in tobacco cessation (11 statements with 4-point likert scale, from strongly disagree to strongly agree). More score in each part indicates higher knowledge, more accepting role, more practices, and more perceived barriers.

Statistical Analysis

Statistical Package for Social Sciences (SPSS- version 21) was used to analyse the data. Descriptive statistics included calculation of means, standard deviation (S.D) and percentages. Data distribution was assessed for Normality using Shapiro-Wilk test and box-plots. Wilcoxon Signed-Ranks test was used to make pair-wise comparison between the pre and post-test responses for non parametric ordinal data, and Student's paired t-test for parametric data. Frequencies for practices before and after training were compared using chi square test. All results were considered statistically significant for a p-value of ≤ 0.05 .

RESULTS

Profile of the Study Participants

A total of 80 participants attended the workshop. All of them filled the pre-test questionnaire. Post-test questionnaire (including responses on practices) was completed by 76 participants (95% response rate), so 76 were entered for analysis. Mean age of the study group was 28.21 years, with a mean of 29.14 among males and 27.41 among females. Characteristics of the study population are shown in Table 1.

Knowledge Regarding Tobacco Cessation

Before the workshop, the mean \pm SD of total knowledge was 6.88 ± 4.68 while after completing the training the mean of total knowledge was significantly increased to 14.46 ± 2.28 ($p < 0.001$) (Table 2). Knowledge scores were significantly improved in all domains. Difference in knowledge was particularly high for the questions on prevalence of tobacco use (Mean difference = 0.60), use of behavioural and pharmacological interventions (Mean difference = 0.68), and use of 'Cold Turkey' method to quit (Mean difference = 0.59). (Table 3).

Attitude Regarding Tobacco Cessation

Before training, the mean \pm SD total score of perceived role was 18.5 ± 2.84 . In the post-training survey, the mean total score for

Table 1: Characteristics of the study population

Characteristics	Study population
Age (in years)	Mean \pm SD 28.21 \pm 2.68
Gender	N (%)
Males	35 (46.1)
Females	41 (53.9)
Designation	N (%)
BDS interns	27 (35.5)
Postgraduate students	21 (27.6)
BDS practitioners	13 (17.1)
MDS practitioners	15 (19.7)
Received undergraduate training on tobacco cessation	N (%)
Yes	36 (47.4)
No	29 (38.2)
Don't know/don't remember	11 (14.5)

Table 2: Pre and post-test knowledge, attitude and practices scores among the dental professionals

Assessment	Mean \pm SD		Test statistic	P value
	Pre-test scores	Post-test scores		
Knowledge [†]	6.88 \pm 4.68	14.46 \pm 2.28	Z = -7.171	<0.001*
Attitudes [†]	18.54 \pm 2.84	20.66 \pm 2.12	Z = -4.355	<0.001*
Practices [†]	16.11 \pm 4.13	27.64 \pm 5.61	Z = -7.221	<0.001*
Barriers [*]	34.23 \pm 2.88	28.9 \pm 4.49	t = 14.814	<0.001*

[†]Wilcoxon signed-ranks test; *paired student's t-test; *statistically significant ($P < 0.05$). SD: Standard deviation

perceived role was significantly higher than those in the baseline survey, with mean \pm SD score of 20.6 ± 2.12 ($p < 0.001$) (Table 2).

The perceived role (attitude) of participants in tobacco cessation was significantly higher for the items- when asked if dental students should regularly advice their patients ($p < 0.001$), whether dentists can play an important role for tobacco control ($p = 0.001$), and if motivation by dental students is effective in cessation counselling ($p = 0.010$), as shown in Table 4.

Practice of Performing Tobacco Cessation Counseling

A significant increase in dentists' practices was found when pre and post-test score was compared (16.11 ± 4.13 vs 27.64 ± 5.61), ($p < 0.001$) (Table 2).

Figure 1 shows the pre and post-test mean scores for all domains of practices. The differences were statistically significant for all domains with a $p < 0.001$ (not shown in figure).

Table 5 shows the frequency of providing counselling pre and post-training. Participants mostly stated sometimes and often for each domain six months after the training. After training completion, great improvement in the ability to perform cessation counseling was observed. As shown in Table 5, all dentists (100.0%) were able to ask, 99% were able to motivate. Nevertheless, dentists' skill in assisting and arranging follow up were poorer with 48.7% able to assist on a regular basis, i.e., often and always, and 34.2% able to arrange follow-up visits more often.

Perceived Barriers in Performing Tobacco Cessation Counselling

Figure 2 shows pre and post training scores for perceived barriers in performing counselling. For all domains, there was a statistically significant decrease in mean scores after the training workshop (not shown in figure). Prior to the workshop, lack of training and lack of knowledge about Nicotine Replacement drugs were scored higher than the other barriers.

DISCUSSION

The present study was initiated as part of a tobacco cessation training workshop held for dentists at Faculty of Dental Sciences, Rama University, Kanpur- India. The study sample consisted of 76 dentists (interns, post graduates and dental practitioners) who participated

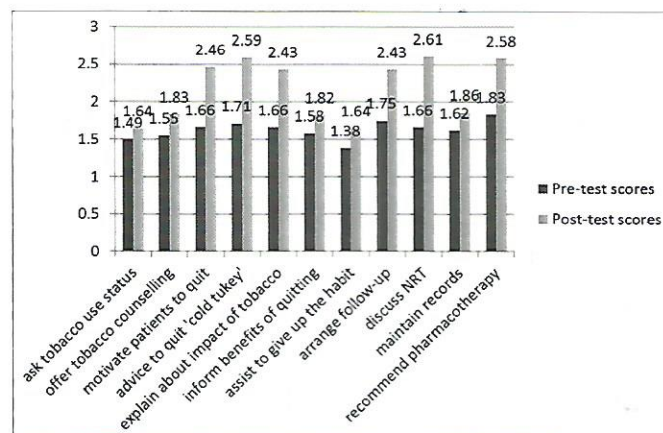


Figure 1: Pre and post-test mean scores for dental professionals' tobacco cessation practices

Table 3: Pre and post-test knowledge scores of the study participants

Knowledge questions	Mean±SD		Mean difference	P value
	Pre-test scores	Post-test scores		
Are you aware of the current prevalence of tobacco use in India?	0.22±0.41	0.83±0.37	0.60	<0.001*
Are you aware of the programmes/treaties in place by government and other organizations for tobacco control in India?	0.05±0.22	0.55±0.50	0.50	<0.001*
Are you aware of the ban on sale of tobacco products to and by minors and sale of tobacco products within 100 yards of educational institutions?	0.51±0.50	0.92±0.27	0.40	<0.001*
Do you think that tobacco use is addictive in nature?	0.93±0.25	1.00±0.00	0.06	0.025*
Do you know that addiction to tobacco has behavioural as well as pharmacological components?	0.47±0.50	0.99±0.11	0.51	<0.001*
Are you aware of the harmful effects of tobacco on oral health?	0.75±0.43	1.00±0.00	0.25	<0.001*
Do you know that chewing tobacco can be as dangerous as smoking tobacco?	0.42±0.49	0.97±0.16	0.55	<0.001*
Do you know that after quitting tobacco, the body starts reversing the health risk conditions almost immediately?	0.39±0.49	0.97±0.16	0.57	<0.001*
Do you think that tobacco intervention with patients should include both behavioural as well as pharmacological treatment?	0.32±0.46	1.00±0.00	0.68	<0.001*
Are you aware of the 5A's and 5 R's of tobacco cessation technique to be used in the dental office?	0.43±0.49	0.80±0.40	0.36	<0.001*
Do you know that the "Cold Turkey" method helps patients to quit the habit abruptly?	0.11±0.30	0.70±0.46	0.59	<0.001*
Do you know that pharmacotherapy can increase the chances of quitting effectively, while taking care of the withdrawal symptoms?	0.34±0.47	0.88±0.32	0.53	<0.001*
Are you aware of the test used to assess nicotine dependence in tobacco users?	0.33±0.47	0.64±0.48	0.31	<0.001*

SD: Standard deviation; *denotes significant values

Table 4: Pre and post-test mean scores for attitude of dental professionals towards tobacco cessation

Statements	Mean±SD		Mean difference	Z	P value ¹
	Pre-test scores	Post-test scores			
Dental students should regularly and effectively advice their patients to quit tobacco use	3.24±0.56	3.63±0.51	0.39	-3.909	<0.001*
Dentists can play an important role for tobacco control in the society	3.09±0.67	3.50±0.64	0.40	-3.302	0.001*
A multi-sectoral and multi-professional approach is required for tobacco control	3.09±1.09	3.47±0.62	0.38	-1.901	0.057
Dental students should be given specific and formal training on tobacco cessation techniques	3.46±0.52	3.53±0.55	0.06	-677	0.499
If dental students motivate patients, they are effective in cessation counselling	2.88±0.73	3.20±0.61	0.31	-2.587	0.010*
There are too many barriers that prevent me from helping patients to quit smoking	2.37±1.19	2.89±0.62	0.52	-3.027	0.002*
A dental student who himself/herself uses tobacco is ineffective in giving tobacco cessation advice	2.89±0.81	3.11±0.62	0.21	-1.715	0.086

¹Wilcoxon signed-ranks test; *statistically significant (P<0.05). SD: Standard deviation

in that training workshop, and answered the pre and post training questionnaire. Only 47.4 per cent of the participants said they had been taught tobacco cessation during their undergraduate training; this level is similar to that reported in a study of dental students in Karnataka, India⁶ as well as Australian dental students.⁷ In India, there are very limited practical and hands-on training on the process of tobacco cessation. Hence, more practical training in helping patients on tobacco cessation should be included in the dental curriculum.⁸

Studies have shown that dentists trained in tobacco cessation counselling were able to contribute to tobacco cessation programs in the community with good success rates, comparable to the rates reported in general medical practice settings.⁹⁻¹² Also, results

of other studies¹²⁻¹⁴ showed that dentists believed that the major constraint for providing tobacco cessation counselling was lack of training. Hence, continuing education and training for tobacco cessation should be organized by the government and health department. These findings emphasize the need for training workshops for the dental workforce in India, and hence the goal of our study.

Training and educational programs for professionals play an important role in learning, and thereby change in knowledge, skills, attitude and social behaviour. In principle, all educational programmes explicitly or implicitly acknowledge that attitude and behaviour are interlinked. Such programs have as their starting-point the view that desired behaviour-change must be preceded by

Table 5: Frequency of dental professionals' tobacco cessation practices before and after the training workshop

Practice questions	Responses	N (%)		Chi square value	P value ¹
		Pre- est	Post-test		
Do you ask about your patient's tobacco use status?	Never	13 (17.1)	0	18.868	0.001*
	Sometimes	49 (64.5)	20 (26.3)		
	Often	14 (18.4)	21 (27.6)		
	Always	0	35 (46.1)		
Do you offer tobacco cessation counselling to your patients?	Never	27 (35.5)	1 (1.3)	8.865	0.181
	Sometimes	43 (56.6)	34 (44.7)		
	Often	6 (7.9)	23 (30.3)		
	Always	0	18 (23.7)		
Do you motivate your patients to quit tobacco?	Never	27 (35.5)	1 (1.3)	8.057	0.234
	Sometimes	43 (56.6)	19 (25.0)		
	Often	6 (7.9)	29 (38.2)		
	Always	0	27 (35.5)		
Do you advice patients to quit cold turkey?	Never	57 (75.0)	15 (19.7)	11.904	0.064
	Sometimes	17 (22.4)	30 (39.5)		
	Often	2 (2.6)	20 (26.3)		
	Always	0	11 (14.5)		
Do you explain patients about the impact of tobacco on general and oral health?	Never	18 (23.7)	2 (2.6)	5.331	0.502
	Sometimes	47 (61.8)	10 (13.2)		
	Often	11 (14.5)	35 (46.1)		
	Always	0	29 (38.2)		
Do you inform patients about the benefits of quitting?	Never	20 (26.3)	2 (2.6)	13.918	0.031*
	Sometimes	44 (57.9)	13 (17.1)		
	Often	12 (15.8)	28 (36.8)		
	Always	0	33 (43.4)		
Do you assist patients to give up the tobacco habit?	Never	42 (55.3)	2 (2.6)	11.985	0.062
	Sometimes	32 (42.1)	37 (48.7)		
	Often	2 (2.6)	18 (23.7)		
	Always	0	19 (25.0)		
Do you arrange follow-up visits to discuss cessation with tobacco using patients?	Never	55 (72.4)	9 (11.8)	6.202	0.401
	Sometimes	20 (26.3)	41 (53.9)		
	Often	1 (1.3)	12 (15.8)		
	Always	0	14 (18.4)		
Do you discuss NRT with your patients?	Never	45 (59.2)	11 (14.5)	8.593	0.035*
	Sometimes	31 (40.8)	46 (60.5)		
	Often	0	14 (18.4)		
	Always	0	5 (6.6)		
Do you keep record of patients tobacco status?	Never	54 (71.1)	12 (15.8)	9.902	0.019*
	Sometimes	22 (28.9)	36 (47.4)		
	Often	0	17 (22.4)		
	Always	0	11 (14.5)		
Do you recommend the use of pharmacotherapy except in special circumstances?	Never	59 (77.6)	59 (77.6)	11.580	0.072
	Sometimes	16 (21.1)	16 (21.1)		
	Often	1 (1.3)	1 (1.3)		
	Always	0	0		

¹Chi-square test; *statistically significant (P≤0.05)

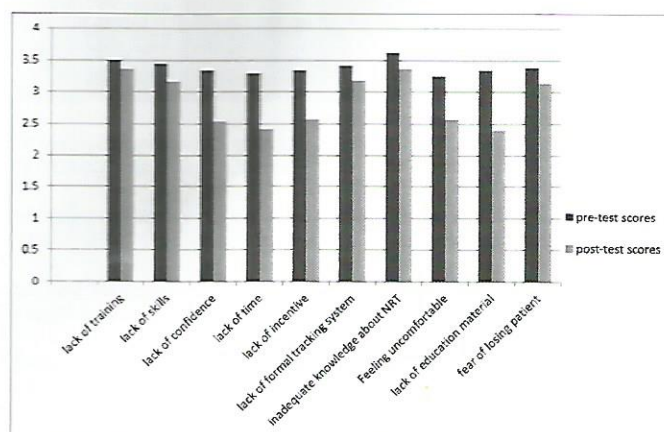


Figure 2: Pre and post-test mean scores for dental professionals' perceived barriers in providing tobacco cessation counselling

appropriate attitude change, rooted in new knowledge. It can indeed be argued that practice or behaviour is applied attitude.¹⁵

The present study revealed that dentists who received training reported having significantly more positive knowledge, attitudes and behaviours related to tobacco-use cessation counselling. This is consistent with the findings of Walsh et al.¹⁶ and Rankin et al.¹⁷ Changes in knowledge would be expected due to course content, and this was observed, with a significant gain in knowledge. Specifically there was increase in knowledge about 5A's and 5R's of tobacco cessation, the use of 'cold turkey' method and knowledge about nicotine replacement therapy. Positive change in knowledge was found in studies by Rankin et al.¹⁶, Walsh et al.¹⁷, Uti and Sofola¹⁸, Kristina et al.¹⁹ and Turker et al.²⁰

Attitudes were assessed by asking questions on their perceived role in tobacco cessation. An especially important finding is that there were significant positive changes in attitude for course participants, which implies a greater chance of positive behavioural outcomes. Turker et al.²⁰ have found in their study that items regarding routine advising smoking and smoking around children, getting a specific training on cessation, banning of smoking in closed area, increase in the price of tobacco products, usefulness of pharmacotherapy and patient's chance of quitting smoking were significantly higher after training among family physicians.

Participation in the course contributed to an increase in practice behaviour compared to baseline at 6 months. Course participants reported a significant increase in the percentage that asked their patients' tobacco use status, and informed about the benefits of quitting. There was also a significant increase in the percentage that discussed NRT and updated patient records. This is consistent with the findings of Rankin et al.¹⁶, Kristina et al.¹⁹ Similar to results obtained by Kristina et al.¹⁹ and Brothwell and Gelskey²¹, the present study also found that fewer dentists were able to assist patients in giving up the habit and arranging follow-up visits. These findings are in line with other studies which found that health professionals were less likely to perform assisting and arranging follow-up as compared to asking and advising (Kristina et al.¹⁹, Tong et al.²², Panda et al.²³

We also assessed perceived barriers in undertaking tobacco cessation counselling among this study population. Before the training course, participants felt that lack of training for providing counselling and inadequate knowledge about NRT were the major barriers for them to undertake counselling for their patients, Lack of

skills, lack of incentives and fear of losing their patients were other important reasons cited as barriers for undertaking counselling. Uti and Sofola¹⁸, Parkar et al.¹², and Walsh et al.¹⁷ have reported similar results in their studies.

The limitations of the study are worthy of note. Firstly, as the participation of dentists was on a voluntary basis, therefore they were highly motivated to undertake training; this reduces the generalizability of the findings. Secondly, being a quasi-experimental design, without involving a control group implies that results of our study should be interpreted with caution. As a recommendation, we would like to suggest that such a study be conducted with an appropriate control group to enhance the validity of the study. Thirdly, while the short-term impact of the course is clearly demonstrated by the findings of this study, the long-term effect of these changes cannot be known. Further research that permits longer follow-up would be valuable, especially when combined with periodic reinforcement of the course messages.

CONCLUSION

Significant improvement in knowledge, attitudes and practices of the participating dentists was observed after receiving single day training on tobacco cessation. Six months post-training, the dentists were better equipped with the knowledge and skills to help their patients through tobacco cessation counselling; their practices of 5A's were significantly improved and barriers in conducting counselling were significantly reduced.

Thus, in countries like India, where curriculum based training on tobacco cessation is lacking, such skills based training workshops are needed to promote significant behaviour changes to integrate these practices into routine patient-care.

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Conflict of Interest

None to declare.

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Evaluation and Compare the Effect of Number of Firings on the Colour Stability of All-ceramic System Using a Spectrophotometer – An In Vitro Study

Abstract

Background: Ceramic restorations have been advocated for superior esthetics, and various materials have been used to improve ceramic core strength, but there is a lack of information on how colour is affected by fabrication procedures. This study was designed to compare the effect of no. of firings on colour stability in all ceramic restoration. **Methods and Materials:** Ten disc shaped specimens are made, 7mm diameter with 2mm thickness of All-ceramic (Ivoclar IPS e-max press). Repeated firing cycles (5, 7, or 9) performed, and associated colour change was compared. Colour differences among the specimens was measured using a spectrophotometer. A portable reflectance spectrophotometer is used. Values of the colour change are recorded in the CIELAB colour system. Data expressed in Commission Internationale de l'Eclairage (CIE) LAB system coordinates. The CIELAB colour space provides L*a*b* values for each sample. Statistical analysis of data was done to draw conclusions. **Result:** The L*a*b* values of all ceramic system were affected with increase number of firings (5,7,9) and veneering porcelain material. L* value nonsignificantly increase. For veneering porcelain, the a* value decreased after repeated firings and the b* value decreased after repeated firings.

Key words: Colour Stability, Ceramic, Spectrophotometer

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INTRODUCTION

Ceramic restorations have been advocated for superior esthetics, and various materials have been used to improve ceramic core strength, but there is a lack of information on how colour is affected by different core substructures and fabrication procedures.

Colour matching between a restoration and natural teeth is a common clinical problem. Despite of careful shade selection, colour of the restoration may be affected by fabrication procedure.

According to Rosenstel And Johnston (1998)¹ study, restoration conducted from different kinds of porcelain showed significant colour difference, while parameters such as firing temperature and condensation technique have little impact on the colour of porcelain.

The purpose of this an in vitro study was carried out to evaluate the effect of repeated firings on colour stability of all ceramic (IPSe.max® Ivoclar Vivadent, Lichtenstein) using a reflectance spectrophotometer.

MATERIALS AND METHODS

The study was carried out in the Department of prosthodontics and was prior reviewed and approved by the ethical committee. Ten disc shaped specimens are made, 7mm diameter with 2mm thickness of All-ceramic (Ivoclar IPS e-max press) (n=10).

The shade employed for fabrication of specimens was A2. Shade from the group of a shade guide (VITA Classical Shade Guide; VITA Zahnfabrik) was selected, as this group accounts for at least 65% of clinical shade selections.

Fabrication of Specimen

In disc shaped specimen, The core thickness and the veneering thickness has been kept constant at 0.5 mm and 1.5 mm as given in literature and recommended by the manufacturer.

Metal dies were fabricated to facilitate standardization of core thickness. After the cores were finished, a micrometer of 1µm sensitivity was used to ensure the accuracy of the core thickness.

An instrument was made to help in veneering of the cores. The internal diameter was wider of the first piece by 30% i.e 1.5 mm to compensate for volumetric shrinkage. The cores were placed in the hollow of the instrument and lowered to a required depth. The veneering was carried out by dentin and enamel ceramic as dentine determined the tooth colour and enamel scattered at wavelengths in the blue range. The discs were then fired according to the respective manufacturer's recommendation.

The fired discs did not have an even smooth surface, so the veneered surface is finished flat at the thickness of correct dimension (2 mm) with a diamond impregnated finishing point of 25 µ grit. Specimen was checked with digital vernier caliper for the desired thickness. As the desired thickness was achieved, specimens were cleaned and glazing was done and tested.

Colour Measurement and Statistical Analysis

The colour of each specimen was measured with a reflectance spectrophotometer using D45 illumination standard and a 100

observer. The CIElab units (L^* a^* b^* values) were recorded and were used for subsequent comparisons. 10 samples were fired 9 times and 3 set of readings were available of each group and that is at the end of 5, 7 & 9 firings. Quantity of colour change (ΔE^*) was calculated each time. The total colour difference (ΔE^*) of each specimen was calculated with the following equation:

$$\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

The readings obtained were statically analyzed and mean and standard deviations were calculated. Based on these values, student's 't' test, group statistics and ANOVA test were applied. The interactions were statically significant ($p < 0.05$).

DISCUSSION

In the present study, Ten disc shaped specimens were made for this study. Same samples were subjected for the repeated number of firings (5, 7 & 9) because study is about the effect of number of firings on particular material, so other confounding factors were kept common which affects the colour stability of ceramic. ADA specification no. for all ceramic is 69. Previous investigators have used specimens of various diameters. As the testing has to be done by spectrophotometer whose testing port is circular and only 3 mm in diameter, the diameter of the disc shaped specimens was taken as 7 mm for convenience of fabrication and measuring. The samples were shaped as discs with flat surfaces as the extra oral spectrophotometer is capable of measuring colour only of a flat surface. The colour of the surface to be measured depends on its surface characteristics.

Douglas & Przybylska et al² tried to predict the ceramic thickness to get the desirable colour for Vintage & VMK 95 porcelain. They were reported that the thickness of ceramic is less or equal to 2 mm in all the porcelain systems to have better colour match. While 2 mm corresponds to the thickness that would be achieved after an adequate tooth reduction at the occlusal and incisal surfaces. It involves core thickness (0.5 mm)^{3,4} and the veneering thickness (1.5mm) as given by the manufacturer.⁵ For fabrication of the specimens, the manufacturers' recommendations⁵ were followed. Core thickness and veneering thickness were kept constant as the thickness is one of the confounding factor and has major effect on the colour of restoration.

The shade employed for fabrication of specimens was A2. Shade from the A group of a shade guide (VITA Classical Shade Guide; VITA Zahnfabrik) was selected, as this group accounts for at least 65% of clinical shade selections.

Metal dies were fabricated to facilitate standardization of core thickness. After the cores were finished, a digital vernier caliper was used to ensure the accuracy of the core thicknesses. This instrument can measure up to 0.001 mm/10 μ , which is as same as that of an optical microscope. With the help of veneering die, veneering is carried out. Discs were then fired. The number of firings and temperature parameters were followed according to the respective manufacturer's recommendation and tested.

Colour Measurements

Colour can be evaluated with various instruments as well as by visual assessment. Culpepper WD40 & Barnagi et al⁶ stated that by visual assessment, variability may result due to several factors including observed object, illuminant position relative to the observer and to each other, colour characteristic of the illuminant, metamerism,

fatigue, aging and emotional state of the observer. Since instrument measurements eliminate subjective interpretation of visual colour comparison, spectrophotometer was used.

The colour measurements were done in the CIELAB colour system, which was developed in 1978 by the Commission Internationale de l'Eclairage for characterizing colour for human perception. The CIELAB colour space is a uniform three dimensional colour order system. The L^* coordinate denotes lightness, analogous to Munsell Value. The a^* coordinate denotes redness or greenness and b^* coordinate denotes yellowness or blueness. The colour difference ΔE is the algebraic distance between two points in the colour space. It represents the relative colour changes that are observed for the materials after treatment or between time periods. The total colour difference (ΔE^*) of each specimen was calculated with the following equation:

$$\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

It has been reported by SeghiRR et al⁷ that ΔE value equal to 1 is considered visually detectable 50% of the time, whereas ΔE value greater than 2 is perceptible 100% of the time. The colour measurement was done using a reflectance spectrophotometer that incorporates 10-degree observer, 45-degree illumination, with light provided by pulsed xenon arc lamp.

According to the study of Shokry TE, Shen C et al (2006)⁸, The influence of the background substrate on the definitive appearance of ceramic specimens is well established. Neutral colours such as white, grey, and black are, by definition, colours that have no hue. Neutral white was selected as a background to minimize the influence of background hue on the colour measurement of the specimens.⁹

The readings obtained were statically analyzed, mean and standard deviations were calculated. Based on these values, student's 't' test, group statistics and ANOVA test were applied. The results obtained were tabulated and graphically depicted.

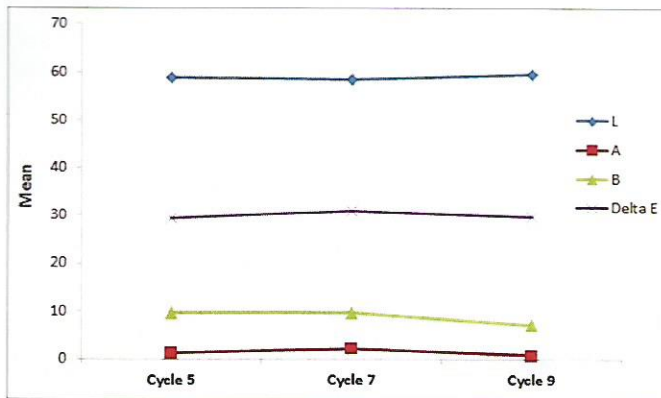
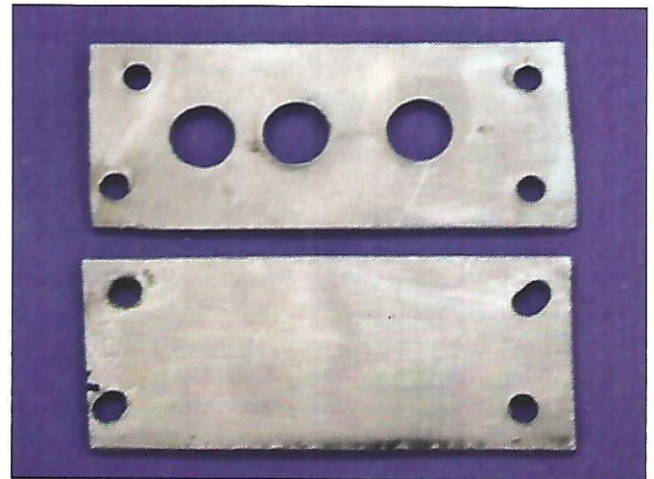
Results of the current study indicated imperceptible colour changes for the tested all ceramic subjected to a repeated number of firings. Uludag B, Usumez A et al⁹ reported that an increase in the number of firings resulted in a decrease in L^* and an increase in a^* and b^* colour values of In-Ceram and IPS Empress specimens with different veneering ceramic thicknesses (Table 1, Graph 1 and Figures 1-6).

