



ISSN 2320-7302  
eISSN 2393-9834

# Journal of Dental Specialities JDS

Volume 3, Issue 2, September 2015

***Bibliographic Listings:***

EBSCO, HINARI, OAJI, Cite Factor, ASI Database,  
SIS Database, DOAJ, ISRAJIF, DJQF, Academic Keys,  
JI Factor, INFOBASE Index, Advance Science Index,  
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Publication of  
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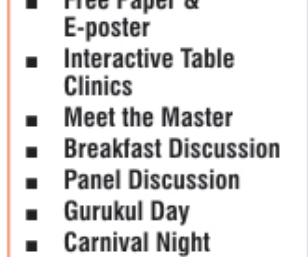
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## ***Zirconia: The new technological marvel in dentistry***



**Prof. (Dr.) Hari Parkash**  
**Editor-in-Chief**

The last decade has witnessed a revolution in milled technology – CAD CAM. This technological marvel has given a boost to a Metal free milled ceramic restorations. Amongst these the most successful have been Zirconia Ceramics.

The term Zirconia is derived from two Persian words: zar meaning gold and gun meaning colour. This material was discovered by German chemist Martin Heinrich Klaproth in 1789. This material does not occur in Free State naturally but is found in as silicate oxides or free oxides. A very interesting phenomenon with this material is its transformation toughening. This material has three forms i.e., cubic phase which is stable above 2370°C with moderate mechanical advantage, tetragonal phase which exists between 1170°C - 2370°C with improved mechanical properties and a monoclinic phase that exists at room temperatures to 1170°C with reduced mechanical properties.<sup>1</sup> Currently, Zirconia being used in dentistry is Partially Stabilized Zirconia to which – mol% of yttria (or CaO/ MgO) has been added. This allows for small tetragonal grains to exist at room temperatures. Under great stresses, if a crack

propagates through this material, there is a phase transformation from tetragonal to monoclinic which is associated with a volumetric expansion of -5% which stops the crack propagation.

The dental fraternity has accepted Zirconia ceramics with a very positive note. From single crown, multiple unit bridges, inlays, onlays, partial veneer crowns, its use have expanded to endodontic posts, implants, implant abutments, orthodontic brackets etc. Various design modifications have also emerged like monolith crowns for posterior areas, Brux Zir crowns for patients with parafunctional activities, high translucency zirconia and super high translucency zirconia for enhanced esthetics.

On the technical forefront, research shows that porcelain veneering can be mislaid at the gingival surface of the connectors to increase their surface area and strength. Estimation according to Fatigue parameters indicate that connector area should be 5.7mm<sup>2</sup>, 12.6mm<sup>2</sup> and 18.8mm<sup>2</sup> for fabrication of crown or long span FPD respectively.<sup>2</sup> Looking at the technical complications of this material it can be concluded that these zirconia restorations in the long

run are comparable to metal ceramic restorations and can withstand long term functional forces. One of the most common complications reported are chipping of veneered ceramic, followed by fracture of core and debonding of the restoration.

As compared to glass ceramics, zirconia prosthesis has a reduced translucency. This translucency of zirconia material is determined by impurities and structural defects. To increase this translucency the effects of impurities and structural defects have to be reduced. The translucency of zirconia material is reduced by different refractory index and segregation nature of the alumina which is added into zirconia for aging stability.<sup>3</sup> In few new age Zirconia, the alumina content is reduced to 0.1 wt% and distribution is improved. This has led to emergence of super high translucent zirconia.

It can be summarized that zirconia technology is among the most recent technological advances witnessed in the CAD/CAM industry. Its use has revolutionized the field of dentistry and has unleashed tremendous potential due to its varied applications. Evidence based results are pouring in and the field of Zirconia is constantly improving & improvising itself for more predictable results. Research is going on in this field in the areas of aging, veneering, framework designing, bonding and repair kit.

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## What would the martian say?? Where we are with evidence based dentistry today?



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Prof Kevin O'Brien from the University of Manchester writes a popular blog and uses this curious incident of the Martian to under scribe some very important points in clinical, research and evidence based outcome domain. This the way it goes, a little green man from planet Mars lands on earth and wanders into a convention of dentists. The dentists are surprised and they ask him who is he? And what is the purpose of his visit? He replies that he is from planet Mars and he visits earth as a part of their mission to discover the universe. In return he asks them who are you? The Dentist spokesperson says, "We are dentists". The Martian asks, "what do you do? ", The dentists say, "we fix teeth, make people smile, look good, improve their health and several other good things". The Martian says: Prove it. While the profession has spoken about this long enough, it is obvious that the only answers to the Martian would come from evidence and filtering information for knowledge. For a long time the profession has been unaccountable, relying on the existing image of the healing profession that we do good and patients need to accept it. This notion is being challenged as awareness grows, patients being entitled to more information, healthcare policy planners need structured information to look at funding services and facilities. Evidence is what is needed both in clinical practice and research.

Clinical research aims at establishing cause, relating cause and effect, and looking at therapeutic outcomes. Clinical research still broadly falls into Randomized and non Randomized studies. Non

Randomized studies fall into observational studies. Randomized clinical trials are the gold standard for assessing the efficiency and safety of interventions. The controversy that arises today is that all studies in Dentistry may not be randomized. It is not possible to have a control group being denied treatment ethically just to study the effect of an intervention. So there is a role for non randomized observational studies to be interpreted and used for clinical decision making and research. Herein lies the difference between evidence based dentistry and evidence based medicine. In medicine 2 different interventions or even a placebo may be in the larger good of the patient. Dental issues are more definitive, they need a precise intervention. A conceptual approach to assessing validity of a trial needs to be learnt and taught. Is the study population different from the population to which we wish to apply the findings? Are the target population characteristics likely to influence the results? Are the results generalizable to the target population not meeting all eligibility criteria?

The debate surrounding the randomized and non randomized studies has been furthered by flaws in both designs published in literature. Is there an agreement between nonrandomized and randomized trials? No publication answers this. But yet to answer the questions raised by the Martian, we need to teach critical appraisal skills so that both studies, randomized and nonrandomized can be used in research and decision making without competing with each other.

# Alterations in plasma lipid profile patterns in leukoplakia and oral submucous fibrosis - a pilot study

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## ABSTRACT

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Received: 28/01/2015

Accepted: 19/02/2015

**Introduction:** Oral submucous fibrosis and leukoplakia are highly prevalent in India. Lipids are the chief cell membrane components which are essential for various biological functions like cell growth and division of normal as well as malignant tissues. Lipids can be helpful for studying the variation in the cholesterol levels for diagnosing and treating the diseases.

**Aim:** The present study evaluated the plasma lipid profiles in patients with Oral submucous fibrosis and leukoplakia and controls.

**Methodology:** 21 patients were selected for the study out of which 7 had OSMF, 7 had oral leukoplakia and 7 were included in control group. Patients with cardiovascular diseases, uncontrolled diabetes, acute hepatitis, thyroid dysfunction, and any drug history were excluded from the study. 5ml blood sample was taken and the serum was tested for triglyceride levels (TG), total cholesterol (TC), LDL, HDL, and VLDL level were analyzed using triglycerides were analyzed by auto-analyzer used for the analysis of the results is a fully automated biochemistry analyzer.

**Results:** In this study TC, HDL, LDL level analysis showed lower levels in oral leukoplakia and OSMF patients than that of the controls.

**Conclusion:** The alterations in the plasma lipid profile patterns were considerable and recommend a still in-depth study with larger sample size in this aspect for early diagnosis and management of oral leukoplakia to prevent malignant transformation.

**Keywords:** Lipids, Cholesterol, Triglycerides, Leukoplakia, Oral submucous fibrosis.

## INTRODUCTION

Lipids are the chief cell membrane components which are essential for various biological functions like cell growth and division of normal as well as malignant tissues. Lipids can be helpful for studying the variation in the cholesterol levels for diagnosing and treating the diseases.<sup>1,2</sup> Changes in circulatory levels cholesterol has been associated in the etiology of colorectal as well as breast cancer.<sup>2,3</sup> Using tobacco is an important etiologic factor which aids in the development of oral precancerous lesions / conditions and head and neck cancer.<sup>4</sup> The carcinogens present in tobacco stimulate free radicals and reactive oxygen species (ROS) generation, which further cause increase in the rate of oxidation / peroxidation of polyunsaturated fatty acids. This peroxidation will further release peroxide radicals. This affects essential components of the cell membrane and can be involved in tumorigenesis.<sup>5</sup> Lipid peroxidation, will increase the consumption of

lipids which includes total cholesterol, triglycerides and lipoproteins for generation of new membrane. Cells carry out these requirements either via circulation, by the production through the metabolism or from the degradation of major lipoprotein fractions like VLDL, LDL or HDL. Reports have shown that antioxidant vitamins have protective effects against lipid peroxidation.<sup>6,7</sup>

Hence the present study was aimed to evaluate the plasma lipid profile including: (i) total cholesterol (TC) (ii) LDL cholesterol (LDLC), (iii) HDL cholesterol (HDLC), (iv) VLDL cholesterol (VLDLC) and (v) triglycerides (TG) patients with oral submucous fibrosis OSMF, leukoplakia and healthy controls.

## METHODOLOGY

A study was conducted in the Department of Oral Medicine and Radiology of I.T.S.-C.D.S.R., Dental College, Muradnagar. A total of 21 patients were taken from those visiting the department in the months of May – June, 2014. Patients were selected after taking a thorough history and on the basis of clinical examination by a trained oral medicine and radiology faculty. Patients with cardiovascular diseases, uncontrolled diabetes, acute hepatitis, thyroid dysfunction, and any drug history were excluded from the study.

Ethical clearance obtained from the institutional ethical committee. Patients were then divided into 3

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	DOI: 10.5958/2393-9834.2015.00001.7

groups, Three groups were leukoplakia, OSMF and healthy controls each group had 7 patients. Patients were informed prior to the study and a written consent form was obtained. All 7 patients with leukoplakia underwent biopsy however only 5 patients with OSMF underwent biopsy. Patients with OSMF are classified on the basis of Khanna et al. After confirmed biopsy report patients were recalled again empty stomach in the morning and 5ml of blood was collected from each patient and was allowed to clot. The serum was separated by centrifugation. Auto-analyzer was used for the analysis of the results. It is a fully automated biochemistry analyzer. After that the lipid profile assay of the specific parameters like HDL, LDL, VLDL, Total cholesterol, Triglycerides were made.

### RESULTS

Patients age group ranged from 19- 50 years. Habit of tobacco consumption in one or the other form (smoking/chewing/snuff) was present in all the cases. Out of 21 patients 20 patients were male and one patient with OSMF was female. In the leukoplakia group out of 7 patients 5 had moderate dysplasia and 2 patients had mild dysplasia. In OSMF group out of 5 patients who underwent biopsy 1 had moderately advanced and 4 had Early OSMF. Other 2 patients had grade III OSMF according to Khanna et al classification.

**Table – 1: Mean of TG, TC, HDL, LD in all the patients of leukoplakia, OSMF, and healthy controls**

	LEUKOPLAKIA (mean)	OSMF (mean)	CONTROL (mean)
TG	126.14	134.85	143.14
TC	114.42	128.57	157.85
HDL	22.85	33.71	42
LDL	35.14	50.14	82.42
VLDL	17.28	26.71	31

**Table - 2: Histopathological stages of dysplasia<sup>12</sup>**

Stages of dysplasia	Features
Squamous hyperplasia	This may be in the spinous layer (acanthosis) and/or in the basal/parabasal cell layers (basal cell hyperplasia); the architecture shows regular stratification without cellular atypia
Mild dysplasia	The architectural disturbance is limited to the lower third of the epithelium accompanied by cytological atypia
Moderate dysplasia	The architectural disturbance extends into the middle third of the epithelium; consideration of the degree of cytological atypia may require upgrading

Severe dysplasia	The architectural disturbance involves more than two thirds of the epithelium; architectural disturbance into the middle third of the epithelium with sufficient cytologic atypia is upgraded from moderate to severe dysplasia
Carcinoma in situ	Full thickness or almost full thickness architectural disturbance in the viable cell layers accompanied by pronounced cytological atypia

### DISCUSSION

Oral submucous fibrosis (OSMF) is a chronic disease of the oral cavity, characterized by an epithelial and subepithelial inflammatory reaction followed by fibroelastic changes in the submucosa.<sup>8</sup> Oral submucous fibrosis has high occurrence in India. Most of the OSMF cases in this study were in their second and third decades with a male predominance. All the cases of OSMF consumed areca nut in some form. OSMF is considered a disease of multi factorial etiology and various theories have been proposed.<sup>9</sup> Excessive use of areca nut may cause fibrosis due to increased synthesis of collagen and induce the production of free radicals and reactive oxygen species, which are responsible for high rate of oxidation/peroxidation of polyunsaturated fatty acids which affect essential constituents of cell membrane and might be involved in tumorigenesis.<sup>10</sup> Leukoplakia is the most common premalignant or potentially malignant lesion of the oral mucosa.<sup>11</sup> Leukoplakia is at present defined as “A white plaque of questionable risk having excluded (other) known diseases or disorders that carry no increased risk for cancer”.<sup>12</sup>