In the current study, repeated firings resulted in a statistically non-significant increase in L^* value but significant decrease in a^* and b^* resulted in less reddish and yellowish specimens for the veneering porcelain A2 shade. Results of Celik G et al's¹⁰ study investigating the colour changes of a zirconia ceramic system with 2 different veneering porcelain shades after repeated firings indicated an increase in the L^* value and a decrease in the a^* value for both A1 and A3 veneering porcelain shades, resulting in lighter and greener specimens; however, the b^* value was not influenced by the number of firings for the A1 veneering porcelain shade and increased for the A3 veneering porcelain shade, resulting in more yellowish specimens. The differences between these 2 previous studies and the current study may be attributed to the optical properties of different core materials, as a zirconia ceramic system was found to be the least translucent ceramic system and more opaque than the IPS e.max system. In addition, the VITA instrument used in the current study, which was found to have both reliability and accuracy values greater than 90%, may be sensitive to translucency changes, and some change may be related

Table 1: The distribution of colour changes due to varies firing cycles in study material

System co-ordinates	All ceramic (A)			p values		
	Cycle 5	Cycle 7	Cycle 9	5 vs 7	5 vs 9	7 vs 9
L	58.8±1.7	58.5±1.4	59.6±0.9	0.873	0.904	0.994
A	1.3±0.07	2.1±0.6	0.73 ±0.1	0.001	0.003	0.001
				(S)	(S)	(S)
B	9.8±0.7	9.8±0.7	7.2±1.1	0.997	0.001	0.001
					(S)	(S)
ΔE	29.4±1.6	30.9±1.4	29.7±0.8	0.050	0.873	0.138
				(S)		

S: Singnificant NS: Non significant

**Graph 1:** The distribution of colour changes due to various firing cycles in study material**Figure 3:** A portable reflectance spectrophotometer -techkon, premier colour scan**Figure 1:** All ceramic specimens (n=10)**Figure 4:** Die (I) for core fabrication**Figure 2:** All ceramic –IPS E.Max ceram (Ivoclar Vivadent) (Shade A2)**Figure 5:** Specially fabricated stainless steel die (II) for vennering

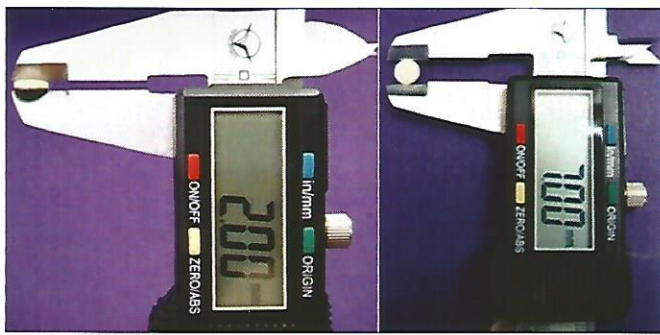


Figure 6: Dimensions of the specimen (thickness & diameter)

to the vitrification of the veneering porcelain. As the porcelain is fired, its translucency may change and the measurements may be slightly altered.

The result of our study suggested that $L^*a^*b^*$ values of the ceramic systems were affected by the number of firings (5, 7, or 9 firings) and veneering porcelain materials. The translucency of the specimen is increasing and opacity is decreased. Overall the specimen becoming lighter than the desired shade due to repeated firings.

Colour change after repeated firings may also be attributed to the colour instability of metal oxides during firing, which can affect the resulting colour of ceramic. Ceramic consist of pigments and opacifiers. Pigmenting oxides are added to obtain various shades needed to simulate natural teeth. The pigments are prepared by fusing metallic oxides together with glass and feldspar.

Different colouring pigments used in dental porcelain are iron/nickel oxide (brown); copper oxide (green); titanium oxide (yellowish brown); manganese oxide (lavender) and cobalt oxide (blue). Opacity may be achieved by the addition of cerium oxide, zirconium oxide, titanium oxide or tin oxide. Several studies have suggested that certain metal oxides are not colour stable after they are subjected to firing temperatures.^{11,12} Studies examining colour changes of surface colourants after firing have demonstrated pigment breakdown at firing temperatures. Crispin et al and Lund and Piotrowski^{11,12} reported that yellow- and orange hued stains were the least colour stable at the manufacturers' recommended firing temperatures. However, Mulla and Weiner¹³ reported that blue was the most unstable stain, while orange demonstrated the greatest colour stability at higher firing temperatures.

Clinical success and colour stability of ceramic restorations depend on laboratory and clinical variables. Ceramic systems in this study exhibited colour differences that could not be detected by the human eye under firing conditions following the manufacturers' instructions. Finally, ceramic restorations should be luted to the tooth substrate using a luting agent with a shade and thickness that contribute to the aesthetic appearance of the restorations. Therefore, further studies on the interaction of ceramic materials with luting agents and other substrates are needed.

CONCLUSION

This in-vitro study was carried out to evaluate and compare the effect of number of firings on the colour all-ceramic system. Within the limitations of this in vitro study, the following conclusion were drawn: Lesser the number of firings, higher is the strength and better

is the esthetics. Too many firings give a lifeless over translucent porcelain.

In a clinical situation, a comparative analysis will help a clinician to choose a restoration that is best suited for a patient and which will restore the esthetics also. Number of firings should be carefully considered to obtain an acceptable colour match of the definitive restorations.

Limitations of this Study

Although a strict protocol for sample fabrication and testing was followed throughout the study, following factors impose certain limitations on the study that include the in vitro use of a spectrophotometer to evaluate shade differences of only a single A2 shade (Vitapan Classic). The other shades available for ceramics also need to be tested for colour stability. Furthermore, the specimens were disc shaped rather than crown shaped. Specimens used in this study were dry. The study was carried out extra orally.

Additional studies are needed to investigate:

- Evaluate the colour stability after repeated firings intraorally with the thin film of saliva.
- Effect of the various luting cements on the colour stability of ceramic.

Compliance with Ethical Standards

Ethical approval

this article does not contain any studies with human participants or animals performed by any of the authors.

Statistical Comments

- 1) All Ceramic Material:
 - a. Co-ordinate L is not significantly different across different firing cycles.
 - b. Co-ordinates A is significantly smaller after firing cycle 9 compared to the firing cycles 5 and 7.
 - c. Co-ordinates A is significantly higher after firing cycle 7 compared to the firing cycle 5.
 - d. Co-ordinates B is significantly smaller after firing cycle 9 compared to the firing.

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Co-relation Between Hemoglobin, Hematocrit and General Blood Picture In Patients With OSMF

Abstract

Aim: To assess and co-relate the serum hemoglobin, hematocrit levels and general blood picture in patients with oral submucous fibrosis. **Materials and Methods:** 30 subjects, who were clinically diagnosed as patients of oral submucous fibrosis on the basis of detailed case history, were selected from the outpatient department and their venous blood samples were collected to estimate their blood hemoglobin levels along with hematocrit and general blood picture. **Results:** Significant difference was observed while comparing the hemoglobin levels between oral submucous fibrosis (OSMF) group and controls where we found that OSMF subjects had lower levels of hemoglobin when compared to controls. It was also observed that hemoglobin levels in stage II OSMF was found to be statistically significantly lower than the other stages of OSMF. **Conclusion:** Low hemoglobin levels are suggestive of anemia. In India, anemia is very common disease in females because of chronic blood loss as in menstruation or in excessive demands as in pregnancy and lactation, poor nutrition intake but in our study majority of subjects were males and they presented with significantly lower hemoglobin levels with no other significant history which we directly co-relate it with OSMF.

Key words: Anaemia, General Blood Picture Hemoglobin, Hematocrit, Oral Submucous Fibrosis.

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INTRODUCTION

Oral submucous fibrosis has been well established in Indian medical literature since the time of Sushruta - a renowned Indian physician who lived in the era 2500-3000B.C. In his book "Mouth And Throat Diseases" he mentioned about a condition "Vidari" the feature of which simulate OSMF.¹ In 1952 Schwartz described five Indian women from Kenya with a condition of the oral mucosa including the palate and pillars of the fauces, which he called 'atrophia idiopathica (tropica) mucosa Oris'. Later it was termed oral sub mucous fibrosis, "idiopathic palatal fibrosis", "sclerosing stomatitis" and "juxta epithelial fibrosis".² Pindborg and Sirsat (1966) defined OSMF as an insidious chronic disease affecting any part of the oral cavity and sometimes the pharynx although occasionally preceded by an/or associated with vesicle formation, it is always associated with juxtaepithelial inflammatory reaction followed by a fibroblastic change of the lamina propria with epithelial atrophy leading to stiffness of the oral mucosa and causing trismus and inability to eat.³

Oral submucous fibrosis (OSMF) is a chronic progressive disorder and its clinical presentation depends on the stage at what the disease is detected. The majority of patients complain of intolerance to spicy food, rigidity of lip, tongue and palate leading to varying degrees of limitation of opening of the mouth and tongue movement. Etiological factors hypothesized to trigger the disease process include areca nut chewing, nutritional deficiencies, immunologic processes and genetic predisposition.^{4,5} One of the most common sign seen in OSMF is pallor or blanching of oral mucosa which can also occur in a variety of the other conditions, most common among them being anaemia.¹ Burning sensation, vesiculation and ulceration of

the oral mucosa render a phase for difficulty in consumption of the normal diet leading to poor nutrition deficiency of iron and vitamin B complex, other trace elements due to nutritional depletion could possibly initiate anemia and altered cell mediated immunity, which in turn acts as a promoting factor to this pre-existing pathologic response of the lamina propria. After a frank establishment of the lesion, anemia may further perpetuate by inadequate intake of food due to fibrosis and trismus.⁶ Iron is essential for overall integrity and health of epithelia of the digestive tract and its importance may lie in its contribution to normal enzymes.^{7,8} Hence, the present study was conducted to chart out the association between OSMF and the levels of hemoglobin and also the association of the levels of packed cell volume (hematocrit) and general blood picture among clinically diagnosed patients with oral submucous fibrosis and comparing the values with that of healthy subjects.

Aim

- To assess the serum haemoglobin level in patients with oral submucous fibrosis.

Objectives

- To compare haemoglobin levels in patients with oral submucous fibrosis and in age and sex matched healthy controls.
- To assess the haemoglobin levels in various stages of oral submucous fibrosis.
- To also assess the packed cell volume and peripheral blood smear examination in patient with oral submucous fibrosis.
- To assess the general blood picture in patients with oral submucous fibrosis.

MATERIALS AND METHODS

- 30 subjects, who were clinically diagnosed as patients of oral submucous fibrosis on the basis of detailed case history, were selected from the outpatient department and their venous blood samples were collected, after obtaining their written consent, to estimate their blood haemoglobin(Hb) levels along with packed cell volume and general blood picture.
- The Hb levels were estimated using Sahli's Haemoglobinometer method.
- The packed cell volume and the general blood picture was measured with the help of Auto Haematology analyzer.

Inclusion Criteria

- All patients who were clinically diagnosed of oral submucous fibrosis.

Exclusion criteria

- Patients with history of any systemic disease except anaemia.

RESULTS

Exactly half the subjects (n=15; 50%) were Stage II OSMF. There were 8 (26.7%) subjects with Stage III OSMF and 7 (23.3%) with Stage I OSMF as shown in Table 1.

A total of 30 healthy controls were also included in the study. The age wise distribution of subjects in two groups has been shown in Table 2 below.

The age of patients ranged from 16 to 80 years. Mean age of patients was 32.73 ± 14.51 years. A total of 17 (56.7%) subjects in both the groups were aged upto 30 years while remaining 13 (43.3%) subjects were aged above 30 years.

Table 3 shows distribution of subjects according to Hb level in two groups.

In control group, there were 5 (16.7%) subjects had haemoglobin levels below normal whereas a total of 25 (83.3%) subjects had normal haemoglobin levels. Mean haemoglobin levels in control groups were 14.09 ± 1.22 mg/dl.

In contrast in cases, there were 19 (63.3%) subjects who had haemoglobin levels below normal whereas remaining 11 (36.7%) subjects had normal haemoglobin levels. Mean haemoglobin levels in study group were 12.95 ± 1.62 mg/dl.

On comparing the data statistically, a significant difference was observed between two groups both for categorical ($p < 0.001$) as well as mean differences ($p = 0.003$).

Table 4 shows the distribution of subjects with according to haemoglobin levels in different stages of study group.

Majority of patients with stage I OSMF (71.4%) had haemoglobin level below normal. There were only 9 (60%) subjects in Stage II OSMF who had haemoglobin levels below normal. In Stage III, there were 5 (62.5%) patients with haemoglobin levels below normal.

However, as regards mean Hb levels in different groups, these were maximum in Stage I (13.24 ± 1.31 mg/dl) and minimum in Stage II (12.85 ± 1.75 mg/dl).

Table 1: Distribution of subjects according to stage of OSMF

S.No.	Stage	No. of subjects	Percentage
1.	I	7	23.3
2.	II	15	50.0
3.	III	8	26.7

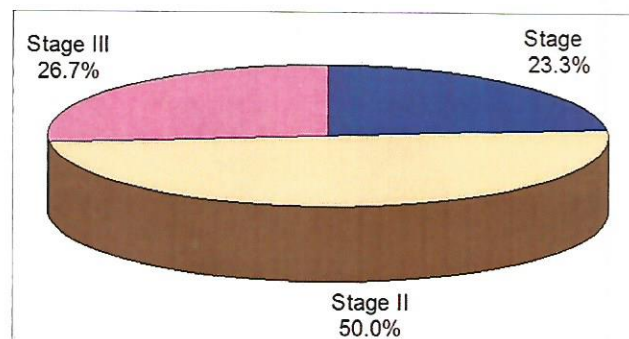
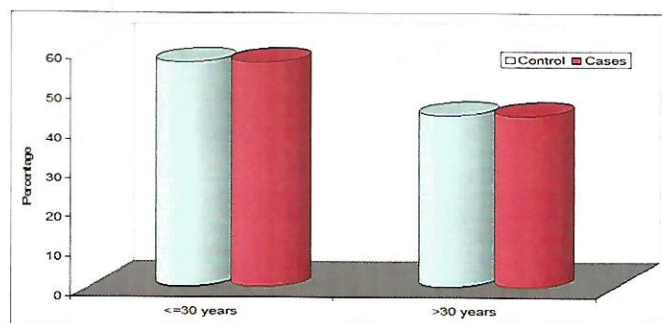


Table 2: Age wise distribution of subjects

S.No.	Age group	Controls (n=30)		Cases (n=30)	
		No.	%	No.	%
1.	<30 years	17	56.7	17	56.7
2.	>30 years	13	43.3	13	43.3

$\chi^2=0$; $p=1$



On comparing the data statistically, no significant difference was observed either for categorical ($p = 0.861$) or for quantitative differences ($p = 0.866$).

Table 5 shows distribution of subjects according to PCV level in two groups.

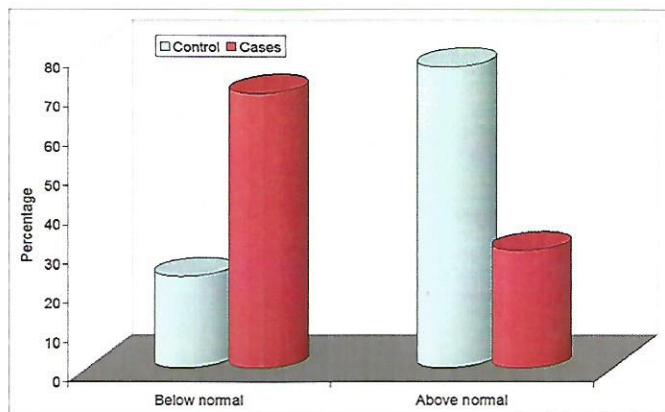
In control group, there were 6 (20.0%) subjects had haematocrit levels below normal whereas a total of 24 (80%) subjects had normal haematocrit levels. Mean PCV in control group was 42.30 ± 3.35 .

In contrast in cases, there were 12 (40%) subjects who had haematocrit levels below normal whereas remaining 18 (60%) subjects had normal levels. Mean PCV in study group was 38.60 ± 5.22 mg/dl.

On comparing the data statistically, no significant difference between two groups was observed for categorical differences ($p = 0.091$), however, mean PCV levels in Control Group were significantly higher as compared to Study Group ($p = 0.002$).

Table 3: Distribution of subjects according to haemoglobin levels

S.No.	Haemoglobin levels (mg/dl)	Controls (n=30)		Cases (n=30)	
		No.	%	No.	%
1.	Below normal	5	16.7	19	63.3
2.	Above normal	25	83.3	11	36.7
Mean Hb±SD		14.09±1.22		12.95±1.62	

 $\chi^2=13.125$; $p<0.001$, $t=14.090$; $p=0.003$
**Table 4:** Distribution of haemoglobin level in different OSMF stages of study subjects

S.No.	Stage	Below normal (n=15)		Normal (n=15)		Haemoglobin levels	
		No.	%	No.	%	Mean	SD
1.	I (n=7)	5	71.4	2	28.6	13.24	1.31
2.	II (n=15)	9	60.0	6	40.0	12.85	1.70
3.	III (n=8)	5	62.5	3	37.5	12.86	1.87
Significance of difference		$\chi^2=0.300$ (df=2); $p=0.861$				$F=0.144$; $p=0.866$	

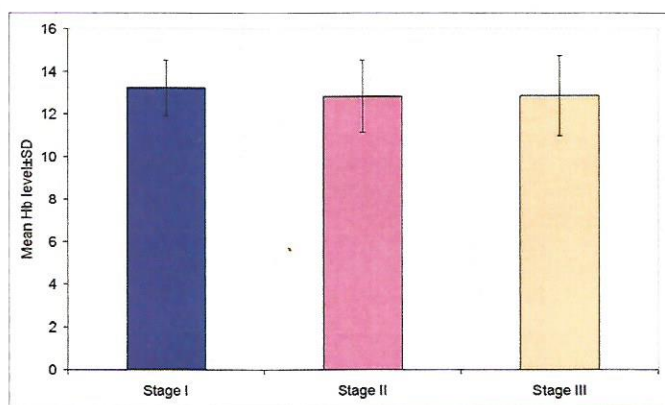


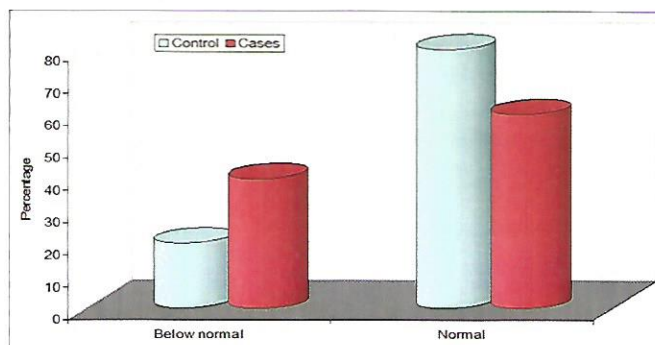
Table 6 shows the distribution of subjects with according to hematocrit levels in different stages of study group.

Majority of patients with stage I OSMF (42.9%) had hematocrit level below normal. There were only 5 (33.3%) subjects in Stage II OSMF who had hematocrit levels below normal. In Stage III, there were 4 (50%) patients with hematocrit levels below normal.

As regards mean Hematocrit levels in different groups, these were maximum in Stage I (39.71±4.75%) and minimum in Stage III (37.75±5.34%).

Table 5: Distribution of subjects according to PCV levels

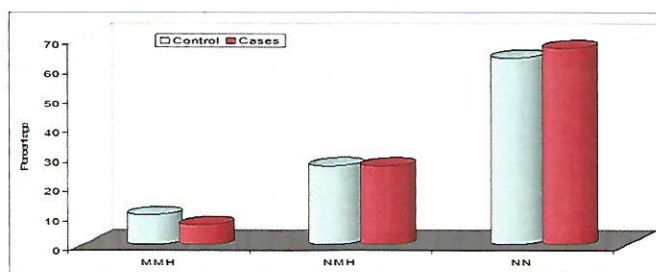
S.No.	PCV levels	Controls (n=30)		Cases (n=30)	
		No.	%	No.	%
1.	Below normal	6	20.0	12	40.0
2.	Normal	24	80.0	18	60.0
Mean Hb±SD		42.30±3.35		38.60±5.22	

 $\chi^2=2.857$; $p=0.091$; $t=3.268$; $p=0.002$
**Table 6:** Distribution of haemoglobin level in different OSMF stages of study subjects

S.No.	Stage	Below normal (n=12)		Normal (n=18)		Hematocrit levels	
		No.	%	No.	%	Mean	SD
1.	I (n=7)	3	42.9	4	57.1	39.71	4.75
2.	II (n=15)	5	33.3	10	66.7	38.53	5.60
3.	III (n=8)	4	50.0	4	50.0	37.75	5.34
Significance of difference		$\chi^2=0.635$ (df=2); $p=0.728$				$F=0.253$; $p=0.778$	

Table 7: Distribution of subjects in two groups according to type of GBP

S.No.	GBP	Control group (n=30)		Study group (n=30)	
		No.	%	No.	%
1.	MMH	3	10.0	2	6.7
2.	NMH	8	26.7	8	26.7
3.	NN	19	63.3	20	66.7
Significance of difference		$\chi^2=0.226$ (df=2); $p=0.893$			



On comparing the data statistically, no significant difference was observed either for categorical ($p=0.728$) or for quantitative differences ($p=0.778$).

Table 8: Distribution of subjects according to their GBP in different stages of OSMF

S.No.	Stage	MMH (n=2)		MNH (n=8)		NN (n=20)	
		No.	%	No.	%	No.	%
1.	I (n=7)	0	0	2	28.6	5	71.4
2.	II (n=15)	1	6.7	3	20.0	11	73.3
3.	III (n=8)	1	12.5	3	37.5	4	50.0
Significance of difference		$\chi^2=1.944$ (df=4); $p=0.746$					

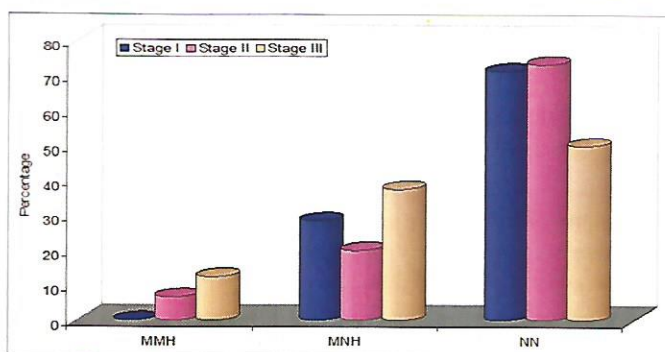


Table 7 shows distribution of subjects in two groups according to type of GBP.

In both the groups, majority of subjects had a normochromic normocytic general blood picture. Statistically, there was no significant difference in GBP of two groups ($p=0.893$).

Table 8 shows distribution of subjects according to their GBP in different stages of OSMF.

In Stage I and Stage II OSMF, more than two third subjects had a normochromic normocytic general blood as compared to 50% subjects in Stage III, however, on comparing the data statistically, this difference not found to be significant ($p=0.746$).

DISCUSSION

OSMF is a chronic, insidious, disabling condition of the oral mucosa that has a high prevalence rate in India and south east asia^{1,9} In the Indian continent alone. The statistics for OSMF is about 5 millions people(0.5%) of the population.^{3,6} The reasons for the rapid increase of the disease are reported to be due to an upsurge in the popularity of commercially prepared areca nut preparations(pan masala) in India and an increased uptake of this habit by young people due to easy access, effective price changes and marketing strategies.^{1,6,10,11}

The hallmark of the disease is submucosal fibrosis that affects the oral cavity and progressively involves the pharynx and the upper esophagus.^{6,10} This leads to burning sensation in the oral cavity, blanching and stiffness of oral mucosa and oropharynx, resulting in restricted mouth opening which in turn causes limited food consumption, difficulty in maintaining oral health and impairs the ability to speak. Soluble irritants such as capsaicin in chillies and spices were observed as one of the predisposing factors of OSMF and alkaloids of areca nut called arecoline act as irritating factors causing a juxtaepithelial inflammatory reaction.⁶ A male predominance was

shown in OSMF by Smar et al in India and the male to female ratio was 6:1¹⁰ Most of these patients were in low socio-economic status and the females affected were limited to household work having poor awareness of oral health and associated premalignant conditions^{1,3} Majority of patients were involved in profession involving long hours performing repetitive skills with little integrity and decision making required eg. drivers, carpenters, farmers, tailors etc. Most of them when required of chewing habit reported chewing on duty also¹ A female predominance was seen in anemic female groups. Most of them were suffering from iron deficiency anemia because of malabsorption, poor dietary intake, folate deficiency, chronic blood loss due to menstruation or menorrhagia, at the time of child birth, excessive demands as in pregnancy and breastfeeding^{1,6,12} Presence of iron deficiency anaemia could be attributed to the clinical nature of OSMF. The initial burning sensation, vesiculation and ulceration, render a phase for difficulty in consumption of the normal diet leading to poor nutrition. Deficiency of iron and vitamin B complex, other trace elements due to nutritional depletion could possibly initiate anaemia and altered cell-mediated immunity^{12,16} After a frank establishment of the lesion, anaemia may further perpetuate by inadequate intake of food due to fibrosis and trismus.^{1,6}

Distribution of Subjects According to Stage of OSMF

In our study we observed that exactly half the subjects ($n=15$; 50%) were Stage II OSMF. There were 8 (26.7%) subjects with Stage III OSMF and 7 (23.3%) with Stage I OSMF.

This finding was in accordance with a study conducted by Taneja L et al 2007¹ who also showed that subjects tend to present with Stage II and Stage III which were the most common types. This particular trend can give rise to the hypothesis that persons chewing areca nut initially showed fewer and decreased symptoms which can explain the less number of Stage I subjects. Thus as the condition progressed further, there have been increase in the severity of the symptoms which led the subjects to consult a specialist.

Tupkari et al 2007³ in a study on 101 patients found that mean Hb % in male patients suffering from OSMF was 11.5gm% and in female patients was 9.5gm%. this also supports the hypothesis put forth by Ramanathan(1981)⁷ that this condition is an Asian version of sideropenic dysphagia where in iron deficiency leads to mucosal susceptibility to irritants such as chilli, betel nut etc.¹³

Age wise Distribution of Subjects

The age of patients ranged from 16 to 80 years. Mean age of patients was 32.73 ± 14.51 years. A total of 17 (56.7%) subjects in both the groups were aged upto 30 years while remaining 13 (43.3%) subjects were aged above 30 years. Similar age distribution among OSMF patients were also noted by Taneja L et al 2007¹, Chiang C.P et al 2002¹⁴, Anuradha CD and Devi SS 1993,¹³ Chaturvedi V.N 1991¹⁵, Shah N et al 1994,¹⁶ Gupta D.S et al 1980¹⁷ and Gupta S et al 2004.¹⁸

It has been demonstrated that gender, age location and distribution of this disease constitute regional variation, which is attributable to differences in the areca nut chewing between the genders and the geographic areas.^{1,19}

The higher prevalence of OSMF patients in younger age group is explained by the popularity of refined areca nut products, which are readily available and the presence of tobacco with betelnut in gutkha packets induces addiction at an early age.¹

Distribution of Subjects According to Haemoglobin Levels

In control group, there were 5 (16.7%) subjects had haemoglobin levels below normal whereas a total of 25 (83.3%) subjects had normal haemoglobin levels. Mean haemoglobin levels in control groups were 14.09 ± 1.22 mg/dl.

In contrast in cases, there were 19 (63.3%) subjects who had haemoglobin levels below normal whereas remaining 11 (36.7%) subjects had normal haemoglobin levels. Mean haemoglobin levels in study group were 12.95 ± 1.62 mg/dl.

On comparing the data statistically, a significant difference was observed between two groups both for categorical ($p < 0.001$) as well as mean differences ($p = 0.003$).

Our study was thus in accordance with the study conducted by Taneja L et al 2007¹ who also showed that haemoglobin levels were lower in cases of subjects with OSMF than in controls.

Hedge K et al 2012⁶ also observed the prevalence of low haemoglobin levels in cases of subjects with OSMF when compared to healthy controls.

Distribution of Haemoglobin Level in Different OSMF Stages of Study Subjects

Majority of patients with stage I OSMF (71.4%) had haemoglobin level below normal. There were only 9 (60%) subjects in Stage II OSMF who had haemoglobin levels below normal. In Stage III, there were 5 (62.5%) patients with haemoglobin levels below normal.

However, as regards mean Hb levels in different groups, these were maximum in Stage I (13.24 ± 1.31 mg/dl) and minimum in Stage II (12.85 ± 1.75 mg/dl).

On comparing the data statistically, no significant difference was observed either for categorical ($p = 0.861$) or for quantitative differences ($p = 0.866$).

Though there was no significant co-relation of haemoglobin levels between either the stages of OSMF but still lower levels of haemoglobin was observed as the stage of the condition progressed further which also also substantiated by the study of Taneja L et al 2007¹ and Hedge K et al 2012⁶. On comparison of OSMF group with the Control group, OSMF group showed significantly lower levels of mean hemoglobin. He also observed that As the clinical stage of OSMF progressed from stage I to Stage IV, there was a significant fall in the hemoglobin levels and the serum iron levels with $p < 0.0001$ ⁶.

Cytochrome oxidase is an iron dependent enzyme which is required for the normal maturation of the epithelium. In iron deficiency state, the levels of cytochrome oxidase are low, consequently leading to epithelial atrophy. An atrophic epithelium makes the oral mucosa vulnerable to the soluble irritants.^{1,6,20} Body iron absorption is controlled by the duodenal mucosa which allows the intake of appropriate quantities of iron to balance exactly the required small daily iron loss if these iron losses are amplified by the disease or if dietary intake and absorption are impaired, a negative iron balance will result. The effects of this negative balance are counter balanced for a short duration time by mobilization of body iron stores, resulting in depletion of tissue and the serum iron falls resulting in failure of iron supply to the bone marrow.⁶

Lack of iron in tissues causes improper vascular channel formation resulting in decreased vascularity. This leads to derangement in the

inflammatory reparative response of the lamina propria resulting in defective healing and scar formation. thus the cumulative effect of these irritating and promoting factors leads to further fibrosis which is a characteristic of OSMF.^{1,6} Fibrosis dictates that OSMF is basically a disorder of collagen metabolism, hydroxyproline is an amino acid found only in collagen which is incorporated in the hydroxylated form. this hydroxylation reaction requires iron and ascorbic acid utilization of iron for the hydroxylation of proline and lysine, leads to decreased serum iron level. So serum Hb content can work as a significant predictor in the progression of OSMF.