On histopathological basis, difference can be seen in dysplastic and non-dysplastic leukoplakia. Dysplasia can be assessed on the basis of architectural disturbance with cytological atypia. In 2005 WHO classified dysplasia in 5 stages. (Table 2).<sup>12</sup> It is supposed that tobacco carcinogens can stimulate production of free radicals as well as reactive oxygen species, which are accountable for the increased rate of oxidation/ peroxidation of polyunsaturated fatty acids. Release of peroxide radicals is promoted by this peroxidation which leads to increased consumption of lipids.<sup>5</sup>

This affects important components of the cell membrane and might be involved in carcinogenesis / tumorigenesis.<sup>13</sup> Animal studies have shown that nicotine, which is a tobacco carcinogen, affects the activity of enzymes responsible for lipid metabolism.<sup>14</sup>

Newly forming and fast proliferating malignant cells need many basic components such as lipids well above the normal physiological limits leading to diminished lipid stores.<sup>15,16</sup> Lipid peroxidation can also develop lipid peroxidation product,

malondialdehyde, which cross-links with deoxyribonucleic acid (DNA) on the same as well as opposite strands via adenine and cytosine. This can contribute to carcinogenicity and mutagenicity in mammalian cells.<sup>17</sup>

The inverse relation was observed between the total cholesterol and disease stage and mortality in various malignancies.<sup>15</sup> In 1999 Rywik SL et al had shown a relatively high risk of cancer mortality with a significant lower total cholesterol and HDL. Lower level of TC was recommended due to increased consumption by tumor cells.<sup>16</sup>

Lower level was observed in plasma HDL in Oral leukoplakia and OSMF than controls were present in the study. This finding is in accordance with earlier reports, that low HDL levels is an additional predictor of cancer. Patel et al also reported that low levels of HDL may be a consequence of disease that is mediated by utilization of cholesterol for membrane biogenesis.<sup>18</sup> Jacqueline et al observed a lower HDL in widespread disease than with localized tumors.<sup>17</sup>

The range of LDL in oral leukoplakia and OSMF patients was respectively lower than the controls. Patel et al did not observe low levels of LDL in head and neck malignancies.<sup>18</sup>

Rose et al reported 66% higher mortality rate due to cancer in the group of cancer patients with lowest plasma cholesterol than in the highest plasma cholesterol.<sup>19</sup> The low plasma lipid status of the patient may be a positive indicator for initial changes occurring in neoplastic cells.

Neufeld et al have reported passive smoking as a significant risk factor for decreased HDLC.<sup>20</sup> In this study TC, HDL, LDL level analysis showed lower levels in oral leukoplakia and OSMF patients than that of the controls. Less difference was present in triglycerides and VLDL levels was observed in leukoplakia and OSMF patients than the control group. Our results have been in accordance to the previous studies that have been conducted before.<sup>21,22,23</sup> There was much more decrease in all the parameters in leukoplakia as compared to OSMF that can be due to the fact that most of the patients suffering from leukoplakia showed more dysplastic changes as compared to the OSMF patients who mostly showed early changes.<sup>24,25</sup> As it was a pilot study small sample size was taken. Tissue level lipid analysis should be done in further studies tissue to determine uptake of lipid by the altered tissue and comparison with oral cancer is also suggested for further studies

In conclusion TC, HDL, LDL level analysis showed lower levels in oral leukoplakia and OSMF patients than that of the controls. Less difference was present in triglycerides and VLDL levels was observed in leukoplakia and OSMF patients than the control group. Study with larger sample size should be done

in this aspect for early diagnosis and management of oral leukoplakia and OSMF.

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**How to cite this article:** Baduni A, Mody BM, Bagewadi S, Sharma ML, Vijay B, Garg A. Alterations in plasma lipid profile patterns in leukoplakia and oral submucous fibrosis - a pilot study. *J Dent Specialities* 2015;3(2):126-129.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Artificial neural network (ANN) modeling and analysis for the prediction of change in the lip curvature following extraction and non-extraction orthodontic treatment

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## ABSTRACT

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Received: 17/02/2015

Accepted: 18/06/2015

**Objective:** To establish and determine the accuracy of ANN model for the analysis of lip curve change following extraction and non-extraction orthodontic treatment.

**Methods:** Forty adult subjects who required various combinations of premolars extraction and non-extraction for the correction of their malocclusion were chosen. Based on the extraction pattern, all the subjects (n=40) were divided equally into an extraction and a non-extraction group. The effect of extraction and non-extraction treatment on the depth of upper and lower lip curvature was measured on the lateral cephalograms recorded in natural head position. The data obtained from the cephalometric analysis were used to produce a trained ANN model and then the model was analyzed to determine its accuracy in the prediction of upper and lower lip curvature change.

**Results:** The mean change in the depth of upper lip curvature following various combinations of premolars extraction and non-extraction treatment was significantly different (P<0.05). The predicted values of upper and lower lip curvature change by ANN model were very close to the actual regression analysis values. However, the mean error in predicting the change in the upper and lower lip curvature by ANN model analysis was only 29.6% and 7% respectively which was much less as compared to the routine regression analysis.

**Conclusions:** The premolars extraction and non-extraction orthodontic treatment had significant effect on the depth of upper lip curve, and the mean error in predicting the change in lip curvature with ANN analysis was much less as compared to computer based statistical analysis.

**Key words:** Lip curvature changes, Extraction and non-extraction treatment, Artificial neural network analysis.

## INTRODUCTION

Evaluation of the human facial profile has always been an essential part of orthodontic diagnosis and treatment planning.<sup>1</sup> Successful evaluation of facial balance and harmony includes a study of the facial soft tissue characteristic. Thus the relationships of nose, lips and chin are important considerations. However, significant consideration has been given to the actual depth of curvature of the lips and the importance of these curves to the overall perception of the lateral facial profile.<sup>2,3</sup> The presence of varying inherent internal soft tissue architecture, however, has complicated the attempts at predicting soft tissue

responses to treatment.<sup>3</sup> Consequently, ratios of lip to incisor retraction have gained only limited acceptance because it has been recognized that the interactions that might determine soft tissue changes are complex.<sup>4</sup>

Currently many multiple-factor analysis methods are available for medical use and among these artificial neural network (ANN) model analysis is very commonly used. ANN is basically an information processing paradigm inspired by biological nervous systems in human brain. The ANN is made up of large number of highly interconnected processing elements called neurons.<sup>5</sup> In true sense artificial neural networks are the simple clustering of the primitive artificial neurons and this clustering occurs by creating layers, which are then connected to one another. As shown in Fig.1, the input layer consists of neurons that receive input from the external environment. The output layer consists of neurons that communicate the output of the system to the user or external environment. There are usually a number of hidden layers between these input and output

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	DOI: 10.5958/2393-9834.2015.00002.9

layers. However, the Fig.1 is a simple structure with only one hidden layer. When the input layer receives the input, its neurons produce output and this becomes input to the other layers of the system. The process continues until a certain condition is satisfied or until the output layer is invoked and fires their output to the external environment. The human brain learns from experience. However, neural networks are called machine learning algorithms, because changing of its connection weights (W in Fig.2) causes the network to learn the solution to a problem. The strength of connection between the neurons is stored as a weight-value for the specific connection. The system learns new knowledge by adjusting these connection weights. The learning ability of a neural network is determined by its architecture and by the algorithmic method chosen for training. The ANN models are particularly beneficial when one is searching various problems because of their ability to process complicated problems of uncertainty, nonconfiguration, nonlinearity and multiple factor interactions. As a result, the application of ANN shows great potential as a support system and management system in medical decision making. In orthodontics, ANN models have only been used for human craniofacial growth classification<sup>6</sup>, prediction of anterior temporal muscle activity<sup>7</sup> and deciding the need of extractions prior to orthodontic treatment.<sup>8</sup> However, the present study was designed to determine the accuracy of ANN model analysis for the prediction of lip curvature change following extraction and non-extraction orthodontic treatment.

## **MATERIALS AND METHODS**

Total 40 adult subjects who required either all first premolars or upper first and lower second premolars or all second premolars extraction or without any tooth extraction for the correction of their malocclusion were included in the study. Prior to the commencement of the trial, all the participants were informed and a written consent was obtained. The study was also approved by the Ethical Committee. All the 40 subjects were treated by using consistent contemporary biomechanical principles and this study was done over a period of seventeen months. The subjects were divided into 2 main groups of each containing 20 subjects i.e. Group-I [Non-extraction group] and Group-II [Extraction group; all first premolars (n=8), upper first and lower second premolars (n=6), all second premolars (n=6)]. The mean age of the subjects at the beginning of study in the extraction group was 19 year 9 months and in the non-extraction group was 18 year 9 months. Pretreatment and post-treatment lateral cephalograms recorded in the natural head position were analyzed by the same investigator (SBN) to determine the upper and lower lip curvature change. All the cephalograms were recorded in the same machine

with similar exposure parameters. In order to provide a consistent reference plane for evaluating horizontal changes in landmarks, both sphenoethmoid (Se) and the inferior pterygomaxillary point (Ptm) on the pterygomaxillary vertical (PMV) line were transferred from the pretreatment tracing to post-treatment tracing, by superimposing on the cranial base landmarks of the pretreatment radiographs as described by Bjork and Skieller.<sup>9</sup> Landmarks chosen for the study were based on the definitions of Nanda et al.<sup>10</sup> Linear measurements were multiplied by a factor of 0.9 to take into account the 9% enlargement factor. In order to access the effect of extraction and non-extraction treatment on soft tissue, the depths of upper and lower lip curves were measured on all pre and post-treatment cephalograms, in relation to skeletally defined PMV line of Enlow et al.<sup>11</sup> The upper lip curvature was calculated as a difference between upper lip thickness at labrale superioris and upper lip thickness at point A in relation to PMV line. Similarly the lower lip curvature was calculated as a difference between lower lip thickness at labrale inferioris and lower lip thickness at point B in relation to PMV line. Various cephalometric landmarks and the linear measurements used for the measurement of depth of upper and lower lip curvatures are shown in Fig.-3.

The ANN model was prepared by utilizing MATLAB software. The model was trained with data of same 40 subjects. The model had two inputs, two outputs, a total of 10 layers with 8 hidden layers, one input layer and one output layer. The input and output layer indices for upper and lower lip curvatures for non-extraction and extraction groups are shown in table-1 and 2. The statistical regression analysis and ANN analysis were done to find out any possible prediction equation where pre-treatment variables can be used to find post-treatment results.

## **STATISTICS**

All the data were analyzed with MINITAB version 13.1 and SPSS version 11 softwares. The data were subjected to the descriptive statistics for the evaluation of mean, standard deviation and range etc. One-way ANOVA was used for multiple group comparison and Man-Whitney test was used for group wise comparison. Stepwise regression analysis was used to identify not only those pre-treatment variables with the most likely influence on lip changes but also to attempt to describe the extent of variability in lip response that might be explained by those variables. The P-value of 0.05 was considered as level of statistical significance.

## **RESULTS**

The change in the curvature of the upper and lower lips following various combinations of premolars extraction and non-extraction treatment is described

in table-3. The curvature of the upper lip was changed significantly ( $P < 0.05$ ) following premolars extraction and non-extraction orthodontic treatment as compared to the lower lip. Correlation and regression analysis for the measurement of relationship between various pre-treatment parameters to predict the post-treatment changes in lip-curve is described in table-4. When analyzing the results of stepwise regression, it became obvious that only prediction of lower lip curvature change in upper first and lower second premolars extraction group was good enough with 95.3% explained variance (Table-4).

The ANN predicted values for upper and lower lip curvature change were very close to the actual prediction values obtained from conventional regression analysis. The neural network prediction values for upper and lower lips curvature changes are shown in Fig.-4. The results of random data of 10 patients which were considered for testing showed very promising (Fig.-5). The mean error in the prediction of upper and lower lip curvature change was 29.6% and 7% respectively which were very less as compared to the statistical regression analysis (Fig.-6 and 7).

**Table 1: The input and output layer indices for upper and lower lip curvatures for non-extraction group.**

SN	Input layers for upper lip curvature	Input layers for lower lip curvature	Output layers for upper lip curvature	Output layers for lower lip curvature
1	4.6	7.1	0.8	2.4
2	2.8	4.4	-2.8	-3.3
3	3	5.6	2	-0.2
4	3.3	8.5	0.5	-0.7
5	3.9	5.2	-5.1	-0.7
6	3.5	6.3	2.7	-0.3
7	4	11.7	-1.2	4.3
8	4.5	1	0.2	-5
9	2.5	4.5	-0.2	-1.2
10	5.2	2.6	1.4	-6.4
11	2.7	6.4	0.7	-5.5
12	4.5	5.2	1.7	2.5
13	1.8	6.5	-0.5	0.6
14	1.9	6.5	1	-1.7
15	4	3.9	-0.6	-2.1
16	4.6	8.3	0.9	3.8
17	4.9	8.3	1.1	-1.8
18	3.9	4.4	0.3	-0.3
19	5.1	6.9	1.7	1.3
20	4.2	9.7	1.7	2.6

**Table 2: The input and output layer indices for upper and lower lip curvatures for extraction group.**

SN	Input layers for upper lip curvature	Input layers for lower lip curvature	Output layers for upper lip curvature	Output layers for lower lip curvature
1	6.2	5.4	0.2	0.9
2	5.1	6.9	1.7	1.3
3	7.3	10.3	-0.1	2.5
4	3.7	8.1	1.9	2.7
5	4.6	8.3	0.9	3.8
6	5.1	9.1	1.3	2.8
7	4.9	8.3	1.1	-1.8
8	3.4	7.6	1.1	-4.6
9	6.9	2.2	5.7	-2.8
10	6.7	2.3	1.6	-2.3
11	6.5	6.8	4.6	2.7
12	4	3.9	-0.6	-2.1
13	6.5	7.5	2	4.7
14	4	7.8	2.1	5.3
15	4.8	6	1.4	3.2
16	5	6.4	1.1	-0.6
17	5	6.8	0.6	0.5
18	6.2	5.4	0.2	0.9
19	3.3	8.5	0.5	-0.7
20	1.8	6.5	-0.5	0.6