Rajendran R (2003)²¹ observed the clinical, pathological feature, biological studies and management of OSMF. He also showed that deficiency of vitamin B12, folate and iron can affect the integrity of oral mucosa and that significant haematological abnormalities including increased ESR, Anaemia, eosinophilia, increased γ -globulin, decrease in the serum iron and increase in the total iron binding capacity is also present in OSMF.

Now, to substantiate this fact and to further enhance the theory and relationship of iron deficiency anaemia with subjects with OSMF we further conducted a study to assess the packed cell volume level and the general blood picture among patients with OSMF and healthy controls and then compare the findings between these two groups.

No previous recorded studies were earlier done regarding this parameter, so we hoped to throw some light on this parameter between OSMF and PCV levels and also between OSMF.

Distribution of Subjects According to PCV Levels

In control group, there were 6 (20.0%) subjects had haematocrit levels below normal whereas a total of 24 (80%) subjects had normal haematocrit levels. Mean PCV in control group was 42.30 ± 3.35 .

In contrast in cases, there were 12 (40%) subjects who had haematocrit levels below normal whereas remaining 18 (60%) subjects had normal levels. Mean PCV in study group was 38.60 ± 5.22 mg/dl. On comparing the data statistically, no significant difference between two groups was observed for categorical differences ($p = 0.091$), however, mean PCV levels in Control Group were significantly higher as compared to Study Group ($p = 0.002$).

Though no statistical difference came out for the haematocrit level when compared between OSMF patients and healthy controls but we did observe 12 patients with OSMF to have the level below normal and mean PCV levels in Control Group were significantly higher as compared to Study Group which lead us to believe that larger sample size should be taken for future assessment and a further evaluation regarding the co-relation between the OSMF group and packed cell volume levels which can help us better know the relationship between OSMF and iron deficiency anaemia.

Distribution of Hematocrit Level in Different OSMF Stages of Study Subjects

According to Hedge K et al 2012⁶ Low levels of hemoglobin and serum iron are suggestive of iron deficiency anemia. Iron deficiency anemia in patients with OSMF could be related to the precancerous nature of this condition. We thus further checked for the PCV levels among the different stages of OSMF.

Majority of patients with stage I OSMF (42.9%) had hematocrit level below normal. There were only 5 (33.3%) subjects in Stage II OSMF

who had hematocrit levels below normal. In Stage III, there were 4 (50%) patients with hematocrit levels below normal. As regards mean Hematocrit levels in different groups, these were maximum in Stage I ($39.71 \pm 4.75\%$) and minimum in Stage III ($37.75 \pm 5.34\%$). On comparing the data statistically, no significant difference was observed either for categorical ($p=0.728$) or for quantitative differences ($p=0.778$).

Again, though no statistical significance was observed in the hematocrit level between the various stages of OSMF, further studies with larger sample of subjects can be taken and observed for the significance of PCV level.

Distribution of Subjects in Two Groups According to Type of GBP

Pillai R et al (1992)²² in reviewed the various pathogenecity and etiology of OSMF and its relation to oral cancer suggesting a multifactorial model. They also observed that iron metabolism is important in maintaining the health and integrity of the oral mucosa. They also observed that serious impairment of cell mediated immune functions also has been found in iron deficient patients. They also were of the view that changes in the oral mucosa can occur before any significant alterations in erythrocyte morphologic characteristics or haemoglobin levels thus signifying the importance of iron in development of oral pre cancers and their conversion to cancer.

In our study both the groups i.e the subjects comprising of the OSMF patients and in healthy controls, majority of subjects had a normochromic normocytic general blood picture.

Statistically, there was no significant difference in GBP of two groups ($p=0.893$).

Distribution of Subjects According to their GBP in Different Stages of OSMF

In Stage I and Stage II OSMF, more than two third subjects had a normochromic normocytic general blood as compared to 50% subjects in Stage III, however, on comparing the data statistically, this difference not found to be significant ($p=0.746$). Though no significant findings were seen regarding the general blood picture both, between the subjects and controls and also among the three stages of OSMF.

Further studies after taking a larger sample is necessitated to get a clearer picture for comparison between the general blood pictures between OSMF patients itself and also while comparing between the various stages of OSMF.

CONCLUSION

Low levels of hemoglobin and serum iron are suggestive of iron deficiency anemia. Iron deficiency anemia in patients with OSMF could be related to the precancerous nature of this condition. Lack of iron in tissues causes improper vascular channel formation resulting in decreased vascularity. This leads to derangement in the inflammatory reparative response of the lamina propria resulting in defective healing and scar formation. Thus, the cumulative effect of these initiating and promoting factors leads to further fibrosis, which is a characteristic of oral submucous fibrosis. Fibrosis dictates that OSMF is basically a disorder of collagen metabolism. Hydroxyproline is an amino acid found only in collagen, which is

incorporated in the hydroxylated form. This hydroxylation reaction requires ferrous iron and ascorbic acid. Utilization of iron for the hydroxylation of proline and lysine, leads to decreased serum iron level.²³ In OSMF patients there is an increase in the production of highly cross linked insoluble collagen type I, loss of more soluble procollagen type III and collagen type VI. The cross linking of collagen due to the up regulation of lysyl oxidase, plays a crucial role in the development and progression of the condition.

Though OSMF and iron deficiency anemia exists as separate conditions, the clinical findings of OSMF are similar to that of iron deficiency anemia, which includes blanching, burning sensation and dysphagia. Histologically in both the conditions, due to a qualitative and quantitative defect in the oxygen and nutrient perfusion of the lamina propria and the overlying mucous membrane, epithelial atrophy occurs. The effect of soluble irritants on the atrophic epithelium, which ensues in due course leads to malignancy. Thus, this unclear line of demarcation between both these precancerous conditions still persists, which calls upon for further extensive studies to understand the correlation between OSMF and iron deficiency anemia as well as the validation of serum iron levels in various stages of OSMF as an indicator of malignant transformation. Determining iron status is a part of biochemical assessment, which may be of proactive intervention for high-risk groups. It is suggested that the biochemical assessment of oral precancerous conditions may help in early diagnosis and prognosis. It also serves in predicting the malignant potential, especially in high-risk groups. It is also of prime importance that iron therapy should be instituted concomitantly with the initial diagnosis along with a proper balanced diet, as a part of the overall treatment of OSMF with other modes of treatment. This helps to cease the further progression of the condition. Further studies in this regard should be carried out to investigate the probable reasons for OSMF.

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A Overview of Nutritional Needs Among Special Age Groups for Oral Health

Abstract

There is no one specific diet which fits for all the people, even if they belong to the same age group. Nutritional needs and requirements of different people vary largely even if a person is from a same age group. All diet plans are personalized and they depend the age, sex, likes and dislikes, tolerance, medical history, activity pattern and lifestyle of a person. Also certain nutritional deficiencies and medical conditions may require administration of a special diet with some restrictions or special considerations.

Key words: Nutritional needs, Special age, Oral health, Nutrition

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INTRODUCTION

Various groups of people have different nutritional needs, with the primary differentiation being among people of different ages and developmental stages. Infants, toddlers, older children, adults, and the elderly all have different nutritional needs.¹ Other groups include pregnant and lactating women and people who have certain health conditions.² The most effective way of determining individual needs is to discuss nutrition with a doctor or licensed nutritionist, although there are general rules of thumb that can be followed for nutrition for each group such as the following:

- Infants, toddlers, preschool children.
- Children with special needs.
- School age children.
- Adolescents, and older adults.
- Older adults.
- Healthy pregnancy and lactation.

INFANTS, TODDLERS, PRESCHOOL CHILDREN

Infants

An infant's health status at birth as well as future lifelong health depends on feeding and nurturing the newborn by the mother or caretaker. The infant is normally able to thrive on human milk

or commercially available artificial baby milk, but many of the physiological systems are immature at birth.¹

Breast Milk

Human milk is the optimal source of nutrients for infants and is tailor made for each infant with all the right nutrients to help babies reach their maximum potential. Human milk is very complex and its exact chemical makeup is unknown. It contains living cells, hormones, active enzymes, and antibodies.³ Breast milk contains substantial amounts of long-chain fatty acids. Arachidonic acids and docosahexaenoic acid (DHA) may play a role in development of the brain and retina tissue. The relatively low mineral content of human milk is ideal for the infant's immature kidneys.⁴

Breast milk is the natural food for babies. It is safe, inexpensive and provides all of the nutrients babies need for the first 6 months of life. It has the very important added advantage of increasing the baby's resistance to disease, as the mother is able to pass her own immune factors for certain diseases through her milk to protect her baby. This ability of breast milk to provide protection against many diseases is an important reason that breast milk is so healthy for babies; during the first six months of life, babies depend on their mother's milk while their digestive and immune systems are developing and maturing. Colostrum, the first milk right after birth,

is an essential food for new born babies.² It contains high levels of vitamin A and substances that protect newborns from infections and disease. Babies who are breastfed have many health advantages over babies fed other milks. Mother's milk contains the perfect amount of protein, fat, carbohydrate and other nutrients for the new baby's growth and development. Breast milk provides about 0.01 mg/day of fluoride regardless of drinking water and material plasma levels which does not increase the risk of developing dental caries.⁵

Babies should be fed only breast milk for the first six months, and should continue breastfeeding until 18-24 months. At the age of six months, babies need to start eating other "complementary" foods in addition to breast milk. Complementary foods for children this age require special preparation to make sure that the foods are clean, soft and easy to eat and digest, and should be introduced gradually. Good first foods are mashed, pounded or shredded soft meats, vegetables, legumes and fruits and a small amount of oil.⁶

Introduction of food between 4 to 6 months of age, infants are usually ready to eat solid foods in addition to breast milk or formula. Most commonly, cereals made of rice, oat, or barley are introduced one at a time mixed with breast milk or formula. The recommended order of introduction for vegetables, meats, and fruits varies among pediatricians. Some advice the introduction of vegetables after cereals, then followed by fruits. When semisolid foods are introduced, the goal should be to include all food groups as soon as possible to ensure a well-balanced diet.⁷

Early Childhood Caries and Baby Bottle Tooth Decay

A leading oral health problem among children under the age of 3 is known as early childhood caries (ECC) also known as nursing bottle caries or baby bottle tooth decay (BBTD). It is characterized by early rampant decay and associated with inappropriate feeding practices. Any sign of smooth surface caries in childhood younger than 3 years of age is indicative of ECC. This is a serious public health problem, especially prevalent in low socioeconomic groups. Treatment of ECC is costly, requiring extensive extractions or restorations and causing serious future oral health problems and unnecessary suffering.⁸

Contributing Factors

The decay is created when a sweetened liquid (including milk or juice) pools around the lingual surfaces of the teeth for extended periods of time. This will lead to demineralization of the enamel. Allowing the baby to go for bed at night or at naptime with a bottle and frequent daytime bottles or habitual use of a no-spill training cup are all factors related to ECC.

A second contributing factor to ECC is infection with streptococcus mutans. Colonization of S.mutans occurs only after infants teeth erupt. Infection with S.mutans occurs through transmission of the pathogen from the caregiver to the infant. The addition of frequent or prolonged fermentable carbohydrates will inoculate S. mutans.⁹

Toddlers

During the second year of life, development of fine motor skills results in toddlers learning to feed themselves, but skills and capabilities do not occur at exactly the same time for every child. Children more than 1^{1/2} years of age who are still taking a bottle containing milk or sweetened liquids are more likely than others to be overweight and have anemia due to low iron intake in addition to increasing the risk

of tooth decay. Milk is a poor source of iron and large amounts of milk deter absorption of iron.⁷

Preschool Children

Preschoolers are relatively independent at the table and can feed themselves. Foods that can be easily chewed are more readily accepted. The body uses the food more effectively and energy levels are more consistent when children refuel every 2 to 4 hours. Children have a high need for energy and nutrients but they have small stomachs and cannot eat large portions of food at one time. For this reason, they need to eat foods rich in protein and other nutrients often: at least 3 times a day, with 2-3 snacks during the day. Although the child is still growing rapidly, the rate of growth is slower than in the first 12 months of life. At the end of the third year of age, girls and boys will have achieved about 50 per cent of their adult height. Both girls and boys grow at approximately the same rate until they reach puberty and they need the same amount of food and have the same nutrient needs. Very active children of either sex may need slightly more food to meet their energy needs than do less active children.⁸

Children with Special Needs

Health conditions, such as mental retardation of unknown origin, cerebral palsy, Down syndrome, infantile autism, and muscular dystrophy have significant oral health and oral hygiene implications. Gum disease is frequently observed in children with Down syndrome. Mastication and swallowing problems occur in all these conditions except Down syndrome. Children with Down syndrome and cerebral palsy may practice bruxism. Bruxism is involuntary grinding or clenching of teeth, which results in abnormal wear patterns on the teeth and joint or neuromuscular problems. Difficulties with sucking, swallowing, spoon feeding skills with semi solid or solid foods, chewing development, and independent feeding are common. Tongue thrust associated with many of these conditions results in significant food waste and may jeopardize nutritional status.¹⁰

Dental problems may become exaggerated in these children as a result of difficulty in maintaining good oral hygiene, the child's unique dietary habits and patterns and the influences of their prescribed medications. Such problems include dental caries and periodontal problems.

School Age Children

These middle childhood years are the result of early growth and development; reserves are laid down for upcoming rapid adolescent growth. The appetite is usually good. Enforcement of a specific amount of time to eat may prevent the child from forming the habit of eating too fast. Poor appetite may be caused by stresses, such as schoolwork and emotional difficulties. This age range also generally marks the exfoliation of all or most of the primary teeth and the eruption of most of the permanent teeth. This is significant since the application of topical fluoride (professional or self-applied) now becomes as effective as systemic fluoride administration.⁹

Adolescents

The period of adolescence is a time of very rapid growth and high demands for nutrients and energy. The rapid growth period starts at the age of 10 or 11 for girls and at the age of 12 or 13 for boys and continues for about 2.5 years. Adolescents need high intakes of calories, vitamins and minerals, especially iron, calcium,

vitamins A, C and D. During this time, boys and girls begin to reach puberty (gaining sex characteristics to mature into men and women) and nutritional needs start to differ, although good nutrition is essential for both sexes to grow into healthy adults.¹¹

Major biological, social, psychological and cognitive changes occur during adolescence. Many adolescent eating practices place them at risk for developing chronic diseases later in life. The slow childhood growth accelerates with pubescence until the rate is rapid as that of early infancy. Growth of long bones, secondary sexual maturation, and fat and muscle deposition create an increased nutrient requirement.¹¹

The need for calcium, vitamin D and iron is of particular importance. A daily calcium intake of 1300 mg in addition to exercise during adolescence promotes calcium retention and bone mineral density. Building good bone mass during adolescence is thought to be the best way to prevent osteoporosis in old age. Vitamin D deficiency is prevalent in female adolescents.¹¹

Adolescent girls need to eat well for their own immediate development and for future motherhood. They especially need to eat foods rich in iron to meet their very high iron needs due to rapid growth and blood loss. Adolescent boys mature differently from girls and may need more calories and protein foods, such as meat, fish, poultry, eggs, dairy products, nuts and legumes. Poor dietary habits result in inadequate folate, riboflavin; vitamin B6, A, C and iron; and calcium intake.¹⁰

Older Adults

Good nutrition during older age can increase a person's ability to continue to be an active, healthy member of the community. While older people tend to eat less, and may need to eat less (fewer calories) if their activity levels decrease, their vitamin and mineral needs may stay the same or even increase if the body absorbs them less efficiently. The need for vitamin D and calcium may actually increase during older age to help reduce the loss of calcium from the bones. Other nutrients, including especially protein, need to be provided in adequate amounts to promote growth and repair of tissue and protect against infection. For older people, eating foods high in fibre can help the digestive system, and maintaining adequate intake of liquids is important, as the skin loses its ability to keep in moisture and protect against dehydration. Foods should include a wide variety of grains, fruits, vegetables, legumes and milk products.¹⁰

Food intake may be affected by some of the body changes that can accompany aging. Illness, loss of taste, smell and thirst sensation can reduce appetite; poor vision may make foods look different; swallowing may be difficult because of a decrease in saliva or because of decreased muscle tone; loss of teeth can make chewing difficult; stomach and intestinal disorders can lead to digestive problems. Eating may also decrease because of difficulty in purchasing, growing and preparing food, dependence on other people, giving food to other family members, and sometimes loneliness and depression. All of these factors, and any other health problems they may have, may affect the nutritional well-being of older people. Special efforts may need to be made to prepare foods that provide adequate energy, vitamins and minerals and are appealing, easy to eat and digest.¹²

The vitamin and mineral needs during older age may stay the same or even increase, especially for vitamin D and calcium. A good diet for older people should provide all the necessary nutrients and be

appealing, easy to eat and digest. The food intake of older people should match their activity levels. Less active older people should eat less high-energy food to avoid becoming Overweight and those who are more active need to eat well to maintain a healthy body weight.¹⁰

Healthy Pregnancy and Lactation

All pregnant women need to eat a good, balanced diet and gain additional weight to support a healthy pregnancy and childbirth. A diet that provides the increased energy (calories) and nutrients needed during pregnancy is necessary for the health of both mother and baby. If the nutritional needs of the mother and baby are not met, the health effects can be serious. The Mother's own stores of nutrients may be reduced, putting her at increased risk of illness. A baby deprived of adequate nutrition before birth is likely to have poor development in childhood and health problems throughout life.¹³ A mother's weight gain in pregnancy directly affects the baby's development, weight and health at birth. All pregnant women need to gain weight during pregnancy, no matter what they weigh before pregnancy. This weight gain is needed for the proper development of the growing baby and for the added growth of the uterus, breasts and blood and other fluids and tissues needed to support the growing baby. Women at a healthy weight when they become pregnant should gain between 11.5 kg and 16.0 kg during pregnancy. Underweight women have a greater risk of low birth weight and pre-term babies (born before 38 weeks of pregnancy). Babies with a low weight at birth (2.5 Kg or less) have more health problems early in life. Severely underweight babies are more likely to die in infancy. Women who are underweight can improve their chances of having a healthy infant by gaining extra weight both before and during pregnancy. Women who are underweight at the time of pregnancy should gain between 12.5 kg to 18.0 kg during pregnancy.¹³

Overweight and obese women are at high risk of health complications for themselves and their baby. The health complications for women who are overweight and obese when they become pregnant include high blood pressure, diabetes during pregnancy, infections at birth and complications of labour and birth. Their infants are more likely to be born post-term (born after 42 weeks of pregnancy) and to be very large. Babies who are very large at birth increase the likelihood of difficulties at birth. Babies born to obese mothers are at greater risk for heart defects and serious defects of the spine and brain. Overweight and obese women should try to be at a healthy weight before becoming pregnant; they should avoid gaining too much weight during pregnancy but should not try to lose weight until after the baby is born.^{1,2,4}

A good diet during pregnancy is very important to meet the higher nutritional requirements of both the mother and baby. All nutrients need to be included in the diet during pregnancy and additional calories are needed to provide the energy required by the mother for the extra demands of pregnancy and by the baby for growth and development. Protein is especially important, as it provides the "building blocks" (amino acids) to create new tissue, such as increasing blood supply, cell and bone growth. Other nutrients that are especially important are iodine, iron, zinc, folate, vitamin A and vitamin C. Pregnant women need to eat about 280 extra calories a day.¹³

Adequate iodine during pregnancy will help prevent serious birth defects, such as brain damage and mental retardation related to iodine deficiency. This need can be met through using iodized

salt and eating sea foods that are rich in iodine. High amounts of iron are needed to prevent anemia in both the mother and baby. Having adequate iron at this time will help reduce the risk of birth defects and deaths in pregnancy and childbirth. Additional servings of foods containing high amounts of iron, such as red meats, fish, poultry and legumes should be eaten. Women who are not able to meet their need for iron through their diet are advised, under the guidance of a doctor or other health professional, to take iron supplements during pregnancy, in addition to eating as many iron rich foods as they can.¹⁰ Very high levels of folate (a form of vitamin B) are needed to prevent severe birth defects during the first few weeks of pregnancy and to prevent anaemia in the mother and baby. The need for folate in preparation for and during pregnancy can be met by consuming at least 5 servings a day of vegetables and fruits rich in folate, especially leafy green vegetables, beans, peas and other legumes, and liver. Because of the high levels of folate needed during this time, and the severity of the birth defects resulting from lack of folate early in pregnancy, women who are not able to meet their need for folate through their diet are advised to eat foods fortified with folic acid (the synthetic form of folate) or take folic acid supplements, in addition to eating folate-rich foods.^{4,5}

A pregnant woman must meet the nutritional needs of both the rapidly growing baby and her own body changes. Poor diets and poor nutrition during pregnancy can lead to serious health problems for both mother and baby. A mother's weight gain in pregnancy directly affects the baby's development, weight and health at birth. Underweight women have a greater risk of low birth-weight and pre-term babies; they need to gain extra weight. Overweight and obese women are at risk of health complications for themselves and their babies; they need to gain less weight but should not try to lose weight in pregnancy.¹⁴

Numerous factors contribute to increased incidence of numerous oral changes that are observed in most pregnant women. Pregnancy gingivitis usually becomes evident in the second month of pregnancy. Hormonal changes associated with pregnancy contribute to an increased susceptibility to gingivitis and periodontitis. Numerous studies indicate that periodontal disease during pregnancy is a significant risk factor for preeclampsia, and/or delivering a premature or low birth weight infant. Nausea is a frequent occurrence during pregnancy; the resultant frequent vomiting increases oral exposure to gastric acid secretions, which may cause erosion of the tooth enamel.¹⁴

Lactation

A good diet by the mother during breastfeeding increases the success of breastfeeding and improves the health of mother and baby. Breastfeeding requires additional nutrients and energy, as the mother needs to replace the nutrients and energy that are passed on to the baby through the milk. The nutrients that are important for a good supply of breast milk are the same as those that are important for a healthy pregnancy. These include protein, zinc, calcium, vitamins A and C, iron and folate. Even more nutrients and an additional 450 Calories every day are required to keep both mother and baby healthy during breastfeeding. Additional servings of milk and high protein snacks between meals or an additional small meal every day are good ways to meet the additional needs of breastfeeding. In addition to extra food, the mother needs to drink extra water and other liquids because of the fluid breast milk that

is provided to the baby. Insufficient food or water can decrease the amount of milk the mother is able to provide, putting the baby at risk.

A good diet during pregnancy and breastfeeding should include additional calories and a variety of foods to ensure getting all the nutrients they need, especially protein, iodine, zinc, vitamins A and C, and high amounts of folate and iron. Pregnant and breastfeeding women have such high nutritional demands, that it may take two to three years after stopping breastfeeding for all of the mother's nutritional stores to be replaced. For this reason, good spacing between pregnancies can help improve the health of the mother and her future babies.¹⁴

CONCLUSION

Eating is an important part of socialization and exerting one's independence. Food choices are influenced by complex external factors such as family, peers, mass media, and economic and sociocultural factors, and internal factors such as physiological needs, body image, self-concept, food preferences and personal values/beliefs toward health and nutrition. The strongest influential factors among adolescents is peer pressure. Most adolescents are stressed because of continual changes. The presence of stress can decrease the utilization of several nutrients, particularly vitamin C and calcium.

The American academy of pediatrics (AAP) issued a policy statement encouraging the restriction of the sale of soft drinks in schools to prevent health problems as a result of overconsumption. The AAP warns of the following potential health problems as a result of high intake of sweetened drinks. 1. Overweight attributable to additional calorie intake; 2. Displacement of milk consumption, resulting in calcium deficiency with an attendant risk of osteoporosis and fractures; and 3. Dental caries and potential enamel erosion.^{1,2,3,4,5}

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Torque in Orthodontics: A Review of Literature

Abstract

Torque plays an important role in dentistry and has its vast application in the field of dentistry also. Torque is the force that enables the orthodontist to control the axial inclinations of teeth and to place them in the harmonizing positions that are so desirable for a nicely finished result. Torque is the force that gives the operator control over the movements of roots of teeth. The factors affecting torque can be broadly classified into Physical factors: Dimension of arch wire, Bracket slot width, materials used in archwire, bracket material used, bracket design, edge bevel etc. Biological factors includes tooth morphology, Collum angle. Torque is probably one of the integral part of orthodontic treatment mechanism. Various mechanics can often be used to achieve the tooth movements desired for orthodontic treatments. It is important however to understand the mechanics involved and to recognize when the appliance will not achieve adequate results or may result in undesirable side effects.

Key words: Torque, Orthodontics, Dentistry

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INTRODUCTION

Torque being more related to engineering terms is defined as "the force system transmitted by and through a structural or machine member, capable of producing pure rotational displacement about the longitudinal axis". Torque plays an important role in dentistry and has its vast application in the field of dentistry also. Torque can be an important factor in determining the stability of an implant; however torque does not necessarily correlate to implant stability. Torque measures the rotational friction between the implant and the bone together with the force required to cut the bone.

Torque in Orthodontics

In orthodontics, as stated by Dr. Earmand D. Rauch¹ "Torque is the force that enables the orthodontist to control the axial inclinations of teeth and to place them in the harmonizing positions that are so desirable for a nicely finished result. Torque is the force that gives the operator control over the movements of roots of teeth". In orthodontics, torque is employed to alter the inclination of all teeth, particularly the incisors. In general, the extent of change in the buccolingual inclination of the crowns depends on the wire torque stiffness, bracket design, the wire/slot play, and the mode of ligation. These facts then bring the orthodontist to the realization that there are two types of torque.

1. Passive torque, which has no action or force on the tooth when engaged, a passive torque in an arch wire is said to be present when the torque in it does not produce torque movement on full engagement of the wire.
2. Active torque, which has a definite action or force on the tooth when engaged. Torque in an arch wire is said to be active when it is capable of affecting a torque movement of teeth in a segment.¹

The torque of a wire, as examined by the inclination that the No. 442 pliers may assume as a result of grasping the wire, does not indicate

the torque force (Tweed plier) that may be delivered to the teeth, since the amount of force delivered is determined only by the relationship of the wire to the bracket that is engaged and the position of the bracket is determined by the position of the tooth.¹

BIOMECHANICS OF TORQUE

Few terminologies that needed to be understand in detail:

Centre of Resistance

Center of resistance is an imaginary point at which the whole object may be considered to be condensed, for understanding and predicting its displacement from the application of forces. The center of resistance is analogous to the center of mass for restrained bodies and is the equivalent "balance point" for restrained bodies.²

There is some difference of opinion about the precise location of center of resistance for a single rooted tooth (though all authors agree that it is between the alveolar crest and the apex). Proffit³ and Nikolai⁴ estimate it at 50% of root length.

Smith and Burstone⁵ said that centre of resistance for single rooted teeth lies between 50% and 33% of root length and Nanda⁵ between 33% and 25% of root length.

However, the center of resistance for single-rooted teeth (Figure 1) with normal alveolar bone levels is about one-fourth to one-third the distance from the cement enamel junction (CEJ) to the root apex.⁶

Centre of Rotation

The center of rotation of the motion is apical to the center of resistance. The tooth rotates around its centre of resistance when subject to the application of force couple. Pure rotational displacement, the centre of resistance is the centre of rotation.⁶ When a single force does not pass through the centre of resistance it causes a combination of translation and rotation of tooth (Figure 2).