**Table 3: Changes in the upper and lower lip curvatures following extraction and non-extraction treatment**

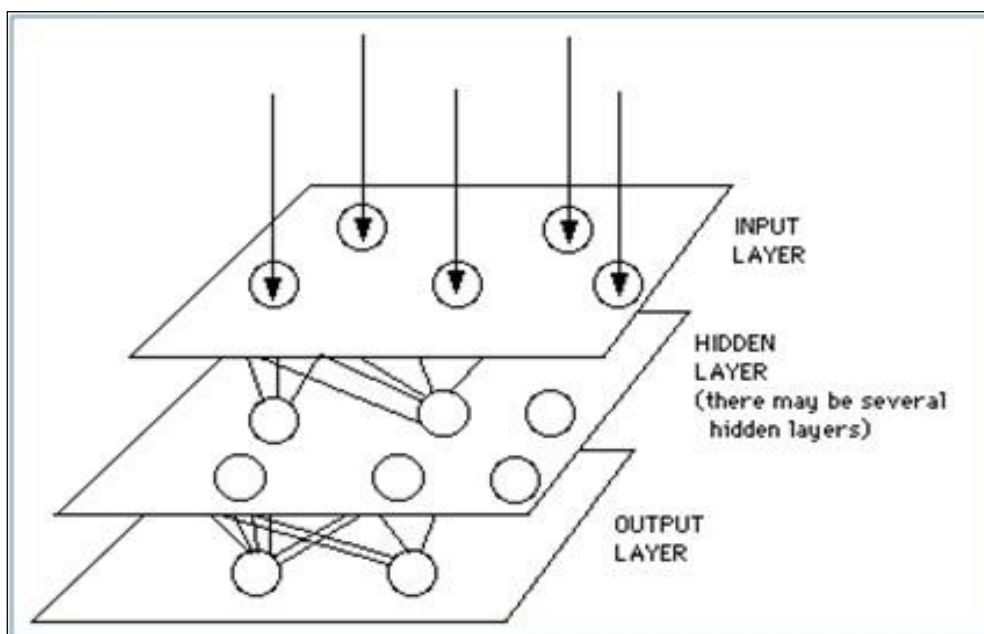
GROUP		UPPER LIP CURVE				
		PRE	POST	LIP CURVE CHANGE		
				MEAN+/-SD	MIN	MAX
4/4 Extraction		4.85+/-1.26	3.71+/-1.79	1.14+/-0.66	-0.1	1.7
4/5 Extraction		5.56+/-1.41	3.62+/-1.56	1.94+/-1.84	-0.1	5.7
5/5 Extraction		4.25+/-1.69	3.86+/-1.43	0.39+/-0.58	-0.5	1.4
Non Extraction		3.74+/-1.01	3.41+/-1.84	0.33+/-1.77	-5.1	2.7
ANOVA	F				3.14	
	P				0.04*	
GROUP		LOWER LIP CURVE				
		PRE	POST	LIP CURVE CHANGE		
				MEAN+/-SD	MIN	MAX
4/4 Extraction		8.37+/-1.09	7.44+/-2.81	0.93+/-3.03	-4.6	3.8
4/5 Extraction		5.65+/-2.43	3.99+/-1.43	1.66+/-3.66	-2.8	5.3
5/5 Extraction		6.73+/-1.1	6.59+/-1.69	0.14+/-0.71	-0.7	3.2
Non Extraction		6.15+/-2.46	6.74+/-2.16	-0.59+/-2.97	-6.4	4.3
ANOVA	F				0.83	
	P				0.49 <sup>NS</sup>	

F – Variance ratio, \* = P< 0.05 NS= Non-significant

**Table 4: Stepwise regression predictions of upper and lower lip curvatures following extraction and non-extraction treatment**

GROUPS	POST TREATMENT LIP CURVE CHANGES	PREDICTION EQUATION	SE	R <sup>2</sup> %
4/4 Extraction	ULCC	ULCC = 3.13 - 0.42 (ULC)	0.5	60.40%
	LLCC	LLCC = -3.24 + 0.52 (LLC)	2.9	7.30%
4/5 Extraction	ULCC	ULCC = -3.61 + 1.07 (ULC)	1.9	42.70%
	LLCC	LLCC = -6.24 + 1.41 (LLC)	0.9	95.30%
5/5 Extraction	ULCC	ULCC = -0.48 + 0.24 (ULC)	0.06	30%
	LLCC	LLCC = 5.65 - 0.76 (LLC)	1.3	32%
Non-Extraction	ULCC	ULCC = -1.01 + 0.35 (ULC)	1.79	4.10%
	LLCC	LLCC = -5.77 + 0.84 (LLC)	2.2	49%

ULCC=Upper lip curvature change, LLCC= Lower lip curvature change, SE = Predicted Variation, R<sup>2</sup> = Explained Variance