Moment Force Ratio

The moment of the force results in some rotational movement also. The moment of the force is the tendency for a force to produce rotation. It is determined by multiplying the magnitude of the force by the perpendicular distance of the line of action to the center of resistance (Figure 3). Its direction is found by following the line of action around the center of resistance toward the point of origin. The units of measurement of moments are in gram-millimetres (Newton millimetres). The importance of the moment of a force is often not recognized in clinical orthodontics, but awareness of it is needed to develop effective and efficient appliance designs.⁶

Types of Tooth Movements

Tooth movement can be described in many ways; however the essentially infinite variety of movements can be categorized into four basic types: tipping, translation, root movement, and rotation. Each type of movement is the result of a different applied moment and force (in terms of magnitude, direction, or point of application). The relationship between the applied force system and the type of movement can be described by the moment: force ratio.⁷

Translation

During translation, all points on the body move in the same direction and with the same magnitude (Figure 4). The center of rotation is effectively at an infinite distance away from the tooth because there is no rotation.⁵

Rotation (pure)

Pure rotation occurs when a body (Figure 5) rotates about the center of resistance (i.e. when the center of rotation is at the center of resistance).⁶

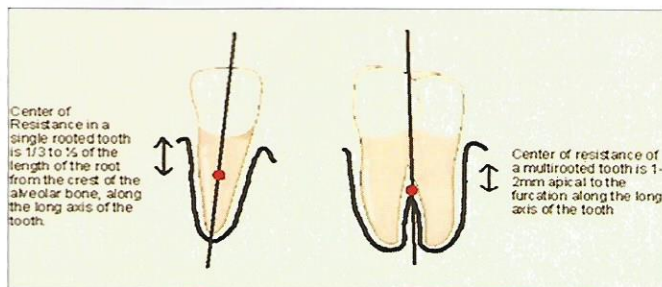


Figure 1: Centre of resistance of incisor and molar

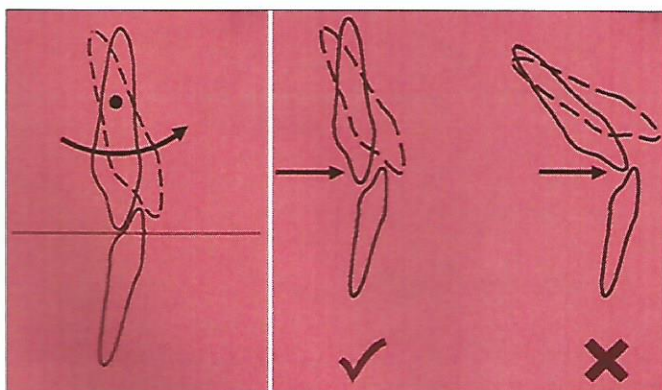


Figure 2: Centre of rotation

Tipping

Tipping is tooth movement with greater movement of the crown of the tooth than of the root. The center of rotation of the motion is apical to the center of resistance. Tipping can be further classified on the basis of the location of the center of rotation into:

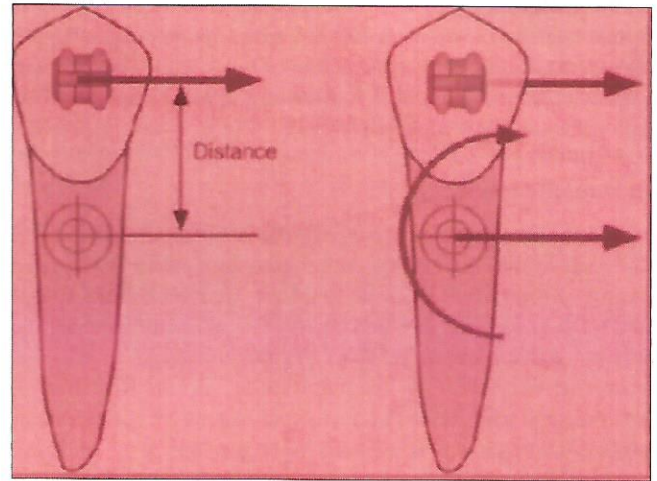


Figure 3: Moment of a force. A force that does not pass through the center of resistance produces a rotational movement as well as linear movement

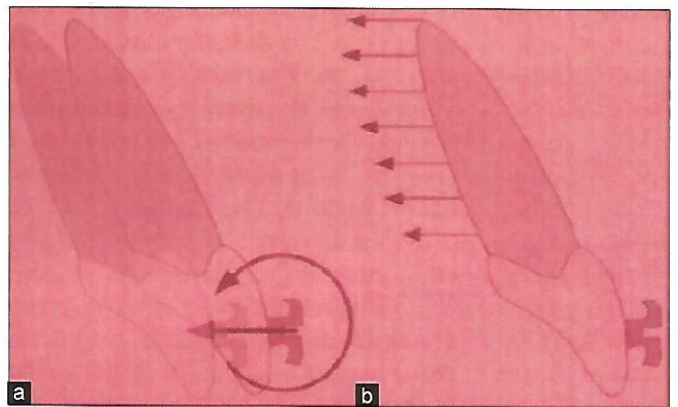


Figure 4: Translation. a) Translation or bodily tooth movement. b) Stress pattern in the periodontal ligament with translation. Uniform stresses occur throughout the periodontal ligament

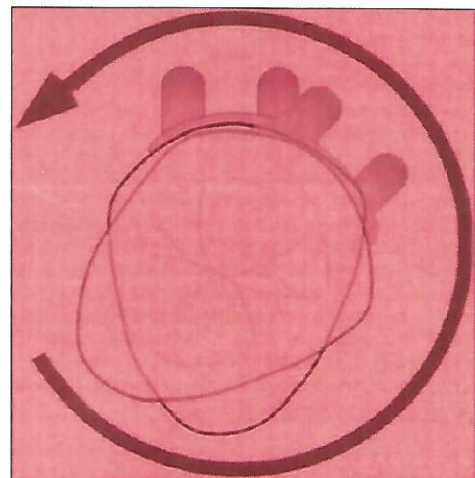


Figure 5: Rotation. Pure occurs around a tooth's center of resistance

- a. Controlled tipping
- b. Uncontrolled tipping

Controlled Tipping

Controlled tipping is a very desirable type of tooth movement. It is achieved by the application of a force to move the crown, as done in uncontrolled tipping, and application of a moment to "control" or maintain the position of the root apex. Figure 6 shows tipping movement with the center of rotation of the tooth at the root apex. A moment/force ratio of 7:1 is generally necessary for controlled tipping (Figure 6).⁶

Uncontrolled Tipping

A single, horizontal, lingually-directed force at the level of a bracket will cause movement of the root apex and crown in opposite directions. The stresses are nonuniform, and maximum stresses are created at the root apex and crown. The moment/force ratio for this type of tooth movement is 0:1 to approximately 5:1. In certain circumstances uncontrolled tipping can be, such as with Class II, Division 2 and Class III malocclusion patients where the excessively upright incisors often need to be flared (Figure 7).⁶

Root movement

Changing a tooth's axial inclination by moving the root apex while holding the crown stationary is termed root movement (Figure 8).

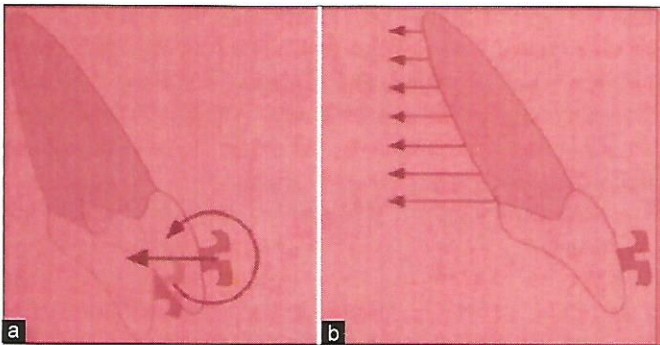


Figure 6: Controlled tipping. a) Controlled tipping with the center of rotation at the root apex. b) Stress pattern in the periodontal ligament with controlled tipping. The stresses are greatest at the cervical margin

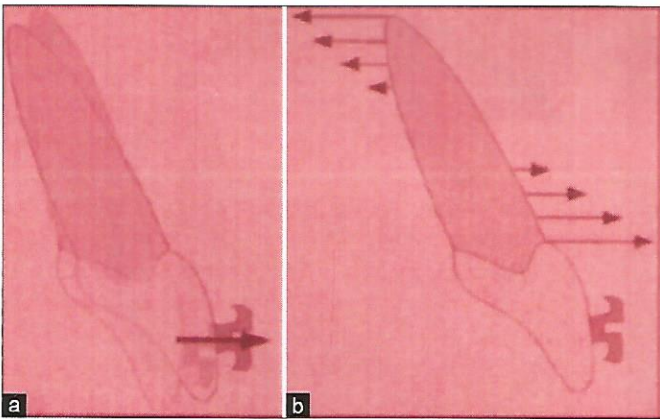


Figure 7: Uncontrolled tipping. a) Uncontrolled tipping produced by a single force (no applied moment). b) Stress pattern in the periodontal ligament. The root apex moves in the opposite direction from the movement of the crown

Moment/force ratios of 12:1 or greater result in root movement. (Figure 8) shows the stress distribution in the periodontium with this type of tooth movement. Placing twists in a rectangular wire or the angle of the bracket slot with the long axis of the tooth and the occlusal plane is often called torque.⁶

For example stating that a 0.018" x 0.025" wire has 17° of torque for four maxillary incisors gives no indication of the magnitude of the moment or the measurable stress placed on the teeth.⁷

Couple System

Another method of achieving rotational movements is through the moment of a couple (Figure 9). A couple is two parallel forces of equal magnitude acting in opposite directions and separated by a distance (i.e. different lines of action). The magnitude of a couple is calculated by multiplying the magnitude of force(s) by the distance between them; the units are also in gram-millimetres. Couples result in pure rotational movement about the center of resistance regardless of where the couple is applied on the object (Figure 9). Torque is erroneously described in terms of degrees by many orthodontists.⁶

FACTORS AFFECTING TORQUE IN ORTHODONTICS

The factors affecting torque can be broadly classified under various headings:

1. Physical factors: it includes various factors
 - a. Dimension of arch wire^{8,9,10}

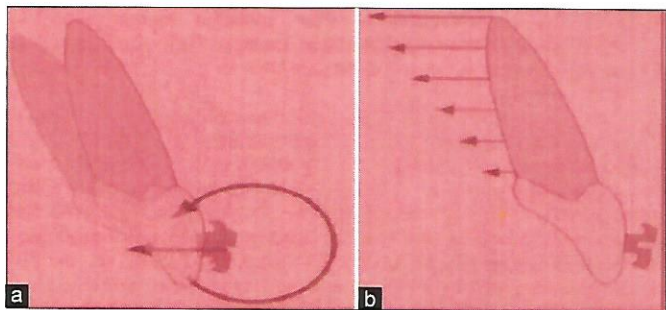


Figure 8: Root movement. a) Root movement with center of rotation at the incisal edge. b) Stress pattern in the periodontal ligament with root movement. The stresses are greatest at the apex

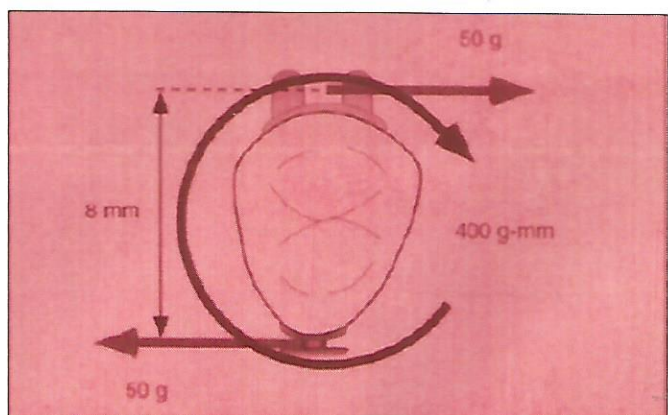


Figure 9: Moment of a couple. A couple produces pure rotation about the center of resistance

- b. Bracket slot width^{11,12,13,14,15,16}
 - c. Materials used in archwire^{17,18}
 - d. Bracket material used^{19,20}
 - e. Bracket design^{21,22,23,24,25,26,27,28,29}
 - f. Edge bevel¹⁴
 - g. Effect of second order^{30,31}
 - h. Bracket height³²
 - i. Mode of ligation^{33,27,34}
 - j. Interbracket distance²⁹
 - k. Surface conditions²⁹
 - l. Loop design³⁵
 - m. Variable modulus orthodontics^{36,37,29}
 - n. Manufacturing process^{38,29}
 - o. Bracket slot surface³⁸
 - p. Wire modulus^{39,38}
2. Biological factors: it includes various factors
- a. Tooth morphology^{40,41,42,32,43}
 - b. Collum angle^{44,45,46,47,48}

CONTROL OF TORQUE IN VARIOUS STEPS OF TREATMENT

Torque Control During Space Closure

Space closure with maximum incisor retraction has been discussed previously.

Torque Control During Minimum Incisor Retraction

As with any problem requiring anchorage control, the approaches to reducing the amount of incisor retraction involve reinforcement of anchorage (the anterior teeth in this situation) and reduction of strain on that anchorage.

A second possibility for reinforcing incisor anchorage is to place active lingual root torque in the incisor section of the archwires, maintaining a more mesial position of the incisor crowns at the expense of somewhat greater retraction of the root apices.

A third possibility for maximizing forward movement of posterior teeth is to break down the posterior anchorage, moving the posterior teeth forward one tooth at a time. After extraction of a second premolar, for example, it may be desired to stabilize the eight anterior teeth and to bring the first molars forward independently, creating a space between them and the second molars before bringing the second molars anteriorly. This strategy can readily be combined with increased torque of the anterior teeth to minimize retraction.³

Torque During Finishing and Detailing

Torque of incisors

If protruding incisors tipped lingually while they were being retracted, Lingual root torque as a finishing procedure may be required. In the Begg technique, the incisors are deliberately tipped back during the second stage of treatment, and lingual root torque is a routine part of the third stage of treatment. Like root paralleling, this is accomplished with an auxiliary appliance that fits over the main or base archwire. The torquing auxiliary is a "piggyback arch" that contacts the labial surface of the incisors near the gingival margin, creating the necessary couple with a moment arm of 4 to 5 mm.²

Torque Control During Pre-Surgical Treatment

Anteroposterior Incisor Position

Just as the position of the incisors vertically will determine postsurgical face height because the surgeon must bring the teeth together at the time of the operation, so the anteroposterior position of the incisors will affect how much one jaw can be moved at surgery backward or forward relative to the other jaw. One difference between patients with class III and Class II problems is that there is an alternative to retracting the protruding lower incisors is relative to their supporting bone; that is, to the mandibular basal bone, including the chin. The options therefore are to retract the incisors or to advance the basal bone via an inferior border osteotomy (Figures 10 and 11).

RECENT ADVANCES OF ORTHODONTICS

Orthos and Elan System

Andreiko introduced Orthos and Elan⁴⁹ system in 1994. Elan begins with digitizing the skeletal and dental entity of the patient. The

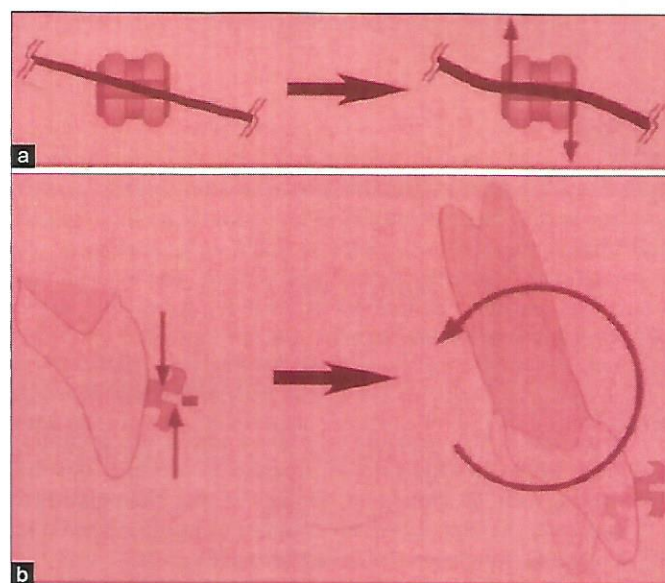


Figure 10: Clinical examples of couples. a) Engaging a wire in an angulated bracket b) Engaging a wire in a bracket slot

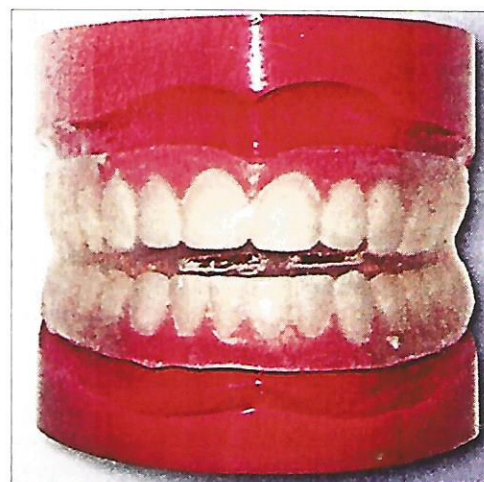


Figure 11: Positioners appliance

CAD/CAM system then proceeds to design an occlusion, based on the practitioner's treatment plan and on algorithms developed to mate the three-dimensional positioning of the dentition to the skeletal framework. Orthos is a new average prescription and appliance design based on computer analysis of more than 100 cases derived from the Elan technology.

Mandibular posterior segments have less negative torque than prior designs to keep these teeth from being inclined lingually. Upper posterior segments have more buccal root torque to keep the dangling lingual cusps from causing balancing interferences with the prominence of today's non extraction and expansion mechanics.⁴⁹

Overlay Appliances

Moving teeth with overlay appliances was popularized by Kesling, who in 1945 reported the use of a vulcanite tooth-positioning appliance. As early as 1926, however, Remensnyder had introduced the Flex-O-Tite gum-massaging appliance, with which he reported achieving minor tooth movements.⁵⁰ Since then, various types of overlay appliances, such as invisible retainers, have been used. Following the approach of Nahoum, Sheridan popularized the Raintree Essix technique of using clear aligners formed over plaster models.

Essix Appliance

The two contemporary systems for moving teeth with plastic appliances are the invisalign and essix systems. The invisalign system is unique in that clinician must be able to plan the path to optimal results before treatment is initiated so that a series of aligners can be constructed to achieve treatment objectives. The essix systems is based on in-course adjustment of what is essentially a single appliance to achieve treatment goals.

There are two type of space that must be evident for a tooth movement with essix appliances:

- Space within the appliance and space within the dentition. Space within the appliance is obtained by blocking out the working cast or cutting of window in the thermoformed appliance. The clinician has the option of using the method that is most efficient for particular circumstances.
- Torque is routinely established in an edgewise bracket by creating a couple, established with equal and opposite moments, within the bracket to wire complex. In effect the tooth rotates around the bracket slot axis with the root moving one way and the crown moving in the opposite direction. Because of this efficiency of edgewise moments are constant because the width of the bracket limits the distance between the torquing moments to space 0.22 inches or 0.018 inch. Essix induced torque is more efficient because the distance between the opposing moments is only limited by the length of the clinical crown, measured in millimetres, rather than the width of rectangular bracket slot measured in thousands of inch. (Figure 12)

An efficient torquing couple to move the root while slightly rotating the incisal edge is established with an induced force and appropriate sections of working cast blocked out (Figure 12).

Essix torque is accomplished by creating a force inducing the projection in the plastic with Hilliard thermopliers or by mounding composite on the enamel surface. This is done in conjunction with the blockout material on the cast to allow tooth movements. For instance, if incisor torque involves moving the incisal edge lingually

and the root labially the working model is prepared by placing a force inducing projection or composite mount, on the incisal 3rd of the labial surface of the crown and on the lingual surface on the gingival 3rd of the crown the force induced are the mechanical couple that will torque the incisor moving the incisal edge lingually while the gingival section of the crown moves labially.

If incisor torque involves holding the incisal edge of the target tooth stationary and obtaining exclusive root movements, essix appliance is constructed to have 2.0mm of the incisal edge covered with plastic and is therefore locked within the appliances. The incisal edge plastic cap holds the incisal edge in place while the root rotates under it due to the induced gingival force (Figure 13).⁵¹

THE INVISALIGN CONCEPT

Kelsey Wirth and Zia Chishti, two MBA students from Stanford University, founded Align Technology in April 1997. The concept on which the company was founded came from Chishti, who had undergone adult orthodontic treatment, but like many patients was not consistent in wearing his clear retainer. After experiencing recrowding of his mandibular teeth, Chishti returned to wearing his overlay retainer, and this realigned his anterior teeth. Frustrated with the relatively slow and modest progress achieved with his overlay retainer, Chishti came up with the idea of using multiple appliances

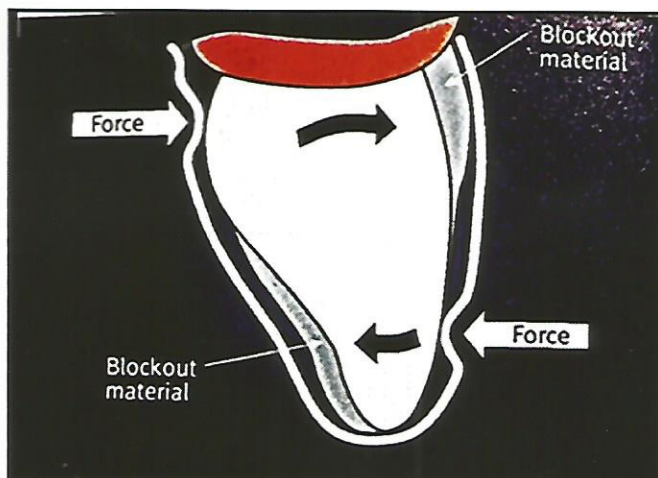


Figure 12: Appropriate sections of working cast blocked out

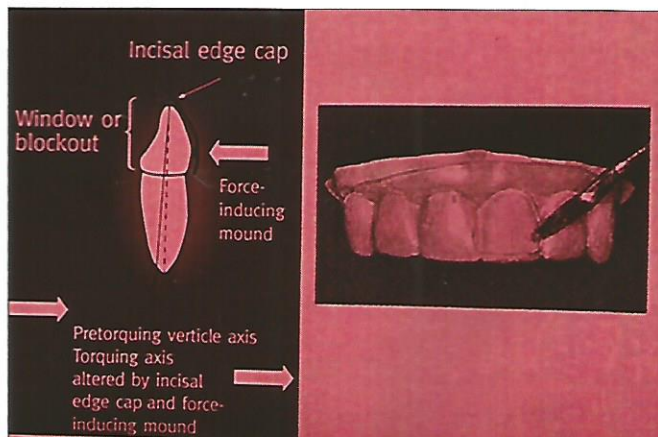


Figure 13: An incisal edge plastic cap or cervically placed mound torques the root while holding the position of incisal edge

and computer imaging technology to effect major tooth movements. From this revolutionary concept, Chishti and Wirth, orthodontics along with a software engineer formed aligned technology in a garage in Palo Alto, California. Today the company is based in Santa Clara, California employed over 800 employees in Europe, Mexico and Costa Rica.

The Invisalign process involves several steps. The first step is the acquisition of complete patient records from the treating orthodontist. One's received at Santa Clara, the records go through a series of steps from scanning to case setup and then back to the clinician for a review called clincheck. The process of manipulating virtual tooth movement is completed when the clinician approved the clincheck. Once the clincheck is approved the aligner are processed and sent to clinician. In this system, the required torque of the teeth are customised according to the individual and built in the clear trays (Figure 14).⁵¹

CONCLUSION

Torque is probably one of the integral part of orthodontic treatment mechanism. The operator's ability to control torque properly will mean the difference between artistically treated cases that has all esthetic beauty desired in a finished denture and an ordinary tooth straightening accomplishment that contains very few of these desirable features. When the orthodontist does not have an understanding of torque, many adverse tooth movements will result, making orthodontic treatment more difficult and results of treatment less desirable.

Torque in edgewise wire is probably the most important and potent force which enables the orthodontist to control axial inclinations of teeth and to place them in harmonizing positions that are so desirable for a nicely finished result. Perhaps third order control is one of the biggest limitations of PEA. Thus the clinician who uses Straight wire discipline might actually require more torque than available preadjusted appliance. Because orthodontist deals with real materials, the prescribed torque should be increased to compensate for bracket wire play, various manufacturing process, Biological factors, malocclusions and clinical procedure, which counteract the expression of the torque value built into the brackets.

Various mechanics can often be used to achieve the tooth movements desired for orthodontic treatments. It is important however to understand the mechanics involved and to recognize when the appliance will not achieve adequate results or may result

in undesirable side effects. This can help us to prevent prolonged overall treatment time and/or compromise in the final orthodontic outcome.

The ultimate result will be a happy patient, with a beautiful smile leaving your clinic at the end of treatment.

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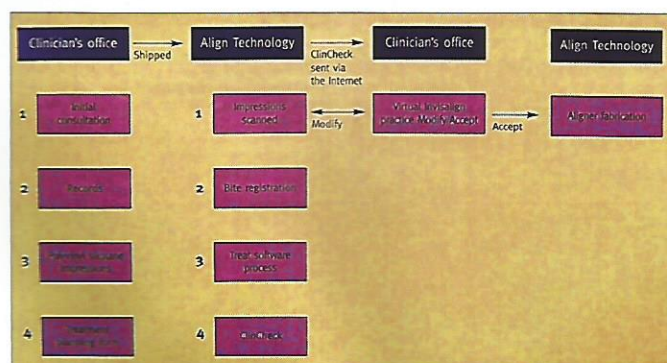


Figure 14: Steps of the invisalign process

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CAD/CAM Dentistry and Chair Side Digital Impression Making: A Review

Abstract

Advancements in computer systems and technologies have revolutionized the field of dentistry as well. These advancements can be seen with the introduction and evolution of CAD/CAM systems. The demand for such systems has grown dramatically over the past decade and a large variety of different CAD/CAM systems have been developed and marketed. The popularity of these systems can be attributed to their efficiency of designing, manufacturing and precision. The main aim of this review is to provide the information on CAD/CAM dentistry and digital impressions which is useful in the fabrication of fixed dental prosthesis.

Key words: CAD/CAM, Digital impressions, Milling, Additive technique, Subtractive technique

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INTRODUCTION

Computer-aided design/computer-aided manufacture (CAD/CAM) was first applied to dentistry by Mörmann and Brandestini in 1987 when they developed the Cerec system. However, computers have been used to design and manufacture industrial products since as early as 1957. The first major application of the technology was in the automotive and aeronautical industries. CAD/CAM has since developed in parallel with the computer industry; as computers have become more powerful, CAD/CAM systems have become more sophisticated.¹⁻⁵ These systems can now enable dentists to harness the power of computers to design and fabricate aesthetic and durable chair-side restorations. The latest innovations in technology made almost all things possible in this world. The lost-wax precision casting of gold alloys, dough modelling and curing of acrylic resins and powder sintering of dental porcelains were originally developed for dentistry and are well established as conventional dental laboratory technologies. It is without doubt that high quality dental restorations can routinely be fabricated through the collaboration of dentist and dental technicians. Nevertheless, dental laboratory work still remains to be labour-intensive and experience dependent. Functional components, occlusal parameters, phonetics and aesthetics are just some of the essential information which dental technician completes with his skills and experience.⁶⁻¹⁰

COMMON CAD/CAM SYSTEMS IN DENTAL PRACTICE

Based on their Production Methods

- In office system/chairside
- CAD/CAM – Dental laboratory models
- CAD/CAM for outsourcing dental lab work using networks.

Chairside Production

All components of the CAD/CAM system are located in the dental surgery. Fabrication of dental restorations can thus take place at chairside without a laboratory procedure. The digitalisation instrument is an intra-oral camera, which replaces a conventional impression in most clinical situations. This saves time and offers the patient indirectly fabricated restorations at one appointment. At present, only the Cerec® System (Sirona) offers this possibility. Other producers also plan to introduce chairside CAD/CAM systems to the market. Since the Cerec® system functions with water-cooling, a variety of materials can be processed, from glass-ceramic to high performance oxide ceramic. Clinical observations on ceramic inlays are available over a period of 21 years. Scientific literature reported success rates for CAD/CAM produced inlays of 90% after ten years and 85% after 12 and 16 years. Historically, this system was the first CAD/CAM system in dentistry and is currently available in its third product generation. One of the benefits of this very mature system is the software that has been supplemented by a very exact three-dimensional reconstruction of the occlusal surface.

Laboratory Production

This variant of production is the equivalent to the traditional working sequence between the dentist and the laboratory. The dentist sends the impression to the laboratory where a master cast is fabricated first. The remaining CAD/CAM production steps are carried out completely in the laboratory. With the assistance of a scanner, three-dimensional data are produced on the basis of the master die. These data are processed by means of dental design software. After the CAD-process the data will be sent to a special milling device that produces the real geometry in the dental laboratory. Finally the exact fit of the framework can be evaluated and, if necessary, corrected on the basis of the master cast. The

ceramist carries out the veneering of the frameworks in a powder layering or overpressing technique.¹¹⁻¹⁵

Centralized Production

The third option of computer-assisted production of dental prosthesis is centralized production in a milling center. Data sets produced in the dental laboratory are sent to the production center for the restorations to be produced with a CAD/CAM device. Finally, the production center sends the prosthesis to the responsible laboratory. EG: Procera introduced in 1994 is the first system which provided outsourced fabrication using a network connection.

CAD/CAM Components

Scanner

The term scanner in dentistry means data collection tools that measure three dimensional jaw and tooth structures and transform them into digital data sets. There are two different types of scanners:

- Optical scanners
- Mechanical scanners.

Optical scanners

The basis of this type of scanner is the collection of three-dimensional structures in a so-called 'triangulation procedure'. Here, the source of light (e.g. laser) and the receptor unit are in a definite angle in relationship to one another. Via this angle the computer can calculate a three dimensional data set from the image on the receptor unit (Mehl et al 1997). Either white light projections or a laser beam can serve as a source of illumination. The following can be named as examples of optical scanners on the dental market:

- Lava Scan ST (3M ESPE, White light projections)
- Everest Scan (KaVo, White light projections)
- es1 (etkon, Laser beam).

The recently introduced Nobel Procera scanner uses conoscopic holography technology. The manufacturer describes this technology as superior to triangulation as projected and reflected beams travel the same linear pathway. This allows scanning of steep slopes of up to 85°.

Mechanical scanner

In this scanner variant, the master cast is read mechanically line-by-line by means of a ruby ball and the three-dimensional structure measured. The traditional Procera Scanners Piccolo and Forte (Nobel Biocare) are the only example for mechanical scanners in dentistry.

This type of scanner is distinguished by a high scanning accuracy; where by the diameter of the ruby ball is set to the smallest grinder in the milling system, with the result that all data collected by the system can also be milled (May et al 1998, Webber et al 2003). The disadvantages of this data measurement technique are to be seen in the inordinately complicated mechanics, which make the apparatus very expensive and long processing times compared to optical systems.

Design Software

Special software is provided by manufacturers for designing various kinds of dental restorations. With such software, crown and fixed dental prostheses (FDPs) substructures can be constructed on the

one hand; on the other hand, some systems also offer the possibility of designing full anatomical crowns, partial crowns, inlays, inlay retained FDPs, as well as adhesive FDPs, telescopic primary crowns and implant abutments (Reiss 2007). The CAD/CAM systems presently available on the market are being continuously improved in the area of software. The latest construction possibilities are continuously available to the user by means of updates. The construction data can be stored in various data formats. The basis therefore is often standard transformation language (STL) data (Mehl et al 1997). Many manufacturers, however, use their own data formats, specific to that particular manufacturer, with the result that data of the construction programs are not compatible with each other.

Processing Devices

The construction data produced with the CAD software are converted into milling strips and loaded into the milling device. Processing devices are distinguished by means of the number of milling axes:

- 3-Axis devices
- 4-Axis devices
- 5-Axis devices.

3-Axis milling devices

This type of milling device has degrees of movement in the three spatial directions. Thus, the mill path points are uniquely defined by the X -, Y -, and Z - values. A milling of subsections, axis divergences and convergences, however, is not possible. This demands a virtual blocking in such areas. All 3-axis devices used in the dental area can also turn the component by 180° in the course of processing the inside and the outside. The advantages of these milling devices are short milling times and simplified control by means of the three axes. As a result, such milling devices are usually less costly than those with a higher number of axes. Examples of 3-axis devices include inLab (Sirona), Lava (3M ESPE), Cercon brain (DeguDent).

4-Axis milling devices

In addition to the three spatial axis, the tension bridge holding the material can also be turned simultaneously. As a result it is possible to adjust FDP constructions with a large vertical height displacement into the usual mold dimensions and thus save material and milling time. Example: Zeno 4820 M1 (Wieland-Dental).

5-Axis milling devices

With a 5-axis milling device there is, in addition to the three spatial dimensions and the rotatable tension bridge (4th axis), also the possibility of rotating the milling spindle (5th axis). This enables milling of complex geometries with subsections, as for example, mandibular FDPs on converging abutment teeth (end molar tipped towards the medial plane), or also crown and FDP substructures that, as a result of anatomically reduced formation, demonstrate converging areas in the exterior of the frame. Examples in the lab side area include: Everest Engine (KaVo), Cercon Expert (DeguDent), LAVA CNC 500 (3M ESPE), ZenoTec T1 (Wieland-Dental). Examples in the Production Centre: HSC Milling Device (Straumann CAD/CAM). The quality of the restoration does not necessarily increase with the number of processing axes. The quality results much more from the result of the digitalization, data processing and production process. The ZenoTec T1 offers the possibility to mill master casts which makes the system compatible to intraoral scanning devices.

CAD/CAM FOR FIXED PROSTHODONTICS

Optical Impression

- Powdering
- Acquiring Single Optical Impression
- Acquiring Multiple Optical Impression.

Powdering Consists of

- Opaque powder system
- Imaging liquid.

Acquiring a Single Optical Impression

To acquire an Optical Impression of the crown preparation, first position the cursor over the Acquire Preparation Icon. To capture an Optical Impression place the foot under the front edge of the CEREC 3 Acquisition Unit and lift up and hold the foot-switch. This activates the camera to display a live digital video image on the monitor.

Acquiring Multiple Optical Impressions

The option to use multiple optical impressions for a restoration should be selected only if there is a specific need, such as to visualize specific obscured margins of a single preparation. Multiple optical impressions are also required to create a larger Virtual Model to restore multiple teeth or to evaluate adjacent tooth contours.

CAD (COMPUTER AIDED DESIGN)

The CAD unit in which optical impression is taken and designing of the restoration is done.

I. CAD

- Digital impression
- Designing of the restoration.

A three-dimensional image of the die is produced over the screen and can be rotated for observation from any angle. Current software allows the crown form to be designed by selecting the proper tooth element from the library and then modelling the crown to fit in with the remaining dentition.

CAM (COMPUTER AIDED MANUFACTURING)

CAD CAM generated restoration can either be fabricated through subtractive technique or additive method. Computer aided manufacturing.

CAM uses computer generated path to shape a restoration. Early systems relied almost exclusively on cutting the restoration from a prefabricated block with the use of burs, diamonds or diamond disks.

Subtractive Technique

After the design of the restorations is completed, data for processing is calculated automatically. Processing devices are distinguished by means of the number of milling axes⁸.

Copy Milling

Different possibilities of working axis: 3 spatial direction X, Y and Z (3axis milling devices); 3 spatial directions X, Y, Z and tension

bridge A (4 axis milling device); 3 spatial directions X, Y, Z, tension bridge A and milling spindle B (5 axis milling device). Copy milling includes fabrication of a prototype (pro-inlay or crown) usually via impression making and model preparation.

MILLING VARIANTS

Dry Processing

Dry processing is applied mainly with respect to zirconium oxide blanks with a low degree of pre-sintering. This offers several benefits: • Minimal investment costs for the milling device • No moisture absorption by the die ZrO₂ mould, as a result of which there are no initial drying times for the ZrO₂ frame prior to sintering. Disadvantages: • The lower degree of pre-sintering results in higher shrinkage values for the frameworks. Some manufacturers also offer the option of milling resin material in a dry milling process [Zeno 4030 (Wieland-Imes), Lava Form and Cercon brain].

Wet Milling

In this process the milling diamond or carbide cutter is protected by a spray of cool liquid against overheating of the milled material. This kind of processing is necessary for all metals and glass ceramic material in order to avoid damage through heat development. 'Wet' processing is recommended, if zirconium oxide ceramic with a higher degree of pre-sintering is employed for the milling process. A higher degree of pre-sintering results in a reduction of shrinkage factor and enables less sinter distortion. Examples: Everest (KaVo), Zeno 8060 (Wieland-Imes), inLab (Sirona).

Additive Technique/Rapid Prototyping Techniques

Rapid prototyping (RP) techniques, the so-called "generative manufacturing techniques", exhibit the potential to overcome the described shortages. simply consists of two phases: virtual phase (modeling and simulating) and physical phase (fabrication). Virtual prototyping is development of model by dynamic and interactive simulation. The course of forming the physical model is formation of 3D physical model by CAD.

In current years, RP is becoming more appealing for dental purposes. The innovations in molding materials and forming procedure have improved the RP techniques so that this technology is no longer adopted only for prototyping; it is used for reproduction of real functional elements. The feasibility of this technique is increasing in different dental practice fields such as oromaxillofacial surgery and prosthesis, production of surgical guide or physical models in dental implant therapies, and prosthodontics.

Classification of RP Technologies in Dentistry

The frequent technologies that are adopted in dental practice are:

- Stereolithography (SLA),
- Inkjet-based system (3DP),
- Selective laser sintering (SLS), and
- Fused deposition modeling (FDM).

While various materials can be employed in these technologies; wax, plastics, ceramics, and metals are commonly used by several studies in dentistry.

Stereolithography

This method includes a photosensitive liquid resin bath, a model-building platform, and an ultraviolet (UV) laser for curing the resin. The layers are cured and bond successively to form a solid object for impression rationales, exploited in reconstructive surgeries and sub-periosteal surgery in dental implant therapies. Fabrication of surgical drilling templates during insertion of dental implants is the current foremost purpose for using SLA models in dental practice. SLA-made surgical drill guides have been proved to benefit from high precision by several well-documented researches.

Selective Laser Sintering (SLS)

Selective laser sintering (SLS) is an additive manufacturing technique used for the low volume production of prototype models and functional components. Starts by converting the CAD data in series of layer. These layers are transferred to the additive SLS machine which begins to lay the first layer of powder. As the laser scans the surface, the material is heated and fuse together. Once the single layer formation is completed, the powder bed is lowered and the next layer of powder is rolled out smooth & subjected to laser. Hence layer by layer formation of the object takes place.

Inkjet Based System or 3-D Printing

In this technique, a measured amount of the raw powder-form material is initially dispensed from a container by a moving piston. A roller then distributes and compresses the powder at the top of the fabrication chamber. A liquid adhesive is then deposited from the multi-channel jetting head in a 2D pattern onto the powder, make it bond and form a layer of the object. When a layer is completed, the piston helps spread and join the next powder layer. This incremental (layer-by-layer) method is gradually continued to achieve a complete built up of prototype. Unbound powder is swept up subsequent to a heating process, leaving the fabricated part sound and intact.

Fused Deposition Modeling (FDM)

The FDM is a rapid prototyping technique in which a thermoplastic material is extruded layer by layer from a nozzle, controlled by temperature. In this technique, a filament of a thermoplastic polymer material suckles into the temperature-controlled FDM extrusion nozzle dome. It is then heated to a free-flowing semi-liquid form. The motion of the nozzle head is controlled by a processor and traces and deposits the material in extremely thin layers onto a subsidiary platform. The head leads the material into place with an ample precision. A portion of the subject is built up layer by layer and the material solidifies within 0.1s after being ejected from the nozzle and bonds to the layer below. The supporting structures are contrived for overhanging geometries and are later removed by cutting them out from the object.

DISCUSSION

The technology is currently at a stage where CAD/CAM dental restorations can be created to similar functional standards as their conventional counterparts. Marginal gaps have reached a clinically acceptable level, wear of materials and tooth structure may be less than with conventional ceramic restorations, and patient acceptance is high. The issue of postoperative sensitivity requires more study, despite its reported transient nature. While these technological

achievements are impressive, the success of CAD/CAM must be demonstrated in routine clinical use.

High quality 10-year randomised prospective clinical trials and systematic reviews have been published for inlays and onlays using the original Cerec technique only. In contrast, only case reports and in vitro data are available for CAD/CAM veneers. It is clear that these newer developments await longer-term studies before recommendations can be made.

As technologies and systems evolve very rapidly in CAD-CAM dentistry, it is important to adopt an evidence-based approach – clinical trials should precede wide scale clinical usage. This is difficult, as the rate of technological development outpaces long-term trials. The 10-year data for the Cerec full coverage crown, which is already used in many dental practices, is awaited.

The aesthetic result of a restoration is a subjective variable, and difficult to measure. In the end, it is the patient who will ultimately be the final arbiter. High patient satisfaction with the aesthetics of Procera crowns has been described after five years in vivo. Reich et al. used one dentist and two dental technicians to attempt to standardise assessment using criteria described by Ryge. Surface staining has been shown to be an acceptable method of characterising monolithic ceramic blocks although an increase in colour mismatch with time has been reported. This may be due to gradual loss of extrinsic staining, or be related to colour change during glazing.

The high cost of CAD/CAM remains an issue. Only one cost-benefit analysis of CAD/CAM restorations has been published. It found that CAD/CAM onlays are more cost effective than gold or laboratory-fabricated ceramic onlays in the German public health system. New developments in CAD/CAM include the fabrication of endodontic crowns. These are designed to bond directly to the endodontically treated tooth and remove the need to create a postcore.

This type of restoration has shown higher success for molars than premolars. The use of CAD/CAM to create custom implant abutments is also promising. Nobel Biocare currently produces a copy-milled titanium custom abutment for use with Procera AllCeram crown copings. This system has been shown to be compatible with many implant systems and may be an alternative fabrication method for custom implant abutments.¹⁶⁻²⁰

CONCLUSION

In conclusion, CAD/CAM offers several advantages over conventional restoration production:

- Restorations can be produced quickly from a wider variety of restorative materials;
- Provisional restorations are not always required;
- Restorations can be produced at the chair side;
- Wear of opposing teeth can be reduced;
- There may be a decreased, or no laboratory fee; and
- Cross infection between the clinic and the laboratory is minimised.

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Control of Oral Habits in Prevention of Malocclusion

Abstract

Malocclusion is a developmental disorder of the craniofacial complex that affects jaw, tongue and facial muscles and is the result of an interaction of genetic and environmental factors. Such disorders can appear in primary dentition, where anterior open bite and posterior cross bite are the most prevalent conditions. Malocclusion causes functional and aesthetic disturbances in affected individuals, and treatment is often costly. There are a number of controversies regarding the major causes of malocclusion in primary dentition and whether or not these are predictive of malocclusion in the permanent dentition.

Key words: Craniofacial, Disorder, Malocclusion

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INTRODUCTION

Oral habits in children brought the dentist a prime attention and concerned about it for many years. Dentists see the possibility harmful effects if habits are continued for a longer period of time, the common problem encounter are; highly malleable alveolar ridges, changes in position of teeth and occlusion.¹

Prevention are done with properly designed nursing nipple and pacifier to achieve normal function and deglutitional maturation.

Most common oral habits encounter in children are:

- Digit sucking habits
- Lip sucking
- Nail biting
- Tongue thrust swallowing habits

DIGIT SUCKING HABITS

Digit sucking habits are considered to be the most prevalent of oral habits, it is believed that continuation of these habits is due to emotional stimuli such as boredom, stress, hunger, hyperactivity, sadness, pleasure and different kind of disabilities.² If these habits continued beyond the time that the permanent teeth begin to erupt, then malocclusion characterized by flared and space maxillary incisors, anterior open bite, retroclined lower incisors, and narrow upper arch are likely the result.³ Bishara⁴ also found that persistence of these habits results in increase prevalence of anterior open bite, reduced overbite and increase overjet and greater maxillary arch depth. It appear that the effect of such habits depends on the direction of force and intensity of the habit and the resistance of the jaw to displacement (Figure 1).

Recommended age for the prevention of these habits should be initiated between 4 years and the eruption of permanent incisors.⁵

Treatment option include relaxation, behavior modification (rewards, encouragements and reminders) preventive therapy like

application of bitter solution or adhesive tape, thumbguard, dove mitten and appliance therapy. The habit appliance generally consists of two molar bands on second primary molars and palatal bar covering the anterior part of the palate.

LIP SUCKING

This habit appears in all ages with a certain frequency, in situation when concentration is requested. Lip sucking lead to anterior displacement as finger sucking, the habits usually occurs during the school age where an child's needs own judgement.¹ Dental Problems associated with lip sucking habit are linguallly placed lower incisors and vestibular upper incisors.

Preventive measures are use of appliances that prevent the lip insertion between the dental arches.

The most commonly used appliances are activator, lip bumper and oral screen in addition with the practice of some exercise or functional myotherapy of the lower lip by the upper lip (Figure 2).²⁻⁷

NAIL BITING

Nail biting is the habit that develops after the sucking age, child go directly from thumb sucking stage to nail biting stage. studies⁶ have estimated that 80% of all individuals are nail biters. It's a normal tension release and parents may not find it quite socially acceptable. Nailbitingchildren linked to psycho emotional state of anxiety and oral stage of psychological development (Figure 3).

Risk factors for nailbiting children in developing malocclusion are; crowding, rotation, attrition of incisal edges, protrusion of maxillary incisors.

To prevent or to stop the habit found to be quite challenging but we can manage well by motivating the patient, offering helpful suggestions in over coming the addiction, removal of emotional factors. Another pteventive measures include well trimmed nails,

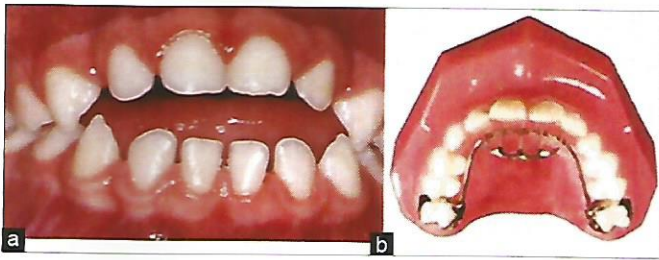


Figure 1: (a) Intraoral photograph showing anterior open bite due to sucking habits, (b) Appliances to prevent thumb sucking



Figure 2: Lip bumper to prevent lip sucking habits

usage of rubber bite piece when he or she patient feels the urge for nailbiting or has anxiety.

TONGUE THRUST SWALLOWING HABITS

Straub⁸ describe tongue thrust swallow implies the existence of a syndrome which includes thrust of the tongue, absence of closure of maxilla and mandible, and overactivity of the orbicularis oris muscle. Much attention has been paid at the various times to the tongue and tongue habits as possible etiologic factors in malocclusion. According to him⁹ abnormal swallowing habits may develop in bottle fed babies who are given nursing bottle with the wrong kind of nipple (Figure 4).

The modern view point is that tongue thrust swallowing is seen in two circumstances: in younger children with reasonably normal occlusion, in whom it represents only a transitional stage in normal physiologic maturation; and in individuals of any age with displaced incisors, in whom it is an adaptation to the space between the teeth.

The treatment of the problem is training the child to hold the tongue in proper position during the swallowing motion. Myofunctional exercises like those employed in limiting effects of thumb sucking. A vertical crib may be constructed, it is similar to that suggested for preventing thumb sucking except the palatal bars are soldered in a horizontal position extending down from the palate to prevent the forward thrusting of the tongue.⁸⁻¹⁰



Figure 3: Photographs showing nail biting habits and attrited incisors



Figure 4: Intraoral photographs showing tongue thrust habit

CONCLUSION

As the word goes, prevention is always better than cure, preventing oral habits at a very early age can do much good for the children than interceptive and corrective procedures at a later age. Hence it is the need of the age, for children and parents to be well informed, educated and motivated to take preventive measures against oral habits.

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Atraumatic Restorative Treatment-A Review

Abstract

Atraumatic restorative treatment (ART) is recommended for use worldwide, not only in developing countries but also in more industrialized countries. Atraumatic Restorative Treatment (ART) is considered to be accepted, both by children and by adult patients. ART is based on the maximum preservation of sound tooth tissue and the minimum discomfort, since there is use of hand instruments also reduces pain due to reduced vibrations occur while use of rotary dental instruments. ART requires use of very minimal portable dental equipment and was designed to use in field/community settings. It was developed for use in less developed countries of the world, where art was seen as an affordable option for patients who can't afford to pay for more sophisticated treatments, but with improved technique and use of improved restorative materials its use has considerably expanded to developed countries as well.

Key words: ART, Developing country, Hand instrument

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INTRODUCTION

Necessity is the mother of invention. Lack of skilled manpower and infrastructure in developing countries lead to development of a simpler technique which would reduce the amount of dental caries in the population. Hence, the Atraumatic Restorative treatment (ART) was developed as a simple technique of restoration using only hand instruments.¹ Tanzania was the first country to apply ART with help of World Health Organization. It was initiated as a community based primary oral health program so that dental care could be made available to socioeconomically weaker sections.² This Atraumatic Restorative Treatment (ART) technique is based on principle of minimal intervention using only hand instruments which are not electrically driven.³ The simplicity of this technique makes restorative procedure available to even the most underprivileged ones in the society.⁴ The technique uses hand excavation of dental caries which eliminates the need for anesthesia and use of expensive equipment. The cavity is restored with glass ionomer cement that bonds to the tooth structure and releases fluoride to stimulate remineralization. Hence, ART is noninvasive restorative approach with high acceptability in patients.⁵

The GICs used in earlier field trials were not specifically developed for the ART technique. They had high failure rate which was partly related to the materials and to the technical skills of the operators during past few years, viscous esthetic conventional GICs with improved handling and physical properties have been marketed specifically for the ART approach. The products release similar amounts of fluoride ions to a metal-modified GIC

(Ketac-Silver - ESPE GmbH, Seefeld, Germany), which is less than for older conventional esthetic restorative GICs.¹

ARMAMENTARIUM USED IN ART

1. Mouth Mirror
2. Explorer
3. Tweezers
4. Spoon excavators (Small, Medium, Large)
5. Enamel Hatchet
6. Double ended carver
7. Enamel access cutter
8. Instrument Tray
9. Mixing pad and spatula

MATERIALS USED IN ART

1. Cotton wool rolls
2. Cotton wool pellets
3. Petroleum jelly
4. Plastic strip
5. Wedge
6. Articulation paper

RESTORATIVE MATERIALS

1. Glass Ionomer Cement
2. Dentin Conditioner

TECHNIQUE OF ART

Step I: Isolation

1. Adequate light source whether natural or artificial should be available.
2. Isolation of the operating area with cotton rolls.
3. Cleaning of cavity with moist cotton and drying it using small cotton pellets or a chipblower.

Step II: Excavation of the Cavity

1. The caries is excavated using suitable sized spoon excavator.
2. Only soft carious infected dentin is removed.
3. All the unsupported enamel is removed with an enamel hatchet.

Step III: Restoration with Glass Ionomer Cement

1. Glass Ionomer Cement is mixed following manufacturers instructions and carried to the cavity using blunt end of the applicator.
2. Small amount of cement is placed and condensed in the cavity at a time. This will ensure complete filling of the cavity without any air voids.
3. Use round surface of a medium excavator to push the mixture into deeper parts of cavity and under any overhanging enamel.
4. The cavity is finally filled by press finger technique. The finger is moved side ways with pressure to remove excess of GIC which is then removed by sharp end of carver.
5. Cavity is restored and the adjacent fissures are sealed with GIC at the same time.
6. Give appropriate setting time for the GIC which is as per manufacturer instructions.
7. Then check the bite using articulating paper and remove any excess cement if needed.
8. Remove the cotton rolls.
9. Advise the patient not to eat or bite hard objects at least for one hour.

ADVANTAGES OF ART

The use of easily available and relatively inexpensive hand instruments eases the restorative process. A biological friendly approach involving removal of only decalcified tooth tissue, which results in relatively small cavities and conserves sound tooth tissue. A straight forward and simple infection control practice without the use of autoclaved handpieces. A chemical adhesion of glass ionomer that reduces the need to cut sound tooth tissue for retention of restorative material.

LIMITATION OF ART

Long-term survival rates of glass ionomer ART restorations and sealants are not yet available. The technique acceptance by oral health care personnel is not yet assured. The possibility exists of hand fatigue from the use of hand instruments. Hand mixing might produce a relatively unstandardized mix of glass ionomer cement.

DISCUSSION

Survival rates of restorations using ART vary depending on several factors. In a meta-analysis of studies reporting survival rates of ART restorations, single surface restorations were found to be more successful than multi-surface restorations in both primary and

permanent dentition. High viscosity glass ionomer was retained longer than medium viscosity.⁶

Lo E C M et al (2001) have shown that the 24-month cumulative survival rates of ART restorations in the primary teeth were 93 and 90% for the ChemFlex and Fuji IX GP class I restorations, respectively, while 40 and 46% of class II restorations placed with the respective materials were satisfactory. In the permanent dentition, only class I restorations were involved and the cumulative survival rates were 95 and 96% for ChemFlex and Fuji IX GP. For the primary teeth after 24 months, net mean occlusal wear was 87 microm for ChemFlex, and 85 microm for Fuji IX GP. The occlusal wear in the permanent teeth was 75 microm for ChemFlex and 79 microm for Fuji IX GP.⁷

Frencken, J E observed that the Results after 1 year revealed a survival percentage for one-surface ART restorations of 93.4 whilst the complete and partial retention percentages for sealants were 60.3 and 13.4, respectively. No caries was observed in teeth restored using ART, and only 0.8% of surfaces diagnosed as having early enamel lesions at the start of the programme and sealed consequently had progressed into active dentinal lesions after 1 year.⁸

Yip, Hak-Kong HK et al used Glass-Ionomer Cement restorations, when the atraumatic restorative treatment method was used, significantly better survival rates were found for Class I (92.9%) than for Class II (64.7%) cavity preparations. There was also a strong trend for relatively better survival rates for the conventional cavity preparation method (86.7%) than for the atraumatic restorative treatment (64.7%) method for Class II cavity preparations. However, both the atraumatic restorative treatment and conventional methods appeared equally effective for Class I preparations.⁹

The opening access must be large enough to perform appropriate caries removal. The use of hatches aids widening the cavity entrance access. According to WHO manual, the minimal opening to reach dentinal caries is about 1 mm.¹⁰ The DEJ also receive special care in excavation because the access to it is limited by the enamel and this area represents a way for fast caries progression. The Bauru Dental School developed a kit containing a longer and thinner excavator intending to reach the DEJ area, specially in buccal and lingual walls of proximal boxes. The instruments are being commercialized in Brazil by SSWhite named ART kit. This KIT has been used at Public dental service in Bauru, within an ART program and has been working properly. Because it is a thin and long instrument it must not be used to open cavities and to access small lesion, otherwise it can be damaged.¹¹ Another critical step is related to caries removal. It is necessary to know when excavation is adequate. Unfortunately, there is no objective parameter to guide excavation. Color and hardness of dentin are the most important to be considered. As dark dentin is not always related to the number of bacteria in a cavity and also darker dentin could be an arrested lesion, hardness becomes the most adequate criteria to determine when the excavation procedure is complete.¹²

Raggio DP et al conducted study Atraumatic restorative treatment (ART) has demonstrated good longevity when used for single-surface restorations, but lower success rates are reported for occlusoproximal surfaces. This systematic review and meta-analysis aimed to verify the pooled success rate of occlusoproximal ART restorations in primary teeth considering the outcomes: longevity, pulp damage, or caries lesion progression. Literature searching was carried out on the studies reporting clinical trials indexed in PubMed and in English language, comprising the outcomes. A meta-analysis was undertaken considering the results from

reviewed studies. An initial search resulted in 126 articles, and three of them were finally selected. The main reasons for excluding articles were the absence of control group, as amalgam, composite resin, or compomer restorations to be compared with ART (hand excavation + high-viscous GIC). The pooled estimate (odds ratio; 95% confidence interval) for ART approach success was 1.04 (0.65-1.66). Atraumatic restorative treatment restorations performed with high-viscous GIC present similar survival/success rates to conventional approach using composite resin or amalgam for occlusoproximal restorations in primary teeth and can be suggested as a good option for occlusoproximal cavities in primary molars. In addition, further randomized controlled clinical investigations concerning occlusoproximal restorations in primary teeth are still necessary.¹³

CONCLUSION

ART is not a compromise but a perfect alternative and biological treatment approach for developing countries and special groups in the industrialized world. It requires minimal cavity preparation that conserves sound tooth tissue and causes less trauma to teeth. Need for local anesthetics are reduced and so is the psychological trauma to patients. Simplifies infection control as hand instruments can easily be cleaned and sterilized. ART approach is very cost effective since it is a friendly procedure. It makes restorative care more accessible for all population groups.

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History of Dentistry: A Review

Abstract

Oral disease has been a problem for humans since the beginning of time. Skulls of the Cro-Magnon people, who inhabited the earth 25,000 years ago, show evidence of tooth decay. The earliest recorded reference to oral disease is from a Sumerian text (circa 5,000 B.C.) that describes "tooth worms" as a cause of dental decay. No one can deny that dentistry has made tremendous strides over the years.

Keywords: Disease, History, Oral

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INTRODUCTION

Dentistry is one of the oldest medical professions, dating back to 7000 B.C. With the Indus Valley Civilization. Additionally, Fauchard first introduced the idea of dental fillings and the use of dental prosthesis, and he identified that acids from sugar led to tooth decay. Days of mankind, teeth have been a big part of our health care. In the earliest days, man did not know the benefits of proper dental care, and as a result regularly lost their teeth. Beginning in Ancient Egyptian times, basic dental care was starting to be practiced. In fact, the earliest instances of dentistry can be traced as far back as 7500 B.C., where the Egyptians began to use replacement teeth in place of missing ones. Over time, dentistry has undergone a number of changes. From the simplest methods for tooth care to the use of modern materials and dental methods, dentistry has changed dramatically.¹⁻³

Moving forward into 5000 BC, the Sumerians blamed tooth worms as the cause of any dental issues, with the worms boring little holes in your teeth and hiding out inside. (Reportedly some ancient doctors even mistook nerves as tooth worms and tried to yank them out. Ouch!) The idea that a worm traveled through your mouth and was the cause of dental pain lasted until it was proven false in the 1700s.³⁻⁶

The earliest dentist was Hesi-Re, who died in 2600 BC

- The first recorded dental surgery consisted of two perforations under the first molar to drain an abscessed tooth. This operation took place in Egypt around 2750 BC.
- Today, dental surgery could range anywhere from removing wisdom teeth to cutting a person's mandible if the person has an under bite.

100 BC

Celsus, a Roman medical writer, writes extensively in his important compendium of medicine on oral hygiene, stabilization of loose teeth, and treatments for toothache, teething pain, and jaw fractures.

500 B.C.E.

Hippocrates and Aristotle write of ointments and sterilization procedures using a red-hot wire to treat diseases of the teeth and oral tissues. They also speak of tooth extraction and the use of wires to stabilize jaw fractures and bind loose teeth.

1013 AD

Albucasis was considered "the great Exponent of Dental Surgery in the middle ages" (cudental.creighton.edu). His book shows some pictures of dental instruments, such as scalers (used to remove stains and plaque), elevators (used for extractions), and forceps.

1300 B.C.E.

Aesculapius, a Greek physician, first writes about the concept of extracting diseased teeth.

1700-1550 BC

An Egyptian text, the Ebers Papyrus, refers to diseases of the teeth and various toothache remedies

1700 B.C.E.

Ancient Egyptian papers called the Ebers papyrus, which date back as far as 3700 B.C.E., contain references to diseases of the teeth, as

well as prescriptions for substances to be mixed and applied to the mouth to relieve pain

2700 B.C.E.

Evidence that the Chinese used acupuncture to treat pain associated with tooth decay.

2600 BC

Death of Hesy-Re, an Egyptian scribe, often called the first "dentist." An inscription on his tomb includes the title "the greatest of those who deal with teeth, and of physicians." This is the earliest known reference to a person identified as a dental practitioner

2900 B.C.E.

Egyptian lower jaw demonstrates two holes drilled through the bone, presumably to drain an abscessed tooth. Egyptians were the first to designate a doctor that specializes in treating teeth.

5000 BC

A Sumerian text of this date describes "tooth worms" as the cause of dental decay.