**Fig. 1: The structure of an artificial neural network**

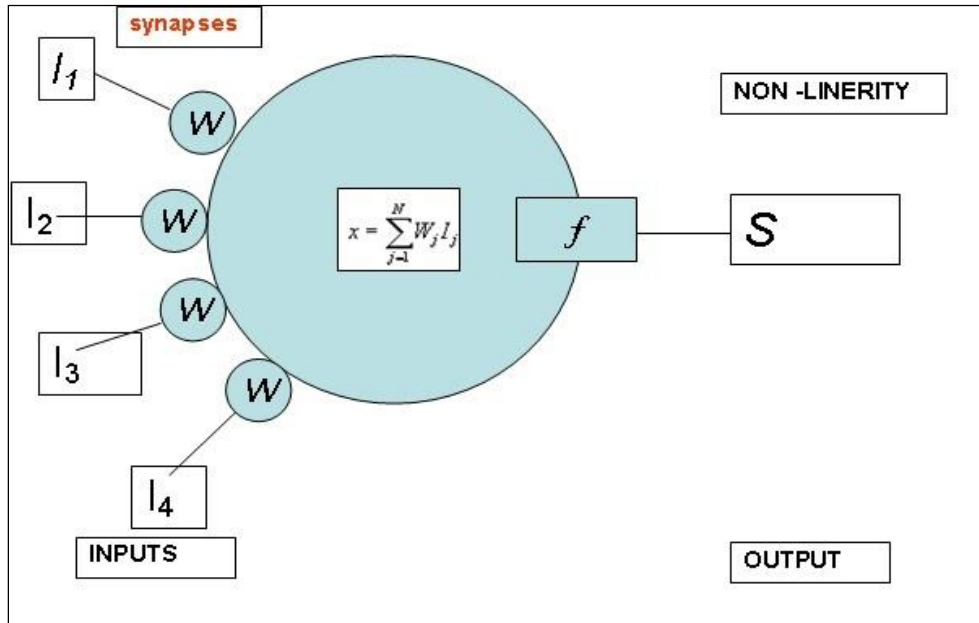


Fig. 2: The basic components of an artificial neuron

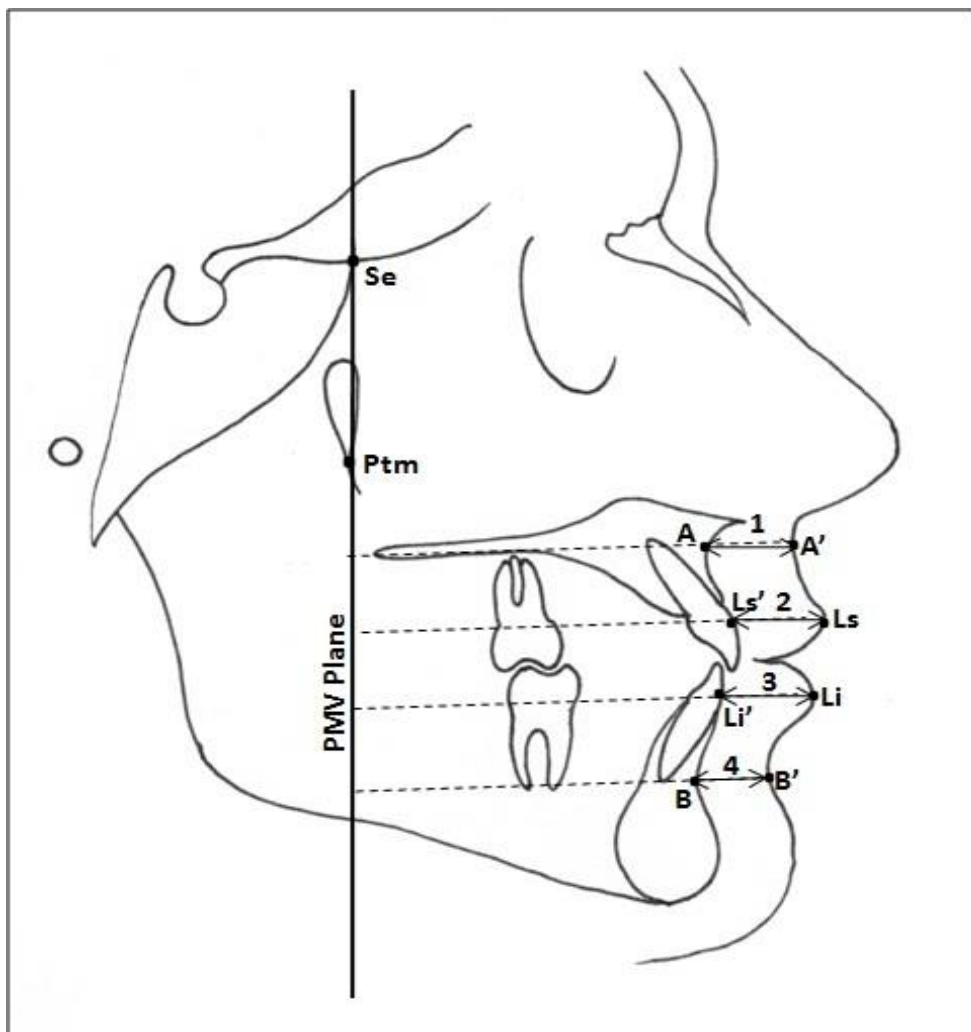
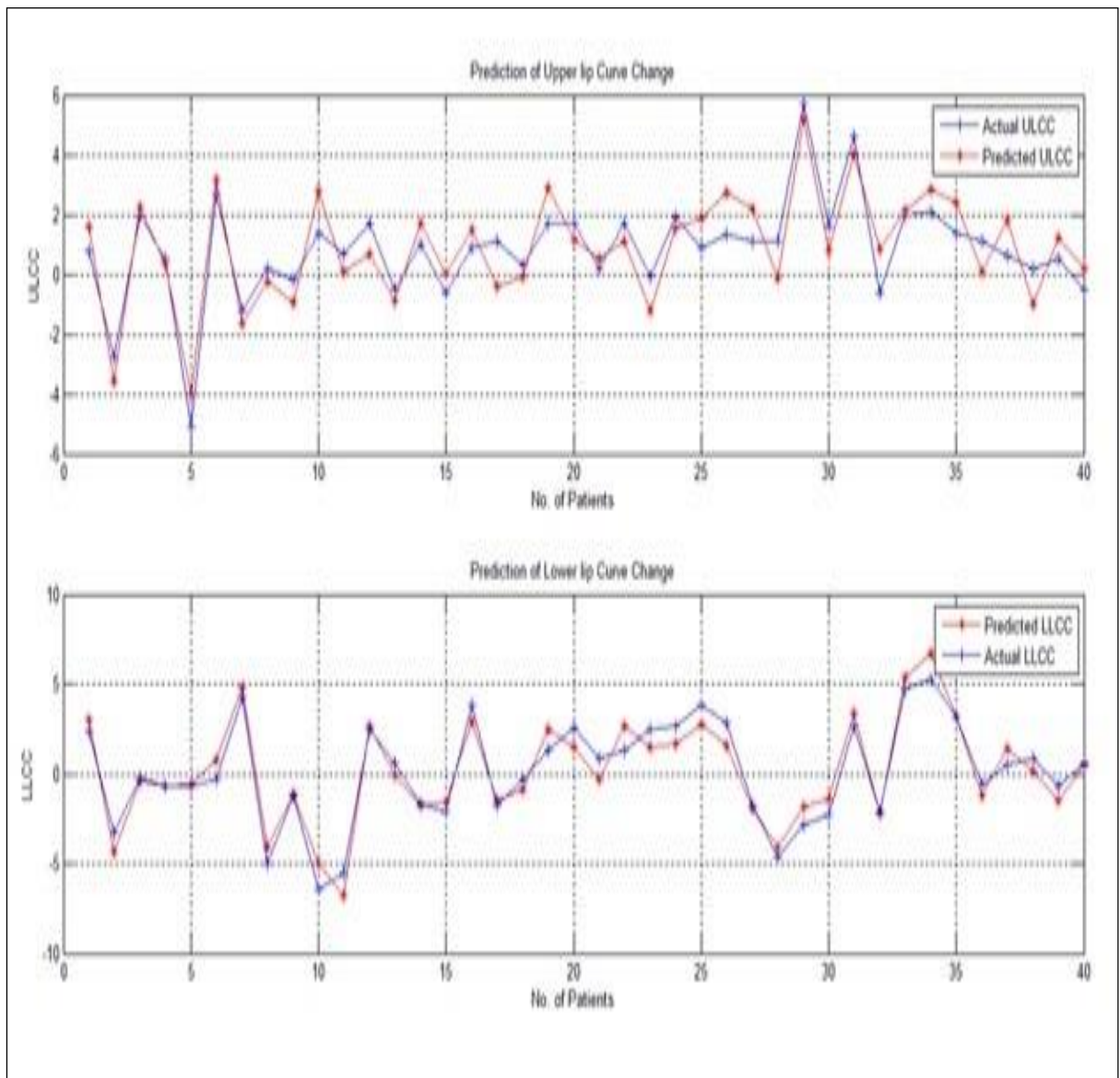