166-201 AD

The Etruscans practice dental prosthetics using gold crowns and fixed bridgework

700

A medical text in China mentions the use of "silver paste," a type of amalgam

1210

A Guild of Barbers is established in France. Barbers eventually evolve into two groups: surgeons who were educated and trained to perform complex surgical operations; and lay barbers, or barber-surgeons, who performed more routine hygienic services including shaving, bleeding and tooth extraction

1400

A series of royal decrees in France prohibit lay barbers from practicing all surgical procedures except bleeding, cupping, leeching, and extracting teeth.

1530

The Little Medicinal Book for All Kinds of Diseases and Infirmities of the Teeth (Artzney Buchlein), the first book devoted entirely to dentistry, is published in Germany. Written for barbers and surgeons who treat the mouth, it covers practical topics such as oral hygiene, tooth extraction, drilling teeth, and placement of gold fillings.

1575

In France Ambrose Pare, known as the Father of Surgery, publishes his Complete Works. This includes practical information about dentistry such as tooth extraction.

1685

First dental textbook is published in English by Charles Allen titled "The Operator for the Teeth.

1723

Pierre Fauchard, a French surgeon publishes The Surgeon Dentist, A Treatise on Teeth (Le Chirurgien Dentiste). Fauchard is credited as being the Father of Modern Dentistry because his book was the first to describe a comprehensive system for the practice of dentistry including basic oral anatomy and function, operative and restorative techniques, and denture construction.

1746

Claude Mouton describes a gold crown and post to be retained in the root canal. He also recommends white enameling for gold crowns for a more esthetic appearance.

1760

John Baker, the earliest medically-trained dentist to practice in America, immigrates from England and sets UP practice

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1760-1780

Isaac Greenwood practices as the first native-born American dentist.

1768-1770

Paul Revere places advertisements in a Boston newspaper offering his services as a dentist. In 1776, in the first known case of post-mortem dental forensics, Revere verifies the death of his friend, Dr. Joseph Warren in the Battle of Breed's Hill, when he identifies the bridge that he constructed for Warren

1785

John Greenwood, who served as George Washington's dentist helps raise public awareness about porcelain teeth.

1789

Frenchman Nicolas Dubois de Chemant receives the first patent for porcelain teeth.

1790s,

A British chemist began to experiment with the use of nitrous oxide as a pain-inhibitor and noted its most famous side effect, laughing. He coined the anesthetic's popular nickname, "laughing gas."

1790

John Greenwood, son of Isaac Greenwood and one of George Washington's dentists, constructs the first known dental foot engine. He adapts his mother's foot treadle spinning wheel to rotate a drill.

Josiah Flagg, a prominent American dentist, constructs the first chair made specifically for dental patients. To a wooden Windsor chair, Flagg attaches an adjustable headrest, plus an arm extension to hold instruments.

1801

Richard C. Skinner writes the *Treatise on the Human Teeth*, the first dental book published in America

1808

when an Italian dentist invented a single porcelain tooth imbedded with a platinum pin

1825

Samuel Stockton begins commercial manufacture of porcelain teeth. His S.S. White Dental Manufacturing Company establishes and dominates the dental supply market throughout the 19th century

1832

James Snell invents the first reclining dental chair

1839

The American Journal of Dental Science, the world's first dental journal, begins publication.

Charles Goodyear invents the vulcanization process for hardening rubber. The resulting Vulcanite, an inexpensive material easily molded to the mouth, makes an excellent base for false teeth, and is soon adopted for use by dentists. In 1864 the molding process for vulcanite dentures is patented, but the dental profession fights the onerous licensing fees for the next twenty-five years.

1840

Horace Hayden and Chapin Harris found the world's first dental school, the Baltimore College of Dental Surgery, and establish the Doctor of Dental Surgery (DDS) degree. (The school merges with the University of Maryland in 1923).

The American Society of Dental Surgeons, the world's first national dental organization, is founded. (The organization dissolves in 1856.)

1841

Alabama enacts the first dental practice act, regulating dentistry in the United States. The act called for the assignment of a dentist to the state's medical board in order to grant licenses for practicing

dentistry in the state, however, the act was never enforced, few dentists are ever assigned a seat on the medical board and only a couple of dental licenses are ever granted during the forty years it was on the books.

1945,

Grand Rapids, Michigan introduced fluoride into their public water systems to help fight tooth decay among residents. At the same time, a group of Wisconsin-based dentists succeeded in getting the state's water system fluoridated. After substantial testing showed that fluoride reduced the incidence of cavities by as much as two-thirds.

1846

Dentist William Morton conducts the first successful public demonstration of the use of ether anesthesia for surgery. The previous year Horace Wells, also a dentist, had conducted a similar demonstration that was regarded a failure when the patient cried out. Crawford Long, a physician, later claims he used ether as an anesthetic in an operation as early as 1842, but he did not publish his work.

1951

the U.S. Public Health Service urged the entire country to fluoridate public drinking water

1855

Robert Arthur originates the cohesive gold foil method allowing dentists to insert gold into a cavity with minimal pressure. The foil is fabricated by annealing, a process of passing gold through a flame making it soft and malleable.

1864

Sanford C. Barnum develops the rubber dam, a piece of elastic rubber fitted over a tooth by means of weights. This simple device isolates the tooth from the oral cavity, a troublesome problem for dentists.

1867

The Harvard University Dental School, the first university-affiliated dental institution, is founded. The school calls its degree the *Dentariae Medicinae Doctorae* (DMD), creating a continuing semantic controversy (DDS vs. DMD).

1870s

Baked porcelain inlays come into use for filling large cavities.

1871

James B. Morrison patents the first commercially manufactured foot-treadle dental engine. Morrison's inexpensive, mechanized tool supplies dental burs with enough speed to cut enamel and dentin smoothly and quickly, revolutionizing the practice of dentistry.

The American George F. Green receives a patent for the first electric dental engine, a self-contained motor and handpiece.

1877

The Wilkerson chair, the first pump-type hydraulic dental chair, is introduced.

1880s

The collapsible metal tube revolutionizes toothpaste manufacturing and marketing. Dentifrice had been available only in liquid or powder form, usually made by individual dentists, and sold in bottles, porcelain pots, or paper boxes. Tube toothpaste, in contrast, is mass-produced in factories, mass-marketed, and sold nationwide. In twenty years, it becomes the norm.

1883

The National Association of Dental Examiners is founded by the members of the dental boards of several states in order to establish uniform standards in the qualifications for dental practitioners, the administration of dental boards overseeing licensing and the legislation of dental practice acts.

1885

The first female dental assistant is employed by C. Edmond Kells, a prominent New Orleans dentist. Her duties include chair-side assistance, instrument cleaning, inventory, appointments, bookkeeping, and reception. Soon "Lady in Attendance" signs are routinely seen in the windows of 19th century dental offices. The American Dental Assistants Association is founded in 1924 by Juliette Southard and her female colleagues.

1887

Stowe & Eddy Dental Laboratory, the first successful industrial-type laboratory in the U.S., opens in Boston, marking the ascendancy of the modern commercial dental laboratory. The earliest known dental laboratory in the U.S. was Sutton & Raynor which opened in New York City around 1854.

1890

Ida Gray, the first African-American woman to earn a dental degree, graduates from the University of Michigan School of Dentistry.

Willoughby Miller an American dentist in Germany, notes the microbial basis of dental decay in his book *Micro-Organisms of the Human Mouth*. This generates an unprecedented interest in oral hygiene and starts a world-wide movement to promote regular toothbrushing and flossing

1895

Wilhelm Roentgen, a German physicist, discovers the x-ray. In 1896 prominent New Orleans dentist C. Edmond Kells takes the first dental x-ray of a living person in the U.S.

1899

Edward Hartley Angle classifies the various forms of malocclusion. Credited with making orthodontics into a dental specialty, Angle also establishes the first school of orthodontics (Angle School of Orthodontia in St. Louis, 1900), the first orthodontic society (American Society of Orthodontia, 1901), and the first dental specialty journal (*American Orthodontist*, 1907)

1903

Charles Land devises the porcelain jacket crown.

1905

Alfred Einhorn, a German chemist, formulates the local anesthetic procain, later marketed under the trade name Novocain.

1907

William Taggart invents a "lost wax" casting machine, allowing dentists to make precision cast fillings.

1908

Greene Vardiman Black, the leading reformer and educator of American dentistry, publishes his monumental two-volume treatise *Operative Dentistry*, which remains the essential clinical dental text for fifty years. Black later develops techniques for filling teeth, standardizes operative procedures and instrumentation, develops an improved amalgam, and pioneers the use of visual aids for teaching dentistry.

1910

The first formal training program for dental nurses is established at the Ohio College of Dental Surgery by Cyrus M. Wright. The program is discontinued in 1914 mainly due to opposition by Ohio dentists.

1911

The U.S. Army Dental Corps is established as the first armed services dental corps in the U.S. The Navy institutes its Dental Corps in 1912.

1913

Alfred C. Fones opens the Fones Clinic For Dental Hygienists in Bridgeport, Connecticut, the world's first oral hygiene school. Most of the twenty-seven women graduates of the first class are employed by the Bridgeport Board of Education to clean the teeth of school children. The greatly reduced incidence of caries among these children gives impetus to the dental hygienist movement. Dr. Fones, first to use the term "dental hygienist," becomes known as the Father of Dental Hygiene

1917

Irene Newman receives the world's first dental hygiene license in Connecticut.

1929

Penicillin is invented, having a major impact on treatment protocols for dental infections.

1930

The American Board of Orthodontics, the world's first dental specialty board, is founded

1937

Alvin Strock inserts the first Vitallium dental screw implant. Vitallium, the first successful biocompatible implant metal, had been developed a year earlier by Charles Venable, an orthopedic surgeon.

1938

The nylon toothbrush, the first made with synthetic bristles, appears on the market.

1948

President Harry S. Truman signs the Congressional bill formally establishing the National Institute of Dental Research and initiating federal funding for dental research. Dr. H. Trendley Dean is appointed its first director. The Institute is renamed the National Institute of Dental and Craniofacial Research in 1998

1949

Oskar Hagger, a Swiss chemist, develops the first system of bonding acrylic resin to dentin.

1950

The first fluoride toothpastes are marketed

1955

Michael Buonocore describes the acid etch technique, a simple method of increasing the adhesion of acrylic fillings to enamel.

1957

John Borden introduces a high-speed air-driven contra-angle handpiece. The Airotor obtains speeds up to 300,000 rotations per minute and is an immediate commercial success, launching a new era of high-speed dentistry

1960

Sit down, four-handed dentistry becomes popular in the U.S. This technique improves productivity and shortens treatment time.

Lasers are developed and approved for soft tissue work, such as treatment of periodontal disease. The first commercial electric toothbrush, developed in Switzerland after World War II, is introduced in the United States. A cordless, rechargeable model follows in 1961.

1962

Rafael Bowen develops Bis-GMA, the thermoset resin complex used in most modern composite resin restorative materials.

1980

Per-Ingvar Branemark describes techniques for the osseointegration of dental implants. The osseointegrated implant was developed in Sweden in the 1960s by Per-Invar Branemark, but it was not introduced to North America until 1982. Since then dental implants have provided patients with the miracle of a "third set" of teeth.

1982,

Brånemark presented his scientific data at the Toronto Conference on Osseointegration in Clinical Dentistry, which proved to be the turning point for the treatment's acceptance

1989

The first commercial home tooth bleaching product is marketed

1990

New tooth-colored restorative materials plus increased usage of bleaching, veneers, and implants inaugurate an era of esthetic dentistry.

1997

FDA approves the erbium YAG laser, the first for use on dentin, to treat tooth decay.

1998

The National Institute of Dental Research is renamed National Institute of Dental and Craniofacial Research to more accurately reflect the broad research base that it has come to support.

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Pterygopalatine Ganglion and It's Relation with Cluster Headache

Abstract

The purpose of this article is to explain the anatomy of the pterygopalatine ganglion, its location in the pterygopalatine fossa in the skull, and relationship it has to the Vidian nerve terminal branches and the fifth cranial nerve. The focus is the pterygopalatine region with discussion of the proximal courses of the seventh and fifth cranial nerves and their pathological processes. The ganglion is used as an example of neuro-anatomical model for explaining cluster headaches. The goal of paper is to underscore a clinical condition and correlate it with the known neuro-anatomical elements. The so-called cluster headaches and the facial-trigeminal cranial nerve complex are appropriate models to illustrate such a relationship.

Keywords: Pterygopalatine, Ganglion, Headache

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INTRODUCTION

The goal of this paper is to underscore a clinical condition and correlate it with the known neuroanatomical elements. The so-called cluster headaches (CH) and the facial-trigeminal cranial nerve complex are appropriate models to illustrate such a relationship.¹⁻³

HISTORICAL BACKGROUND

Sluder in 1908 described a constellation of symptoms that some clinicians now describe interchangeably to Cluster headache. He was the first to describe this type of headache as nasal headache in 1908 due to sphenopalatine (Meckel's) ganglion involvement, but later he called it sphenopalatine ganglion neuralgia. Cluster headache is a recurring pain that comes under a variety of names, for example, paroxysmal nocturnal cephalgia, histamine headache (Horton headache), cranial autonomic syndrome, etc. Some authors have referred to this disorder as Sluder Neuralgia.

More recently (2004) the International Headaches Society (ICHE-II) suggested a new term, the Trigeminal Autonomic Cephalgia (TACs) to explain a group of primary headaches, which are unilateral, of short duration in the trigeminal nerve distribution, and associated with autonomic symptoms ipsilaterally. This group of cephalgias include: Paroxysmal hemicranias, cluster headache, short-lasting unilateral neuralgiform headache attacks with conjunctival injection and tearing (SUNCT)⁴⁻¹⁰

ANATOMY OF PTERYGOPALATINE FOSSA AND GANGLION

The Pterygopalatine Fossa

It is a bilateral, cone-shaped depression extending deep from the infratemporal fossa all the way to the nasal cavity via the sphenopalatine foramen. It is located between the maxilla, sphenoid

and palatine bones, and communicates with other regions of the skull and facial skeleton via several canals and foramina. Its small volume combined with the numerous structures that pass through makes this a complex region for anatomy students.

The Borders of the pterygopalatine fossa are formed by the palatine, maxilla and sphenoid bones:

- Anterior: Posterior wall of the maxillary sinus.
- Posterior: Pterygoid process of the sphenoid bone.
- Inferior: palatine bone and palatine canals.
- Superior: Inferior orbital fissure of the eye.
- Medial: Perpendicular plate of the palatine bone.
- Lateral: Pterygomaxillary fissure.

The Pterygopalatine Ganglion and Facial Nerve

(Meckel's ganglion, nasal ganglion or sphenopalatine ganglion) is a parasympathetic ganglion found in the pterygopalatine fossa. It is largely innervated by the greater petrosal nerve (a branch of the facial nerve); and its axons project to the lacrimal glands and nasal mucosa. The flow of blood to the nasal mucosa, in particular the venous plexus of the conchae, is regulated by the pterygopalatine ganglion and heats or cools the air in the nose. It is one of four parasympathetic ganglia of the head and neck, the others being the submandibular ganglion, and ciliary ganglion.

The pterygopalatine ganglion (of Meckel), the largest of the parasympathetic ganglia associated with the branches of the maxillary nerve, is deeply placed in the pterygopalatine fossa, close to the sphenopalatine foramen. It is triangular or heart-shaped, of a reddish-gray color, and is situated just below the maxillary nerve as it crosses the fossa. The pterygopalatine ganglion supplies the lacrimal gland, paranasal sinuses, glands of the mucosa of the nasal cavity and pharynx, the gingiva, and the mucous membrane and glands of the hard palate. It communicates anteriorly with the nasopalatine nerve.

Roots

It receives a sensory, a parasympathetic, and a sympathetic root.

Sensory Root

Its sensory root is derived from two sphenopalatine branches of the maxillary nerve; their fibers, for the most part, pass directly into the palatine nerves; a few, however, enter the ganglion, constituting its sensory root.

Parasympathetic Root

The preganglionic parasympathetic neurons arise from the superior salivatory nucleus in the pons and via the nervous intermedius of facial nerve (VII) traversing but not synapsing at the geniculate ganglion and comes out into the middle cranial cavity as Greater petrosal nerve which at the level of foramen lacerum enters into the pterygoid with Deep petrosal nerve together they are called vidian nerve or nerve of pterygoid canal, it synapse with neurons of pterygopalatine ganglion and postganglionic axons, vasodilator, and secretory fibers are distributed with the zygomatic branch of maxillary nerve to the mucous membrane of the nose, soft palate, tonsils, uvula, roof of the mouth, upper lip and gums, and upper part of the pharynx. It also sends postganglionic parasympathetic fibers to the lacrimal nerve (a branch of the Ophthalmic nerve, also part of the trigeminal nerve) via the zygomatic nerve, a branch of the maxillary nerve (from the trigeminal nerve), which then arrives at the lacrimal gland. The nasal glands are innervated with secretomotor from the greater petrosal. Likewise, the palatine glands are innervated by the nasopalatine, greater palatine nerve and lesser palatine nerves. The pharyngeal nerve innervates pharyngeal glands. These are all branches of maxillary nerve.¹⁰⁻¹⁶

Sympathetic Root

The ganglion also consists of sympathetic efferent (postganglionic) fibers from the superior cervical ganglion. These fibers, from the superior cervical ganglion, travel through the carotid plexus and then through the deep petrosal nerve. The deep petrosal nerve (carrying postganglionic sympathetic) joins with the greater petrosal nerve (carrying preganglionic parasympathetics) to form the nerve of the pterygoid canal known as vidian nerve with passes through the pterygoid canal, it passes through the ganglion without synapsing and reaches lacrimal gland and nasal mucosa through the zygomatic nerve

Branches of Pterygopalatine Ganglion

- Orbital branches.
- Nasopalatine nerve.
- Greater palatine nerve.
- Lesser palatine nerve.
- Medial and Lateral Posterior Superior and Posterior Inferior Nasal Branches
- Pharyngeal branch of maxillary nerve.

MAXILLARY NERVE

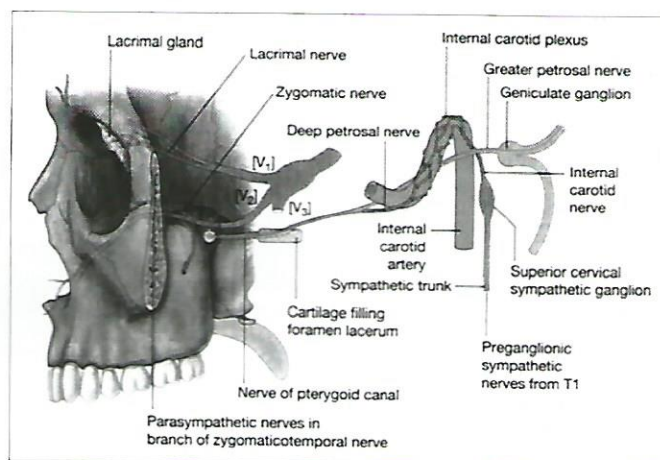
It enters the skull through the foramen rotundum and traverses superiorly in the pterygopalatine fossa giving 2 to 3 branches through which pterygopalatine ganglion hangs in the pterygopalatine

fossa and post ganglion sympathetic and parasympathetic fibers reaches the target organ through this nerve.

The seventh nerve parasympathetic innervations increases the secretomotor function of nasal-palatal mucosa. The sympathetic innervation is inhibitory to the same elements. The secretomotor production is more watery-mucoid with parasympathetic stimulation, and more viscous-mucoid with sympathetic stimulation.

CLINICAL FEATURE

Cluster headache is a severe pain, unilateral, localized in or around the eye, mostly in young males, clustering for a period of time recurring at specific time of night, often starting 1-2 hours after falling asleep or in the early morning, lasting for 6-12 weeks. Then the subject is free of symptoms for months or even years. However, trigger points and lancinating paroxysmal characteristic are absent, therefore it is different from trigeminal neuralgia. Cluster headache is associated with autonomic nervous system dysfunctional symptom. Hyperparasympathetic release can be associated with hyperlacrimation, mucosal congestion, and rhinorrhea. Conjunctival vascular injection can also occur as part of the dysautonomia. Rarely, miosis (Pupillary constriction) occurs, which is predominantly an oculomotor parasympathetic stimulating response. In short, Sluder's CHs are of complex origin involving both, the sympathetic and the parasympathetic systems. It is a dysautonomia with a seventh cranial nerve parasympathetic propensity.



Pathophysiology of Cluster Headache

It has long been unknown and is complex. The primary defect in cluster headache is thought to be located in regulatory centres in the hypothalamus.[3] Alterations in biological rhythms of secretions of hypothalamus hormones during active cluster headache periods and in remissions, and positron emission tomography studies showing an increased blood flow and structural changes in the hypothalamic grey area during cluster headache attacks, support this hypothesis. positron emission tomography studies during cluster headache attacks also show activation in the region of the major basal cranial arteries and cavernous sinus, specifically the intracranial segment of the internal carotid artery, which is likely to result from vasodilation.

Dilation of the intracranial segment of the internal carotid artery during cluster headache attacks is thought to be caused by a loss of

sympathetic function upon activation of the hypothalamus.[6] The disturbed sympathetic function also explains the ptosis and miosis during attacks. Clinical and animal data confirm that in cluster headache, a trigeminal para sympathetic reflex occurs. Such a reflex runs via the so-called trigeminovascular system.

The trigeminovascular system is a system of bipolar cells of the ophthalmic division of the trigeminal nerve, the ophthalmic nerve (V1).[10] The peripheral (afferent) processes of these bipolar cells synapse with large cranial vessels, such as the internal carotid artery. The centrally projecting processes synapse with the spinal part of the sensory trigeminal nerve nucleus, called the trigeminal nucleus caudalis, which is located in the caudal brainstem or high cervical cord. During cluster headache attacks, the trigeminal para sympathetic reflex is triggered and leads to the following sequence of events: afferent pain signals from the dilated cranial vessels run through V1, and synapse in the trigeminal nucleus caudalis. After synapsing, pain afferents project to the thalamus, resulting in pain in the V1 area via activation of the cerebral cortex. Pain sensation directly leads to reflex activation of the para sympathetic system through the trigeminal para sympathetic reflex. The signal is transmitted from the trigeminal nucleus caudalis to the superior salivatory nucleus, the para sympathetic nucleus of the facial nerve. Activation of the superior salivatory nucleus provides signals to the facial nerve and its branches, predominantly the greater superficial petrosal nerve. The greater superficial petrosal synapses in the pterygo palatine ganglion. [3] From the pterygo palatine ganglion, efferent signals are sent out to para sympathetic end organs resulting in ipsilateral cranial autonomic features: lacrimation, conjunctival injection, nasal congestion, as well as dilation of cerebral arteries.

The major features of cluster headache: V1 distribution of pain and cranial autonomic features, can be explained via activation of the trigeminovascular system. [11] The role of the pterygo palatine ganglion in cluster headache is best described as being part of the efferent component of the trigeminal para sympathetic reflex generated by the trigeminovascular system.

Medical Treatment

The Options for medical treatment during acute attack of Cluster headache are: Sumatriptan, ergotamine tartrate, analgesics, and oxygen inhalation of 100%. The prophylactic therapy options are valproic acid, calcium channel blockers, lithium, corticosteroids, and ergotamine, as few examples.[14]

SURGICAL TREATMENT

Sluder in 1908 initiated the procedures for Cluster headache with cocaine moisture applicator cotton just posterior to the posterior tip of middle turbinate over the pterygopalatine ganglion. He also applied silver 2%, or formaldehyde 0.5% with variable results. Later on in 1913, he reported injecting phenol-alcohol to the region of sphenopalatine (SPP) foramen.[13] Multiple neurosurgical strategies were tried for this group of chronic refractory Cluster headache: Gasserian Ganglion alcohol injection, thermocoagulation of the gasserian ganglion and pterygopalatine ganglion, glycerol rhizotomy, microvascular decompression of trigeminal nerve, trigeminal nerve root sectioning, and stereotactic radiosurgery of PG. Recently, deep brain stimulation (DBS) of posterior hypothalamus has been considered due to circadian nature of this disorder.

MODERN SURGICAL MANAGEMENT OF CLUSTER HEADACHE

The exquisite visualization of the PPG with modern imaging and understanding of the anatomy of this region allows for completely noninvasive approach to the treatment of CH.

De salles et al., kano et al., and few other investigators have pioneered new approaches for treatment of CH using stereotactic radiosurgery.

Kano et al. and De Salles et al. reported that radiosurgery provided 60% lasting pain reduction in patients with medical refractory CH [4,16] In addition, the noninvasive technique is an advantage for the comfort of the patient. The use of Gamma Knife in treatment of CH is an ongoing process pending the final result of the North American Gamma Knife Consortium.[10]

The 60% lasting reduction in CH is promising. In addition, with further refinement of the treatment parameters, and also the experience of the neurosurgeons involved in using the focused radiation of the PPG, with thin sections of PPG generated by CT/MRI scans, it is possible that stereotactic radiosurgery will become an important option for the neurosurgical treatment of the CH.

There are other causes of increased lacrimation that are not CH in origin. Apart from CH, PPG and its neuronal circuitry network lesions and inflammations of the surrounding anatomy play a major role in certain diseases of the eye. Hyperlacrimation, hypolacrimation, and inappropriate tearing could be due to lesions along the parasympathetic pathway from the pons up to lacrimal gland [6]. One example is the phenomenon of crocodile tears (Bogorad Syndrome) in which profuse and inappropriate tearing manifests when taste buds stimulation occurs and activates posttraumatizing and aberrant regenerated and misdirected facial parasympathetic fibers, erroneously re-routed to the lacrimal gland.[6]

CONCLUSION

The pterygopalatine ganglion and region are a cross road of sensory, sympathetic, and parasympathetic fibers that when dysfunctional can cause severe and variable symptoms involving the face. The most severe of these symptoms is severe and seasonal pain that impairs immensely the quality of life of patients suffering from these dysautonomias.

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Orthodontically Induced Root Resorption and its Management

Abstract

External root resorption is a feared complication during orthodontic procedures. It can affect not only the apex, but also the cervical zone of the roots subjected to orthodontic forces for tooth movement and can compromise the future of the involved teeth. The patient must be informed about the risks of resorption as a consequence of orthodontic treatment. The detection of resorptions can occur during and/or after the active phase of orthodontic treatment. Apical resorptions, generally not infected, can mostly be stopped by discontinuing orthodontic forces. Cervical resorptions, with a bacterial component, will require surgical intervention with curettage and restorative build-up of the resorbed area.

Key words: root resorption, orthodontic force, OIIRR, CBCT

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INTRODUCTION

Resorption is a clinical condition associated with a physiological or pathological process leading to a loss of dentin, cementum and/or bone structure. All orthodontic treatment is accompanied by self-limiting and reversible micro-resorptions of root and cementum.

According to Andreasen et al.¹, these surface resorptions are followed by spontaneous repair with the formation of new cementum. This is neither a physiological process nor a pathological process but instead a controlled orthodontic therapeutic process, as long as the dentin is not affected. The action of the odontoclasts reaches beyond the cementum to the underlying dentin. This is a pathological process because once the dentin is affected, it continues in an irreversible manner. These resorptions can affect the tooth at the apex as well as the neck. A new diagnostic tool, the cone beam, already extensively used by endodontists, compensates for the diagnostic inaccuracy of panorex and periapical radiography.

Development of External Pathologic Inflammatory Root Resorptions

Histologically, the dentin exposure to osteoclast precursor cells, originating in the periapical ligament and differentiating into odontoclasts, marks the starting point of the pathological process^{2,3}. In fact, only the cementum has the potential for repair, and as soon as the dentin is attacked and is in root resorbed, the loss of root structure becomes irreversible⁴. Brezniak and Wasserstein⁵, in 2002, suggested the use of terminology specific to orthodontics and spoke of orthodontically induced inflammatory root resorptions (OIIRR), emphasizing the importance of this phenomenon.

It is important for the orthodontist to be aware of the possibility and nature of other possible causes of resorption. Therefore, they should also be listed as risk factors or additional etiological factors to orthodontically induced external root resorption.

Predictive Factors for the Appearance of Root Resorptions in Orthodontics?

• Genetic factors predisposing to resorption

According to Sameshima and Sinclair⁶, Hispanic patients are more susceptible to resorption than Asian patients. Furthermore, Hartsfield² explains that the activation of the osteoclasts resorption cells) may be genetically linked. Iglesias-Linares et al.⁷ demonstrate that genetic variations involving the interleukine-1 β gene (implicated in the inflammatory process associated with orthodontic movements), may explain the appearance of certain external apical resorptions.

• Risk factors related to general health of the patient

Brezniak and Wasserstein⁵ report that patients with chronic asthma, whether treated or not, have a greater susceptibility to apical OIIRR on the upper molars. Certain teeth whether traumatized or not, must be treated endodontically, and in the orthodontic literature, there are many debates about whether these filled teeth are more susceptible or less susceptible to resorption.

Mah et al.⁸ show that orthodontically induced apical resorptions are slightly greater for endodontically treated teeth even if the difference is not statistically significant, whereas Bender et al.⁹ arrive at the opposite conclusion. Similar to traumas, in the case of orthodontic treatment, the risk for resorption of a tooth that has undergone an internal bleaching will be greater. The present use of sodium perborate mixed with water is a much safer procedure and less likely to induce resorption. Surgical procedures can, for example, because of trauma inflicted on neighboring teeth during manoeuvres for extraction (luxating and elevating with force), may be the cause for collateral trauma to cementum.

• The risk factors associated with orthodontic treatment and the treated teeth

In his thesis, Makedonas¹⁰ refers to a number of studies and concludes that maxillary incisors, and more particularly

lateral incisors are more frequently affected by orthodontically induced apical resorption. Apices that are either blunt or dropper-shaped present a greater degree of resorption compared to normally shaped apices. Next, he mentions the vulnerability of the lower incisors and the upper premolars.

The root anatomy must also be considered as a factor. Lavander and Malmgren¹¹ studied the relationship of the shape of the root to the incidence of apical resorption. Apices having thin "pipette-like" or blunt shapes had a greater degree of resorption than normally shaped apices.

There is a debate as to whether or not orthodontic forces alone cause root resorption. Should the applied forces be below a threshold so as to avoid resorption? Lopatiene and Dumbravaite⁴ attempt to answer this question and agree on forces of 7 to 26 g/cm². Maltha et al.¹² confirm that the magnitude of the force exerted is a decisive factor and that its intermittent application causes less damage than when it is continuous. Esteves et al.¹³ are in agreement and think that the use of intense force increases the likelihood of orthodontically induced resorption.

Induction of Inflammatory Resorption, its Time of Appearance and Form

Apical resorption can appear during the active phase of orthodontic treatment and this is why the term resorption in orthodontics is often closely associated with the apex. Orthodontists diagnose them while performing routine radiographical examinations occurring periodically during the active phase of treatment. The 6-9 month period after beginning treatment seems to be important for screening and detecting apical resorption.^{4,11}

As for cervical resorptions, they are generally diagnosed much later. Heithersay³ diagnosed them in patients whose orthodontic treatment had taken place 18 to 33 months earlier. External cervical resorption differs also because of direct exposure to the oral environment and therefore to bacterial infestation. Due to this exposure, Heithersay¹⁴ is insistent about the invasive nature of these resorptions and describes their aggressive behavior.

A system of classification for the various types of resorption makes it possible to make a precise diagnosis regarding their degree of severity. For apical resorptions, the Lavander and Malmgren system¹¹ distinguishes four levels of apical lesion (Fig. 1):

- Level 1: the resorption is minimal and simply leaves an irregular apical root contour.
- Level 2: the resorption lesion is no greater than 2 mm on the hard tissues. The authors call it minor resorption.
- Level 3: the resorption destroys up to the first third of the root. Therefore, the resorption is qualified as severe.
- Level 4: the resorption extends beyond the first third of the root length and is now considered extreme.

For external cervical resorption, the Heithersay system of classification distinguishes four levels of cervical lesion (Fig. 2):

- Level 1: the resorption is a small invasive cervical lesion that presents a shallow dentinal erosion.
- Level 2: the resorption lesion is very limited and penetrates the dentin close to the pulp chamber but does not extend as far as or only slightly onto the root dentin.
- Level 3: the resorption lesion presents a deep penetration into the dentin up to the first third of the root.

- Level 4: the resorption lesion is widely invasive and spreads apically beyond the first third of the coronal root.

Root resorptions also can be divided into three broad groups: (1) trauma induced tooth resorption; (2) infection induced tooth resorption; and (3) hyperplastic invasive tooth resorptions. There are some rare tooth resorptions of unknown cause that do not fit into any of the above categories and they are usually labelled "idiopathic".

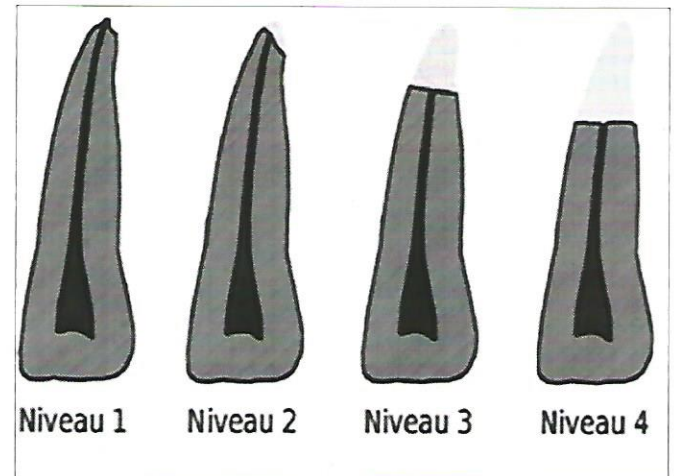


Figure 1: The different levels of apical lesions (according to Lavander and Malmgren¹⁷)

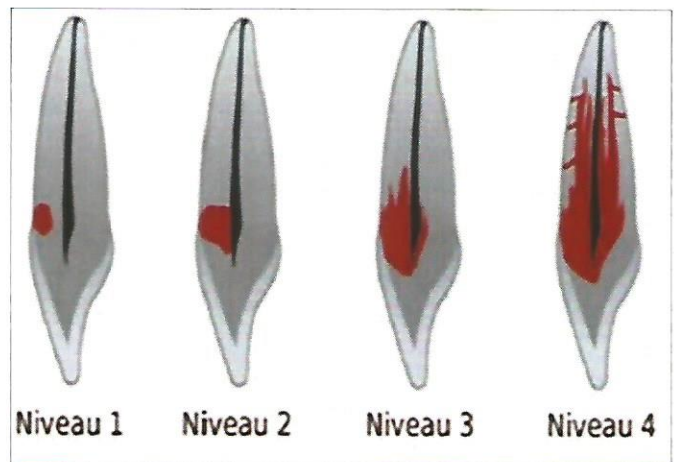


Figure 2: The different levels of cervical lesions (according to Heithersay¹³)

HOW TO DETECT OIIRR: INPUT FROM THE CONE BEAM

The clinical picture of an external cervical resorption can be limited to a simple sensation of discomfort with a pinkish cervical discoloration upon examination, whereas the clinical picture for apical resorption can be totally asymptomatic.

Because early detection is so essential, it calls for regular complementary radiographic examinations. The orthopantogram is currently used to conduct examinations during the course of treatment, but, even with periapical films, the diagnostic accuracy¹⁵ of this radiographic examination is often limited. Since the end of the '90s, a new tool has been available, known in the Anglophone world as CBCT¹⁶ or "cone beam computed tomography" scanner.

MANAGEMENT OF TOOTH RESORPTION

Therapeutic Solutions

Therapeutic solutions are closely related to both

- The location of the resorption (apical or cervical),
- and to their stage of development (especially for cervical resorption).

Pressure resorption and orthodontic resorption

More extensive trauma induced non-infective root resorption may be induced by the pressure of a crypt of an unerupted/erupting tooth or some neoplasms and more commonly during orthodontic treatment. The resorption is often extensive and easily observable radiographically. With the removal of the initiating "trauma", these non-infective resorptions will become inactive and uncomplicated repair will occur.

When the first radiographic signs appear, it is advisable to temporarily interrupt orthodontic treatment for a period of 3 months. In a survey of recent literature, Walker says that stopping treatment for 2 to 3 months makes it possible to completely reduce the progression of root resorption. Tirpuwabhut et al.¹⁹ adopt the solution of stopping treatment and confirm that in instances of orthodontically induced resorption, the practitioner should, in this case, follow the protocol essentially based on eliminating the causal factor, i.e. orthodontic displacements. The Norwegian authors continue to state that in the absence of infection (in other words pulpal necrosis), endodontic treatment is absolutely useless and would even be contra-indicated since the elimination of the pulp of a tooth during the resorptive process does not restrict the development of resorption. Other authors recommend the use of ultrasound or anti-inflammatory medication¹⁶⁻²⁰.

External cervical resorption is often detected after orthodontic treatment is completed. According to Heithersay³, the detection can occur from 1½ years to 33 years after orthodontic treatment. Therefore, most frequently either a dentist or an endodontist will make the diagnosis and choose the therapeutic treatment for resorption.

As soon as the first signs are detected either clinically or radiologically, the practitioner should take an interventionist therapeutic approach.

Although the diagnosis is often made radiologically, clinically a pink spot can appear in the cervical area. This pinkish discoloration signals the presence of very vascularized granular tissue under both the enamel and the dentin that are eroded by resorption²¹. The intervention will therefore consist of (sometimes after lifting the periodontal flap) a total elimination of the granulomatous tissue, followed by a reconstruction of the residual cavity of the resorption with either glass ionomer or composite cement (Mineral Trioxide Aggregate or Biodentine™). This therapeutic approach has four main objectives: to stop the process of resorption, to restore the lost structure, to prevent a recurrence and finally to preserve esthetics.²²

The decision for intervention depends on the extent of the lesion's development and its placement on the Heithersay scale²¹. For levels 1 and 2 of resorption, Heithersay indicates that intervention is often the right prognosis since the pulp is still protected both by outer and inner dentinal walls. For level 3, the clinical condition is more complicated but intervention is still indicated²³. However, when the cervical lesion is level 4, as long as it remains asymptomatic,

Heithersay advises that the practitioner withhold treatment. In fact, intervention at this stage runs the risk of fracturing and therapeutic failure that would require removal of the tooth. When level 4 is accompanied by all signs and symptoms, the tooth must be removed.²¹⁻²²

CONCLUSION

The risk of orthodontically induced root resorption is a proven fact, but in most cases, it can be controlled. Therefore, it is important to screen for resorption in every case but even more so for high risk cases during both the active phase of treatment as well as after the end of treatment. This monitoring must include both the apical and the cervical zones of the teeth subject to orthodontic forces. If there is suspicion of resorption, the cone beam is a very precise diagnostic reference point. For the orthodontist, it is essential to temporarily or even indefinitely stop treatment in cases of apical resorption in order to halt the process of resorption. In cases of cervical resorption, the orthodontist should intervene as soon as resorption is detected given its invasive and evolving nature when directly exposed to the oral environment.

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Pulp Stone: A Review on Their Prevalence and Correlation with Cardiovascular Disease

Abstract

The number of pulp stones in a single tooth may vary from 1 to 12 or even more with sizes varying from minute particle to large masses obliterating almost the entire pulpal chamber. Dentine dysplasia, Dentinogenesis imperfecta, Van der Woude syndrome are some of the systemic/genetic diseases and syndrome where in pulp stones can be observed. Aging, caries, operative procedures, periodontal disease and various other etiological factors may predispose formation of pulp stones. In summary, CNPs are strongly associated with diseases characterized by dystrophic calcification. They are of major concern in the area of endodontic treatment due to the clinical difficulty they present during root canal treatment. The radiographic method of detecting pulp stones used as a screening method, may help in the early identification of potential cardiovascular disease and thus may interest the general dentist also.

Key words: Pulp stone, systemic disorders, periodontitis, cardiovascular

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INTRODUCTION

Pulp stones are discrete calcified masses found in the dental pulp of healthy, diseased and even in unerupted teeth often visible on the radiographs. They are also a type of extraskeletal calcification disease as stated by Jinfeng Zenget al. Johnson and Bevelander stated that stones may exist freely within pulp tissue or it may be attached to, or embedded in dentin. The number of pulp stones in a single tooth may vary from 1 to 12 or even more with sizes varying from minute particle to large masses obliterating almost the entire pulpal chamber.^[1-10]

Pulp stone incidence is not significantly different among gender groups. As per Nayak et al occurrence of pulp stones was higher in maxillary molars (12.36%) as compared to (5.95%) mandibular arch.^{[4][11]} On the contrary Baghdady et al found more pulp stones mandibular teeth than maxillary teeth and Gulsahi et al found that frequencies of pulp stones were similar in both maxillary and mandibular jaw. The frequency of pulp stones was higher in molars than premolars. First and second molars were the teeth most commonly affected. No significant difference was found between sides.^[11-20]

Dentine dysplasia, dentinogenesis imperfecta, Van der Woude syndrome are some of the systemic/genetic diseases and syndrome where in pulp stones can be observed.

Many prevalence studies have identified pulp stones using radiographic criteria [20-25%], on the contrary histological examinations reveal higher percentages.

Etiology and Formation Pulp Stones

Aging, caries, operative procedures, periodontal disease and various other etiological factors may predispose formation of pulp stones.^[4]

As per Sayegh et al calcification in the pulp increased with age and these changes in the aging pulp could further promote the formation of stones. On the contrary, Sundel et al proposed, hyalinization of damaged cells and disorders of circulation a predisposition for formation of pulp stones.^[7]

As per few studies it was shown that a high frequency of cell islands, considered to be of epithelial origin, were observed together with pulp stone formation in teeth that had been subjected to experimental intrusion^[8,9,10] Moss-Salentijn & Klyvert (1983) also worked on epithelia-induced pulp stone formation in recently erupted, noncarious premolars.^[11]

Recent studies by Jinfeng Zenget al has suggested that CNPs might play an important role in the calcification of dental pulp.^[21-36]

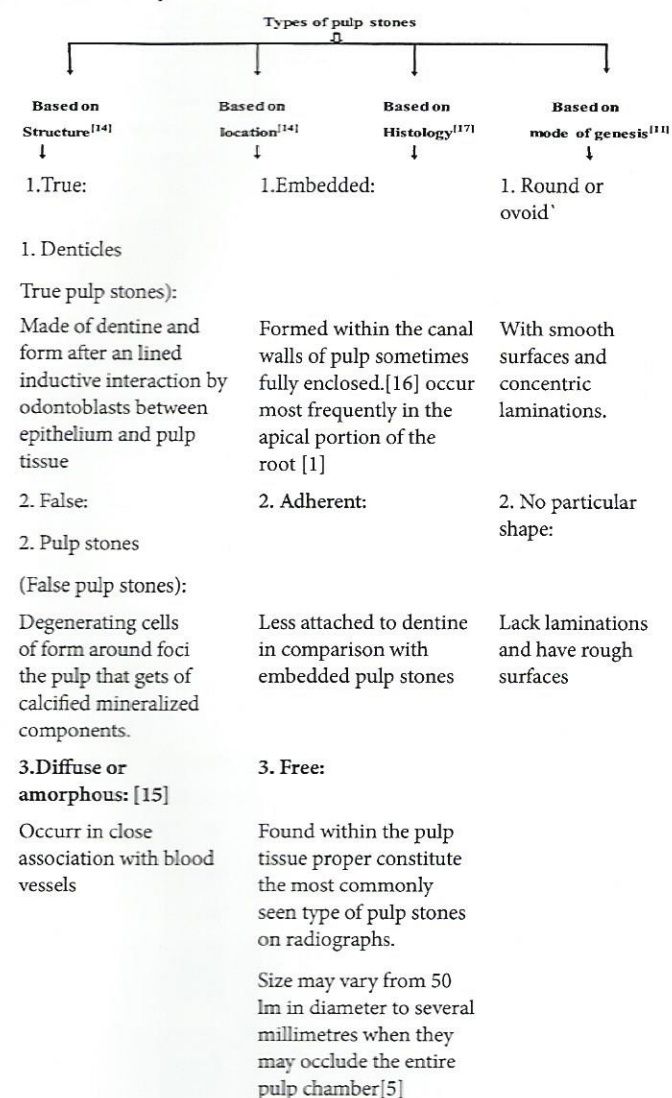
Composition of Human Pulp Stones

Calcium [32.1%] and phosphorus [14.7%] constitute the two major elements of stones. This average concentration results in a calcium/phosphorus weight ratio of 2.19 which is very near to the 2.15 of pure hydroxyapatite. Fluorine (0.88%), sodium (0.75%) and magnesium (0.51%) are the other elements found with potassium, iron, chlorine, zinc and manganese in trace concentrations.^[12]

As per a immunohistochemical study, Type I collagen formed one of the major organic matrix component of free pulp stone. Osteonectin and osteocalcin were not detected. Osteopontin detected in the peripheral area of the pulp stones suggested that it plays an integral part in the calcification front, and that it has come from less differentiated pulp cells.^[13]

Classification of Pulp Stones

Some radiographic surveys on pulp stone prevalence Chandler et al (Table 1)

Classification of Pulp Stones:**Pulpstones and Age Changes**

The incidence of pulp stones increase with age due to the deposition of secondary and tertiary dentin within the pulpal space.

Some studies about relation of pulp stone and age changes (Table 2)

Pulpstones and Caries

Some studies about correlation of pulp stones and caries (Table 3)

Pulpstones and Operative Procedures

The relationship between coronal pulp stone formation and experimental operative procedures was studied by Sudell et al. Their study was based on the microscopic examination of 470 serially sectioned teeth. In all teeth, Class V cavities were prepared under local anaesthesia using a variety of low- and high-speedcutting techniques, coolants and restorative materials.

Teeth were divided into eight groups depending on the post-operative extraction time (0 to over 50 days). Their results revealed that pulp stone formation was most common perivascularly. However, in some specimens calcific nodules were found in the lumina of vessels. This might indicate that pericytes or even multi-potent stem cells derived

from blood could be the source of hard-tissue forming cells in the dental pulp. Of various factors that underwent correlation analyses, the most promising relationship was between calcific nidi and the post-operative interval (correlation coefficient 0.2), rather than the traumatic potential of the restorative procedure. Although this is a very weak association and does not prove causation, if capillary thromboses or vascular wall damage as a result of operative procedures were to mineralize, then pulp stone formation could occur. A longer follow-up period with fewer initial variables might result in clearer associations revealed that pulp stone formation was most common perivascularly.

Pulpstones and Periodontitis

A statistically significant relationship occur between PS and periodontitis. The reason for the same is unclear. However, the relationship may be connected with the increased irritation which pulp tissues teeth with chronic periodontitis are prone to.^[33]

Correlation of Pulp Stones and Systemic Disorders

Pulp stones have been noted in patients with systemic or genetic disease such as dentinogenesis imperfecta, Vander Woude syndrome etc. [3] Stafne et al found no definite relationship between pulp stones and cholelithiasis, renal lithiasis, gout, hypercementosis, migraine or torus linguae/palatines. They found a stronger (albeit only suggestive) correlation with the presence of arteriosclerosis, osteitis deformans and acromegaly. [34]

Generalised pulp stones are also seen in conditions like tumoral calcinosis (Burkes et al. 1991), dentine dysplasia type II (Diamond 1989, Dean et al. 1997), Saethre-Chotzen syndrome (Goho 1998), elfin facies syndrome (Kelly & Barr 1975), familial expansile osteolysis (Mitchell et al. 1990), Ehlers Danlos syndrome type I (Hollister 1978, Pope et al. 1992), osteogenesis imperfecta type I (Lukinmaa et al. 1987, Levin et al. 1988) and otodental syndrome (Sedano et al. 2001). [22]

Correlation of Pulp Stones and Cardiovascular Disease

Edds et al studied the correlations of pulp stones with cardiovascular disease using periapical radiographs (no of teeth not mentioned) of 55 patients between the ages of 20-55. They completed a questionnaire regarding their CVD status and that of their parents and siblings. Inclusion criteria included at least one asymptomatic, minimally restored, noncarious molar and no history of gout, renal disease, or renal lithiasis. Patients' periapical radiographs showed that there was a significant relationship between pre-existing CVD and pulp stones (odds ratio of 4.4 with a 95% confidence interval of 1.1, 18.7), but no relationship was found for family history of CVD and pulp stones (odds ratio of 1.7 with a 95% confidence interval of 0.5, 5.5). Seventy-four percent (14/19) of patients with reported CVD had detectable pulp stones while only 39% (14/36) of patients without a history of CVD had pulp stones.

As per the pilot study conducted, the patients with CVD have an increased incidence of pulp stones in teeth with noninflamed pulps compared to patients with no history of CVD. There was no relationship found between presence of pulp stones and family history of CVD. This study suggested that routine dental radiographs may be used as a rapid screening method for early identification of potential cardiovascular disease (CVD). [24]

High incidence of calcification was reported by Maura and Paiva in the dental pulp of patients with coronary atherosclerosis upon radiographic examination.

Table 1:

Investigator	Methodology	Sample (n)	Age of subjects (yr)	Prevalence %
Kumar et al. (1990) ¹⁸	Radiographs	120 primary teeth	Not stated	6%central incisor
	(extracted teeth			25 second molar
Tamseet al. (1982) ¹⁹	Full mouth periapical surveys (including bitewings)	150 males, 150 females	20-40	20.7
Baghdadyet al. (1988) ²⁰	Radiography, 6228	2880 from males, 3348 from females	13-14	19.2
Hamasha&Darwazeh (1998) ²¹	Radiography	814 patient records, 73 teeth	18-60	22.4
Ranjitkaret al. (2002) ³	Bitewings	217 subjects, 3296 teeth	17-35	10.1
Chandler et al. (2003) ²²	Bitewings	121 subjects, 445 first molars	18-25	4
Gulsahi et al. ²³	radiographs	519 patients	Patients selected randomly	627 (5)
		313 (60%) were female and 206 (40%) 13,474 teeth		

Table 2:

Investigator	Methodology	Sample (n)	Age of subjects (yr)	Prevalence %
Bernick&Nedelman 1975 ²⁶			15 to 75 years	Increased with age
Bernick1967a ²⁷	Histologic sections	Upper and lower, noncarious, erupted teeth (150)	40-70 yrs	90
Seltzer 1972 ²⁸				
Hill 1934 ²⁹	Histologic sections	132 teeth	10- to30-year	66
			30- to 50-year	80
			50- to 70-year	90
Hillmann & Geurtsen (1997) ³⁰	Histologic sections	332 teeth	10-30	14.9
			31-51	44.4
			52-72	65.1
Gulsahi et al. ²⁵	radiographs	519 patients	Patients selected randomly	627 (5)
		313 (60%) were female and 206 (40%) 13,474 teeth		prevalence of pulp stones increased with age
Nitzan et al. (1986) ³¹	Histologic sections	52 impacted, uninjured canines	11 to 76 years	56 Equal distribution among the age groups
		19 teeth	11- to 24-year	
		17teeth	25- to 39-year	
		14teeth	40- to 76-year	
Arys et al. (1993) ³²	Microradiography and light microscopy	42 primary molars, with less than one-third of their roots resorbed : 42 children of both sexes	5 to 13 years	age does not have any influence on the occurrence of pulpal calcifications
Hamasha&Darwazeh (1998) ²¹	Radiography	814 patient records, 73 teeth	18-60	22.4 Pulp stone incidence was not significantly different among different age
Udoeye CI and Sede MA ³³		142	18-30	PS occurred more often in the 41-50 years age group (57.6%), whereas it was rare in the 18-30 year age band
		88	31-40	
		59	41-50	
		11	51-60	

Table 3:

Investigator	Methodology	Sample (n)	Age of subjects (yr)	Prevalence % [caries teeth:non carious teeth]
Sayegh & Reed (1968) ⁵	Histologic	591 teeth	10–34 year-old	36:8
Tamse et al. (1982) ¹⁹	Full-mouth radiographic surveys	1380 mandibular premolars and molars	20 to 40 years	No significant difference found
Baghdady et al. (1988) ²⁰	Radiographic	6228 teeth	13–14-year-old	Slightly higher percent-ages of stones were found in carious teeth compared with intact teeth
Gulsahi et al. ²⁵	Radiographs	519 patients 313 (60%) were female and 206 (40%) 13,474 teeth	Patients selected randomly	No association between pulp stones and caries
Arys et al. (1993) ³²	Microradiography and light microscopy	42 primary molars, 23 untreated carious teeth, 14 treated with amalgam restoration and 5 caries-free teeth	5 to 13 years	Lower incidence of pulp stones in treated and carious molars

Bernick found calcification and lumen narrowing within extirpated dental pulp vessels, in both medium and small precapillary arteriole of cardiovascular patients.

Another radiographic study of correlation between systemic disorders and pulp stones carried out by Moksha et al among the Indian population reported a positive correlation between systemic disorder and pulp stones where in the cardiovascular patients had maximum number of pulp stones followed by dental-wear defects and least number of pulp stones were evident in control group. A total of 150 patients between the age of 20 and 55 years were examined. The eligibility criteria for the participation was that the patient had to have fully erupted, minimally restored, non-carious teeth, free from radiographically observable periodontal disease and pulpal sclerosis.

The total no of patients were divided into 5 groups and 4296 teeth were examined. Group I: Patients with history of cardiovascular disorders, Group II: Patients with a history of diabetes mellitus, Group III: Patients autoimmune disorders, Group IV: Patients with dental-wear defects and Group V: Control group. Among the 4296 teeth analyzed, 402 (9.35%) pulp stones were detected. Groups II and III patients had lesser number of pulp stones (7.69 and 7.63%, respectively), compared to Group I patients (15.86%), Group I had maximum pulp stones (15.86%) followed by Group IV (10.94%). The least number of pulp stones were evident in control group (4.76%).^[4]

Pulp stones and CNPs:

Calcifying nanoparticles (CNPs) formerly referred to as nanobacteria, have been identified in tooth pulp stone, saliva, and dental plaque and may enter the blood stream during normal daily trauma to mucosal surfaces attaching themselves to the aortic valve leaflets.^[36] The CNPs have the capacity themselves to precipitate calcium in the shape of apatite crystals at physiological calcium and phosphate concentrations.^{10,11}

Recent studies has revealed an association between dental pulp stones and calcifying nanoparticles. In this study, sixty-five

freshly collected dental pulp stones, each from a different patient, were analyzed. Thirteen of the pulp stones were examined for the existence of CNPs in situ by immunohistochemical staining (IHS), indirect immunofluorescence staining (IIFS), and transmission electron microscope (TEM). The remaining 52 pulp stones were used for isolation and cultivation of CNPs; the cultured CNPs were identified and confirmed via their shape and growth characteristics. Among the dental pulp stones examined in situ, 84.6% of the tissue samples stained positive for CNPs antigen by IHS; the corresponding rate by IIFS was 92.3 %. In 88.2% of the cultured samples, CNPs were isolated and cultivated successfully. The CNPs were visible under TEM as 200–400 nm diameter spherical particles surrounded by a compact crust. CNPs could be detected and isolated from a high percentage of dental pulp stones, suggesting that CNPs might play an important role in the calcification of dental pulp.^[35]

Miguel A et al studied the possible relationship between valve colonization by CNPs and calcific aortic valve stenosis. Calcific aortic valves were obtained from 75 patients undergoing surgical valve replacement. The control group was formed by eight aortic valves corresponding to patients with heart transplants. In the microbiology laboratory, valves were screened for CNP using a 4–6 weeks specific culture method. The culture for CNP was positive in 48 of the 75 valves with aortic stenosis (64.0%) in comparison with zero of eight (0%) for the control group ($P = 0.0005$). The observation of cultures by way of scanning electron microscopy highlighted the resemblance in size and morphology of CNP.

The present study showed the presence of CNPs in a greater proportion in calcified valves with aortic stenosis in comparison with noncalcified valves that were used as controls.

Low-grade chronic or recurrent bacterial endocarditis with specific calcifiable bacteria is a cause of calcification of the aortic valves previously investigated in an animal model.³³ The results of this study suggested that recurrent low-grade endocarditis from calcifying oral bacteria, particularly when occurring with synergistic strains, may be one cause of calcific aortic stenosis.

The data from this study implicate a possible link between the presence of CNPs and the development of calcification, which is the hallmark of 'degenerative' aortic stenosis. However, whether CNPs contribute to the pathogenesis of the disease or are only innocent bystanders need to be clarified in further studies.^[36]

In summary, CNPs are strongly associated with diseases characterized by dystrophic calcification. [Pulp stones are amongst changes that include more diffuse pulp calcifications such as dystrophic calcification Chandler et al] These associations have been observed with electronic microscopy in carotids, aortic aneurysm, and calcified cardiac valves and have been isolated from calcified cardiac arteries and valves as well as from atheromatous plaques.^[36]

CONCLUSIONS

Pulp stones which are physiologic manifestations whose etiology goes ill defined may also be described as symptoms of changes occurring in pulp tissue in relation to any long standing irritation. They are of major concern in the area of endodontic treatment due to the clinical difficulty they present during root canal treatment. Among the histological and radiographic methods used to detect pulp stones, radiographic method being non invasive, time saving can also be employed on large scale basis though its limitations being pulpstone less than 200µm in diameter, beyond radiographic resolution power may be missed sometimes. Their relationship with cardiovascular disease may be confirmed by longitudinal studies with adaptation of standardised study design, sampling protocols and radiographic techniques.

The radiographic method of detecting pulp stones used as a screening method, may help in the early identification of potential cardiovascular disease and thus may interest the general dentist also.

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Management of Complicated Crown-Root Fracture of Maxillary Molar By Fragment Re-Attachment: A Case Report

Abstract

Acute masticatory trauma is an uncommon event in posterior teeth. This article presents the management of complicated crown-root fracture of a maxillary molar by fragment re-attachment. Acute masticatory trauma led to the fracture of the mesio-palatal cusp with pulpal involvement and extension onto the root. Of the treatment options available for crown-root fractures, the technique used in this particular case was removal of coronal fragment followed by osteotomy to enable fragment re-attachment, and subsequent restoration with a full coverage restoration. Tooth re-attachment is referred to as autogenous tooth fragment re-attachment, biological restoration, and endodontic bio-adhesive treatment. The relative merits and demerits of conventional treatment modalities are compared with those of re-attachment techniques. Radiographic and clinical follow-up at 3 months showed satisfactory restoration with reduction in periodontal probing depth.