Fig. 3: Various cephalometric landmarks, reference planes and linear parameters used for the evaluation of upper and lower lip curvature changes. Cephalometric landmarks: Sphenoethmoidal point (Se), the intersection of the

greater wings of the sphenoid with the floor of the anterior cranial fossa; Pterygomaxillary point (**Ptm**), the inferior and most posterior point on the anterior outline of the pterygomaxillary fissure; Point A (**A**); Projected point A (**A'**), point constructed where a line, perpendicular to PMV plane and passing through skeletal A point intersects the soft tissue outline; Labrale superius (**Ls**); Projected labrale superius (**Ls'**), point constructed where a line perpendicular to the PMV plane and passing through labrale superius intersects the hard tissue outline; Labrale inferius (**Li**); Projected labrale inferius (**Li'**), point constructed where a line perpendicular to the MPV plane passing through labrale inferius intersects the hard tissue outline; Supramentale point (**B**); Projected supramentale point (**B'**), the point of intersection of the soft tissue profile with a line drawn perpendicular to PMV plane through supramentale (B point). *Reference plane*: Pterygomaxillary vertical (PMV) plane, plane drawn from the sphenothmoid point (Se) to the pterygomaxillary (Ptm) point. *Linear parameters*: 1. Upper lip thickness at Point A (A-A'); 2. Upper lip thickness at labrale superius (Ls-Ls'); 3. Lower lip thickness at labrale inferius (Li-Li'); 4. Lower lip thickness at B point (B-B').



**Fig. 4:** The neural network prediction values for the upper and lower lips curvature changes.

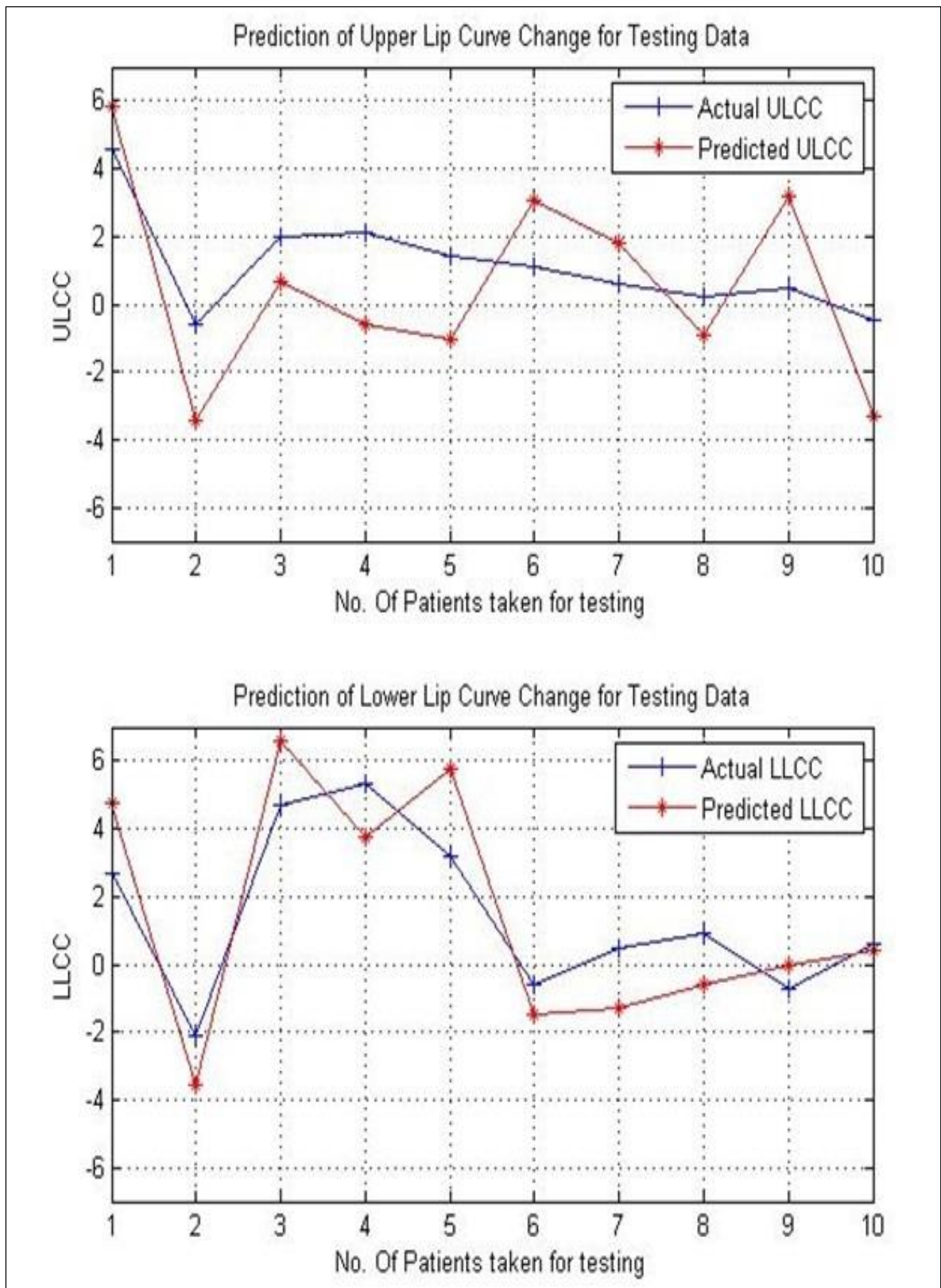


Fig. 5: Prediction of upper and lower lip curve change for the testing data.