Key words: Complicated crown-root fracture, Fragment reattachment, Injury of molar

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INTRODUCTION

Unlike crown fracture involving the anterior teeth, posterior crown fracture due to acute trauma is an uncommon type of dental injury. Generally, chronic masticatory trauma is observed in posterior teeth, due to tooth structure loss by caries and extensive restorations.¹

It has been generally considered as a long-term provisional, based on laboratory studies that show 20-60% less fracture resistance in reattached as opposed to intact teeth.¹ On the contrary, Andreassen et al. consider it an alternative/final solution with acceptable clinical retention rates.²

There are a multitude of studies published regarding anterior tooth re-attachment, but literature fails to demonstrate its use in posterior teeth.^{1,3,4}

CASE REPORT

A 50-year-old female patient reported to outpatient department of Conservative dentistry and Endodontics with chief complaint of pain on biting in upper right back tooth. She gave history of biting on hard object 8 days ago. Pain was continuous and subsided on taking pain-killers. Medical history was non-contributory.

Oral examination revealed fracture of mesiopalatal cusp of tooth 26 (Figure-1a). The intact coronal portion was non-tender on percussion, and mobility was within normal range. On probing, periodontal pocket depth recorded was ~4mm (palatal), and 2mm (mesial). Adjacent tooth 25 revealed intact tooth structure, non-tender on percussion, with grade-I mobility. There were no periodontal pockets for teeth 25,27.

Pulp sensibility tests (cold, EPT) revealed no response for 25; and painful, lingering response for 26. Radiograph revealed intact tooth structure of 26, with no apparent fracture line detected. There was widening of periodontal ligament (PDL) of 25 with loss of lamina dura (Figure-1b).

Provisional diagnosis was symptomatic irreversible pulpitis secondary to complicated crown-root fracture (26); and pulp necrosis with asymptomatic apical periodontitis (25).

The patient was informed of treatment options, and need for exploratory surgery. Surgery was required to assess fracture line extension and viability of fragment re-attachment as treatment option. Aim of treatment was to preserve alveolar bone and respect biological width.

Under local anaesthesia, fragment was removed, revealing palatal pulp horn exposure of 26 (Figure-1C). Fragment was placed in

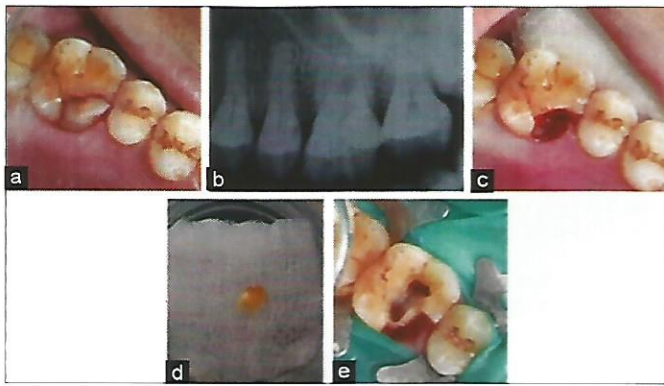


Figure 1: (a, b) Pre-operative; (c, d) Fragment removed & stored in saline; (e) Access opened

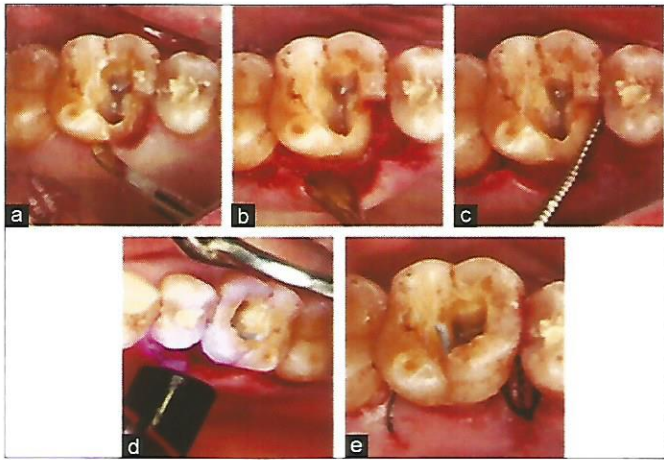


Figure 2: (a, b) Incision & flap elevation; (c) Osseous Recontouring; (d) Fragment bonded; (e) Suturing

saline (Figure-1D). Under rubber dam isolation, access opening was done (Figure-1E). No fracture lines were detected on pulp chamber floor. Working length was determined, and cleaning & shaping was done with Mtwo® rotary upto 30/.05 (buccal canals-26) and 40/.04 (25; palatal canal-26). After placement of calcium hydroxide medicament, closed dressing was given.

Periodontal procedures were carried out, starting with intracrevicular incision with #12-D blade from mid-palatal aspect of 25 to 27, placed upto crestal bone (Figure-2a). Full thickness mucoperiosteal flap was raised (Figure-2b), revealing a fracture line extending 2mm below CEJ, and at the level of alveolar bone. This oblique fracture did not involve pulp chamber floor. Osseous recontouring was done with bone file so as to expose 1mm of tooth margins (Figure-2c). Curettage was done.

Master gutta-percha cone was inserted into palatal canal to prevent entry of bonding agent into palatal canal orifice during re-attachment procedure. Fractured fragment try-in was done. Moist gauze was placed to control bleeding. For the intact tooth and fractured fragment, 37% phosphoric acid etching was done (N-etch gel), followed by adhesive bonding (Adper Single Bond). Flowable composite (Filtek Z350 XT) was used and light-cured from all sides (Figure-2d). Excess composite was removed with #12-D blade.

Simple interrupted suture was placed for 1 week (Figure-2e). After suture removal, cold lateral obturation was done (Figure-3a,b) followed by post-endodontic restoration with composite for teeth

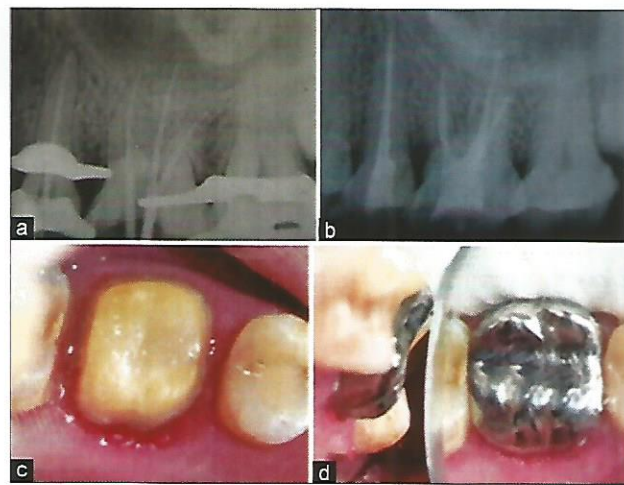


Figure 3: (a, b) Obturation; (c) Tooth prepared for crown; (d) Crown cemented

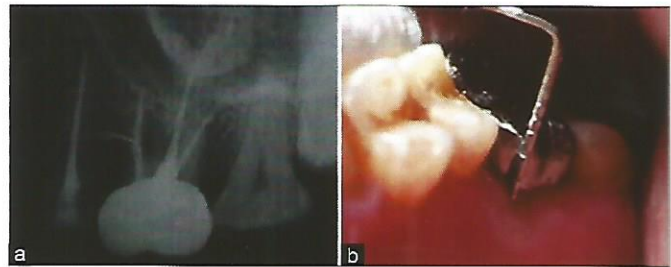


Figure 4: (a) Follow-up at 3 months; (b) Reduced probing depth

25, 26. Three weeks later, tooth was preparation for full coverage restoration (Figure-3c). Crown was cemented with type-I luting glass-ionomer cement. (Figure-3d).

Follow-up at 3 months revealed 26 to be asymptomatic with probing depth of 2.5 mm (palatal) and 2mm (mesial) (Figure-4a,b).

DISCUSSION

Complicated crown-root fracture (Andreasen & Andreasen's classification type-VI) is quite common and usually presents serious treatment problems due to the complex nature of injury. If impact force exceeds shearing strength of hard dental tissues, a fracture will occur which initially follows enamel rods of labial surface of crown and then takes an oblique course below palatal gingival crest. During its course through dentin, the fracture will often expose pulp.⁵

Left untreated, crown-root fractures result in pain from mastication due to movement of coronal fragment. Plaque accumulation along fracture line leads to inflammation of pulp, PDL and gingiva.⁵

Clinical diagnosis of crown-root fracture is apparent when coronal fragment is mobile. Radiographic diagnosis is more difficult with respect to its lingual extent since fracture line is usually perpendicular to central radiographic beam.⁵ Fracture line extension was ascertained only by direct visualization after flap was raised.

Subluxation injuries represent minor injuries to PDL and pulp caused by acute impact. Teeth are tender to touch/tapping, with increased mobility. Frequency of pulp necrosis is very low.⁶ Thus, it was concluded that previous incident of acute masticatory trauma led to pulpal necrosis of 25.

Literature evidence reveals good short- and medium-term outcomes (upto 5-7yr) for anterior tooth re-attachment.⁷ Long-term results are unknown. A clinical study by Cavaller et al. revealed greater success of fragment re-attachment (80%) compared to direct composites (at 5yr).⁸ Maia et al. hypothesized that these results were due to similar wear of tooth-to-tooth contacts.⁹

Conventional treatment options of crown lengthening and core and/or post requires 4-4.5 mm of supra-alveolar tooth structure to obtain ferrule and preserve biological width. It is not feasible in this particular case where osseous recontouring may have encroached onto the trifurcation (mesially).¹⁰ Extent of osseous recontouring undertaken in this case was only to expose tooth margins and permit isolation.

Dangaria et al. demonstrated that PDL stem cells attach to natural & synthetic hydroxyapatite.¹¹ Therefore fragment re-attachment provides restoration of natural tooth substrate for possible PDL reattachment. Reduced periodontal probing observed may be the result of either PDL reattachment (ideal), or formation of long junctional epithelium.¹²

In reattachment, only an extremely thin bonded fracture line interacts with gingiva. In case of failure, one may always revert to traditional clinical options. For artificial restorations (ceramics, composite), subgingival biocompatibility is in question. Junctional epithelium forms adjacent to composite, not on its surface. Also, unreacted monomers may leach out and delay gingival healing.¹³

A requisite for re-attachment is perfect juxtaposition with no inter-fragmentary space.¹⁴ Compared to dehydrated state that led to collagen network collapse and negative effects on bonding, saline/milk is a better storage medium.¹⁵ In this particular case, adhesive was combined with flowable composite to ensure improved mechanical properties.¹⁶

CONCLUSION

Biological restoration was the restorative technique chosen for this clinical case as it presents excellent aesthetic and functional outcomes. An advantage of using tooth fragments is the enamel's natural surface translucency and smoothness, in addition to physiological wear. The greatest advantage is that, in case of failure, one can revert back to traditional treatment options. It is a conservative and esthetic option compared to core/post. In the latter, crown lengthening, biological width and subgingival biocompatibility are critical factors to be considered. Multi-disciplinary approach and

long-term follow-up is of utmost importance in cases of fragment re-attachment.

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Simplified Technique to Gain the Natural Appearance of Lines of Relaxations on the Dorsal Surface of Fingers: A Case Report

Abstract

Hand deformities affect aesthetics, function of hand severely compromised and also cause psychological disturbances. Restoring the natural appearance with prosthesis eliminates the trauma generated by the dysfunction and represented an efficient psychological therapy. This report describes the simplified technique to gain the natural appearance of lines of relaxations on the dorsal surface of fingers in fabrication of a silicon finger prosthesis for patient after an accident at work. The finger prosthesis was retained by finger ring on the stump and shade selection was done by cosmetic shade guide available in market.

Key words: Technique, Lines, Fingers

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INTRODUCTION

Function and form are important attributes of the hand. The active hand is represented by its prehensile activities in grip, grasp and transferring and absorbing forces. Hands also have an aesthetic impact. They can emphasize the beauty of a gesture or the grace of a movement. Hands may be affected by many conditions varying from congenital abnormalities to disease, but the greatest cause of functional impairment is trauma. Finger and partial-finger amputations are some of the most frequently encountered forms of partial-hand losses.¹⁻⁵

Currently, many severely injured and traumatically amputated digits can be saved by microsurgical replantation. In some patients, however, reconstruction is contraindicated or unsuccessful. It is in group of patients that a prosthesis can be provided and may offer great psychological help.

Esthetic prosthesis for the hand can offer psychological and rehabilitative advantages. By restoring the natural appearance to the hand, a prosthesis eliminates the trauma caused by constant reminder of the handicap and thus offers true psychological therapy by permitting a more normal professional and social life.

CASE REPORT

A 45 year-old male patient was referred to the department of prosthodontics, bharativedyapeeth dental college and hospital, pune for prosthetic replacement of two fingers of left hand, 7 yrs. After an accident at work. The patient had first and middle finger traumatized at the middle phalynx. His chief complaint was replacement of missing fingers for aesthetic purpose. Finger stumps were appears

normal and covered with normal skin. Function of the remaining part was normal.

Treatment plan was decided to fabricate finger prosthesis with silicon material (Figures 1-9).

PROCEDURE

1. A thin film of Vaseline is applied to the amputated fingers.¹
2. Alginate impression material is then mixed and applied to the hand and place the fingers in a container filled with alginate and allow to set.
3. The impression made are removed and properly poured in dental stone to obtain the studying and working models.
4. The impression made of fingers from the other person's hand features of similar fingers with alginate and wax patterns are prepared.² Fingers patterns extend to the metacarpal phalangeal joint so that the margins of the prosthesis may be hidden under a decorative ring.
5. Wax patterns tried on patient for length,width.the location of the palmer crease and lines of relaxation are marked on wax patterns.
7. Features of similar fingers from the other hand are copied in an impression with addition silicon (putty).
8. Wax patterns are placed on the cast and putty impression is cut vertically from proximal surface.
9. Cut impression in two halves shows the impression of palmer crease and lines of relaxation.
10. Wax patterns are soften over the area marked the location of palmer creases and putty impression is pressed in that region to gain the natural appearance of these lines.

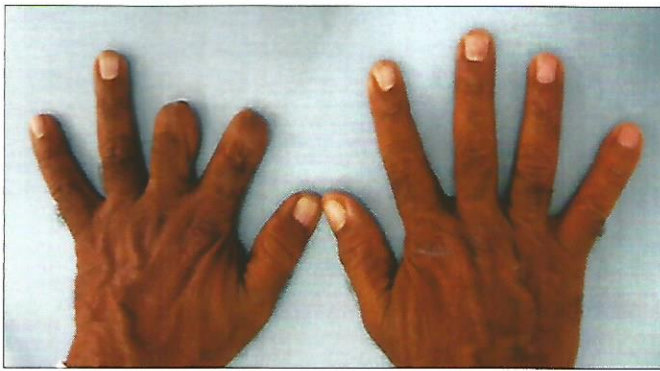


Figure 1: Pre operative

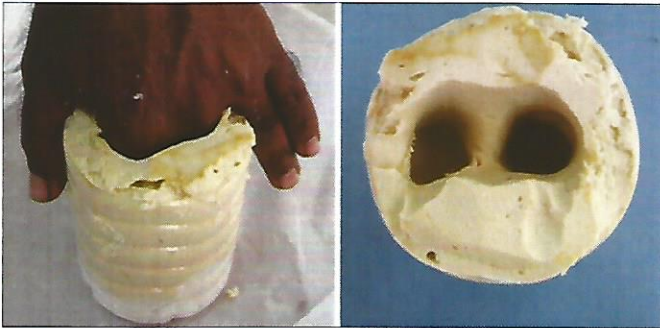


Figure 2: Alginate impression taken



Figure 3: Final cast

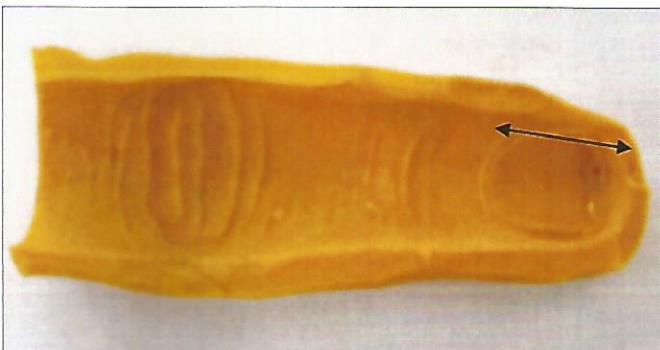


Figure 4: Putty impression showing lines of relaxation\

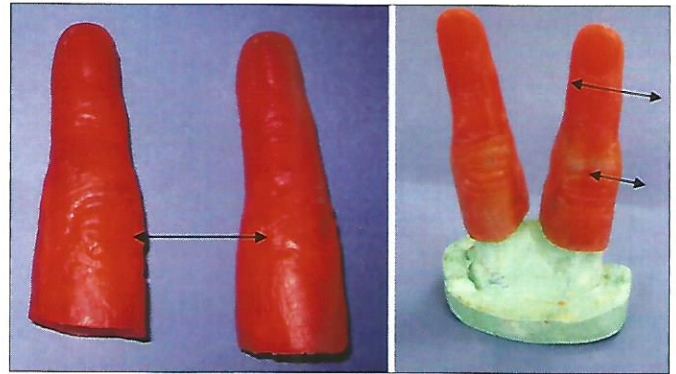


Figure 5: Wax patterns showing natural appearance of finger lines

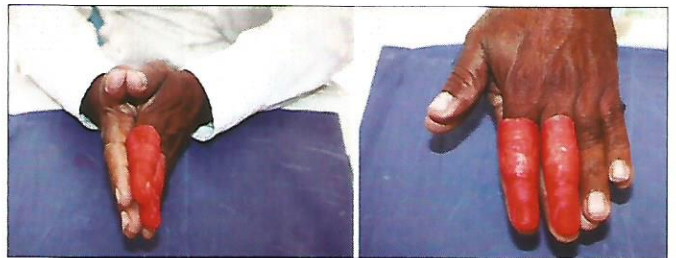


Figure 6: Wax pattern trial



Figure 7: Shade selection and preparation



Figure 8: Casting

11. Same procedure is followed for the dorsal surface of fingers to gain the natural appearance of lines of relaxations. This procedure reduced the time and gives natural appearance to the fingers instead of carving.
12. After the wax patterns are finished, final trail is done on patient.
13. The wax patterns are then invested in a flask and a mould is

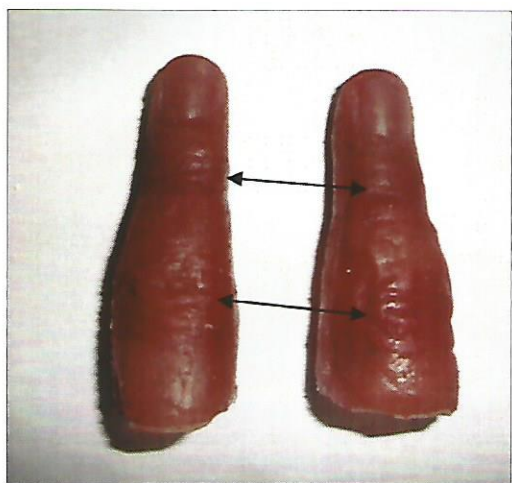


Figure 9: Final Silicon finger prosthesis showing detailing of lines of relaxation

made. dewaxing is carried out and coated with separating medium.^{1,2,5}

14. Shade selection is done with the help of cosmetic shade guide available in market (). And also done by mixing intrinsic colour (red and brown) in small amount of silicon material and match it by placing it on patient's hand.
15. Silicon is mixed on a glass slab after proper color matching.
16. Silicon is filled in upper and lower half of the flask and the flask is closed. It is kept under pressure using the bench press and is allowed to cure for twelve hours. The flask is then opened and the prosthesis is recovered.¹
17. The thickness of the prosthesis was maintained at 0.2 mm to 0.3 mm around the edges, with a gradual increase in thickness towards the distal end.³
18. Fingernails molded from the base silicone material and pigmented to match the patient's natural nails. Patients is instructed to always paint their fingernails and remove

prosthesis for more vigorous activities including instrumental music, gardening, swimming, kitting and cooking.

DISCUSSION

This technique provides, natural appearance of finger lines, skin colour and texture to the finger prostheses. Carving these palmer creases and lines of relaxations on dorsal surface are time consuming and technique sensitive. The method shown in this article gives more esthetics within less time. The sectional method of fabrication makes it hollow and light weight. It is simple, easy to fabricate, less time consuming and cost effective. The disadvantage of this prosthesis is that individual folding movement is not possible.

CONCLUSION

- Good suspension alone is not sufficient.
- A high level of cosmesis is paramount.
- A pleasing shape, thin margins, lifelike fingernails, and realistic color, contours and detail are also essential for patient satisfaction.
- Although not natural, prosthetic hands may help handicaps regain or gain their manipulation skills.

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Semi Precision Attachment: A Case Report

Abstract

The success of precision attachment partial dentures depends on creating an ideal architecture for the mouth. All the teeth that support bridgework are prepared with full shoulder preparations (flat ledges) in three-dimensions. In other words, the prepared teeth relate to each other, the gingival (gums) and the underlying bone. Any defects must be corrected surgically in order to create health and the best architectural foundation to support dentistry. The dentistry must conform to sound principles of biomechanics that minimize forces on this foundation. These principles include narrow occlusal (biting surface) diameters, adequate room for hygiene, proper length and anatomy, solid and passive fit, and adequate occlusion (bite) at the correct jaw relationship. The importance of accurate impressions and models to the overall success of a precision attachment case cannot be over-emphasized. Precision attachments must be used in a precise manner in order to maintain a high percentage of longevity. Great care must be taken to ensure precision at every step and steps cannot be skipped or the final result will be compromised. Precision attachment cases must fit with precision—the abutments must be stable and the frameworks must fit properly without rock.

Keywords: Precision attachment, Semi precision attachment

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INTRODUCTION

The use of attachments as connectors was popularized in the twentieth century by dry Herman ES. The fabricated dental bridge work in segments that were connected by key and keyway attachment. His philosophy was to provide a physiologic tooth movement similar to that of natural teeth by using dental attachments in treatment planning. This concept eventually led to the development of various rigid or resilient stress relieving or stress breaking attachments. Acting as a fixed bridge dry chaves slot type of dental attachments was quite rigid and provided for removable and cleanability. Over years attachments were fabricated to accommodate a wide range of controlled micro-movements are now selected on a case by case basis, according to how the final prosthesis is planned to function on the remaining supporting elements. Semi-precision attachments are much less precise in their fit and usually have much more resiliency than their precision attachments counterparts. These attachments are cast from refractory patterns and male or female parts may be made of nylon or metal. These attachments can allow up to 15 degrees of rotational movement and up to 600 microns of vertical movements. In removable cases they are cast within the crown or splint and are placed outside the counters of the teeth. In over denture prosthesis, they are either cast on top of copings, incorporated onto the post which are cemented into the roots or abutment teeth or incorporated into over denture implant abutments. Their resiliency allows the prosthesis to transfer most of the occlusal load to the tissues and away from the abutment teeth to which they are connected. The choice of attachment to use depends on the patient and all the data that is gathered during the treatment planning processes. This allows the dentist to make decisions that will build longevity into the prosthesis and satisfy the needs of the patient. Offer considerable advantages in dentistry because of their flexibility. Nevertheless, they have been in past been largely

ignored. There is no doubt that they were already seen the results of this public awareness in a greater demand for complex restorations. The selection depends upon the extent of edentulous region, abutment teeth and mucosa of underlying bone.

Precision attachment consists of two halves, a matrix and a patrix that form a precise but separable joint.

Types being active, passive retention, rigid or resilient attachment, prefabricated or custom made, intracoronal or extra coronal attachment.

Based on the geometric, design key and keyway, interlocks, ball and socket, bar and clips, telescopic and hinge.

Advantages, improved esthetics, improved psychological acceptance, direct forces along long axis of the teeth, reduces non axial forces, cross arch load transfer and stabilization.

Disadvantages, complexity of the design, minimum occlusogingival height abutment teeth, limited facio-lingual teeth, wearing attachment, components require aggressive tooth preparation.

contraindications, poor periodontal support, reduced crown to root ratio, poor oral hygiene, increases caries rate, inadequate space.¹⁻⁴

First semi precision attachment was done by GILLET (1923) with rectangular deep rest with buccal and lingual wrought clasp arms

A CASE REPORT

A 65 year old male patient reported to the department with chief complaint of missing teeth to be replaced. On clinical examination 11,12,13,21,22,23 were present in maxillary arch and mandibular all the teeth were present. The teeth were periodontally compromised.



Figure 1: Final impression



Figure 2: Master cast with PFM crowns attachment and cast-partial

The treatment plan was to do intentional root canal treatment of all maxillary teeth and semi-precision attachment retained cast partial attachment was done. Tooth preparation was done to receive porcelain fused to metal crown was done, impression were made with elastomeric impression and poured in die stone, temporary was given. The attachment system was selected (RHEIN 83). The male component was attached to the axial surface of the abutment bilaterally on both the arches in relation to 13 and 23 using dental surveyor, investing and casting was done, metal try in of the coping was done to evaluate the fit of the casting, ceramming was done on the metal framework. The fabricated metal ceramic were cemented with the attached male component. Impression was made with elastomeric impression with light body to fabricate cast-partial denture with precision attachments, cast were poured and cast partial frame work fabricated along with the female component (HOUSING AND NYLON CAP), evaluate the fit over the male component, jaw-relation recorded, try in done and acrylisation completed.

DISCUSSION

In our fast paced and upwardly society, Patients will see a dentist for two main reasons and or esthetics. The dental professional must be able to relate to the patients concerns both physically and psychologically. Attachments provide a very important psychological union in treating a patient as a whole and not merely as a disease. The desire to balance between functional and cosmetic in partial denture gave rise to precision attachment.



Figure 3: PFM crowns on the cast

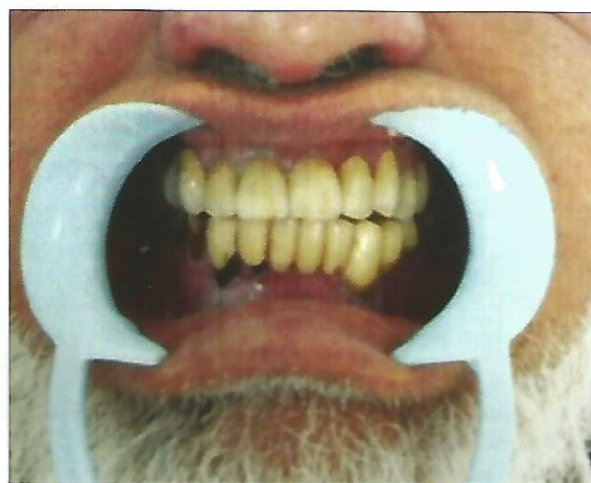


Figure 4: Completed prosthesis

It sometimes said to be a connecting link between fixed and removable prosthesis. Benefit being consistent quality, controlled wear, reduced wear, easier repair, standard parts interchangeable. The success of prosthesis depends on careful treatment plan. It presents a challenge in technical skill. A knowledge of different attachments is of great importance.⁵⁻⁸

CONCLUSION

The desirable to balance between functional and cosmetic in partial denture gave rise to precision attachment. It some times said to be connecting link between fixed and removable prosthesis. Benefits being consistent quality, controlled wear, decrease wear, easier repair, standard parts interchangeable. Attachments provide a very important psychological union in treating a patient as a whole and not merely a disease. The success of prosthesis depends upon on careful treatment planning. It represents a challenge in technical skill. A knowledge of different attachments is of great importance. The dental profession must be able to relate to the patients concern.

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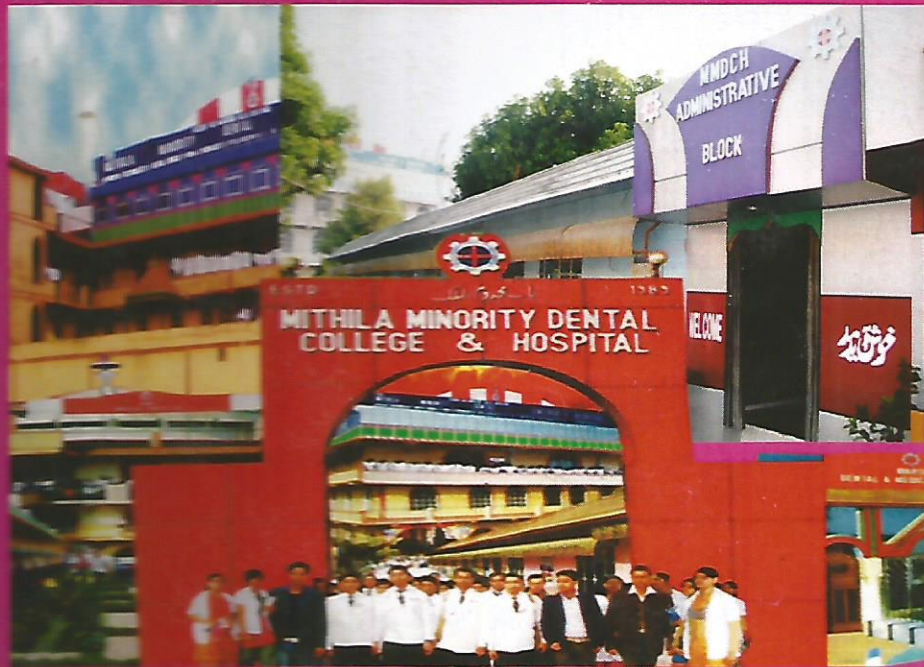


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