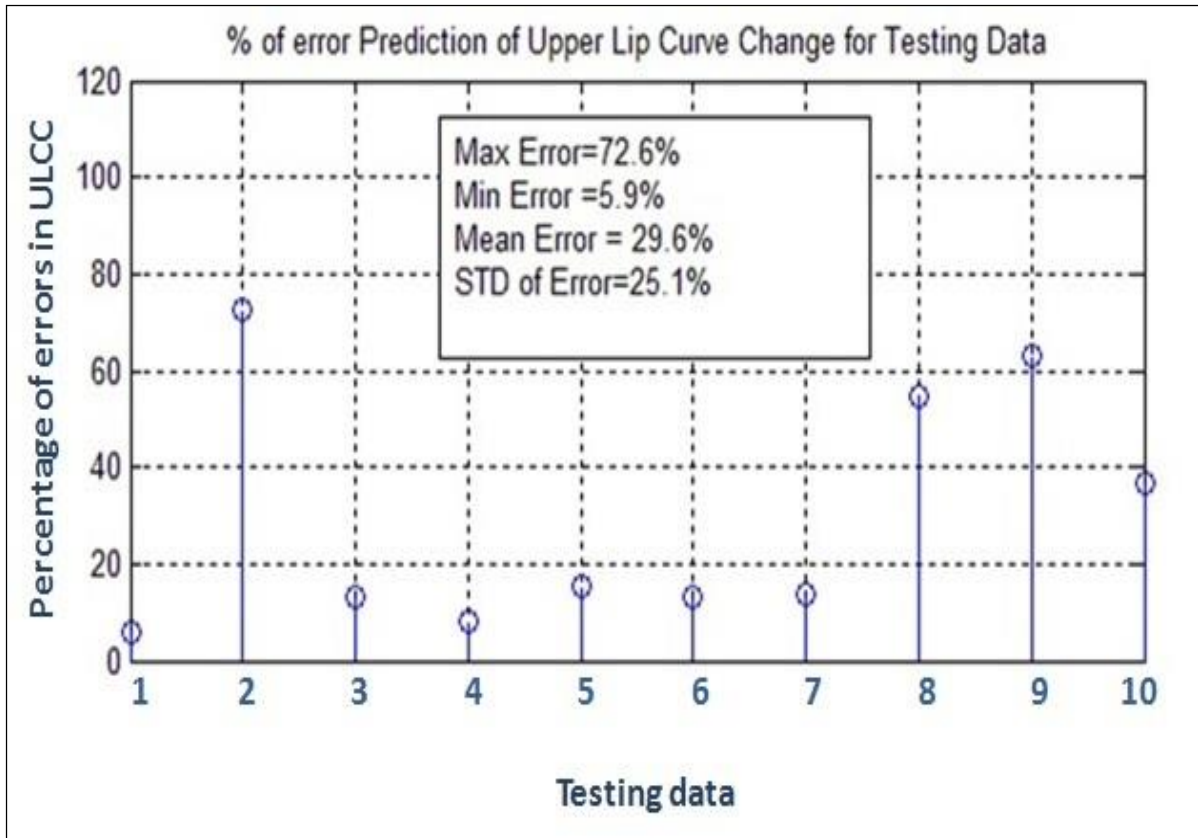


Fig. 6: The comparison of percentage of mean error in the prediction of upper lip curve change for testing data by ANN analysis and regression analysis.

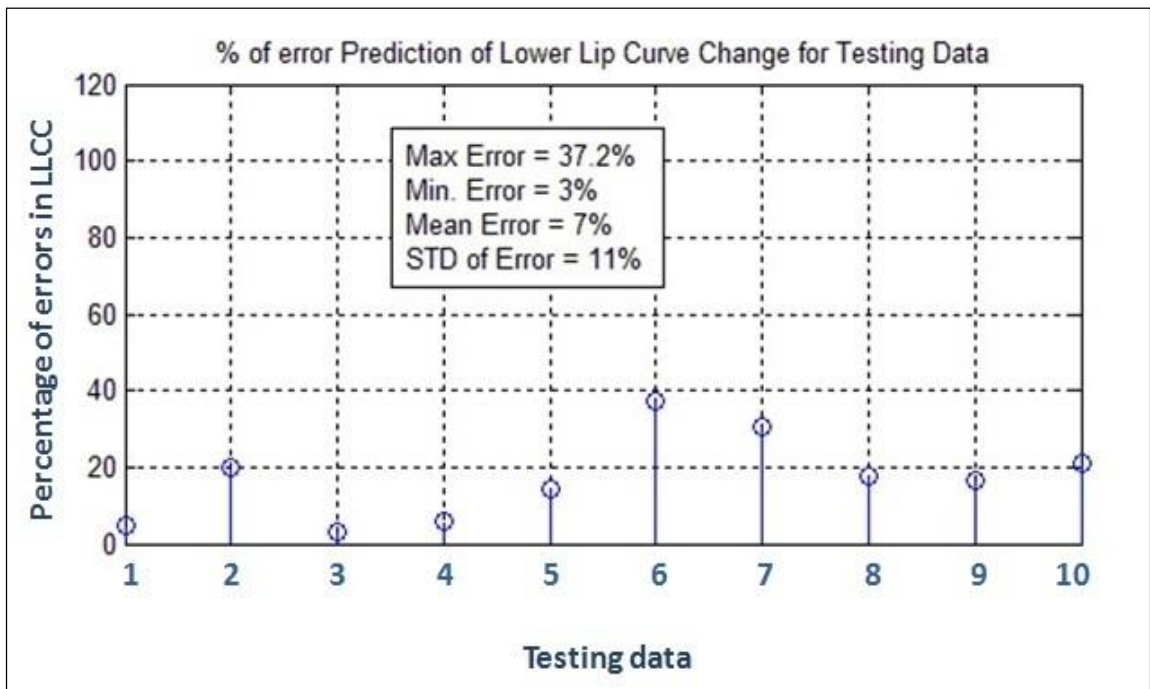


Fig. 7: The comparison of percentage of mean error in the prediction of lower lip curve change for testing data by ANN analysis and regression analysis.

## DISCUSSION

Artificial neural network (ANN) models have been used widely in medicine for solving a wide variety of problems.<sup>12-17</sup> However in dentistry, ANN models have been tried occasionally.<sup>6,8,18-20</sup> In orthodontics, ANN models have been used for the analysis and classification of human craniofacial growth,<sup>6</sup> prediction of electromyographic signal values of anterior temporal muscle among children undergoing orthodontic treatment<sup>7</sup> and deciding the need of extractions prior to orthodontic treatment.<sup>8</sup>

From the present study we found that the mean change in the depth of upper lip curvature following premolars extraction treatment was significantly different as compared to the non-extraction treatment. However, there was no change in lower lip curvature following premolars extraction and non-extraction treatment. However in contrast to our observation many previous studies reported no change in the depth of upper and lower lip curvature amongst the various extraction and non-extraction treatment.<sup>21,22</sup> The inherent morphology of the soft tissue appeared to be the greatest determinant of lip curve behavior with extraction and non-extraction treatment.<sup>22</sup> Wholley and Woods also reported that changes in the depths of curvature of both the upper and lower lips were not solely dependent on the selection of a particular premolar extraction sequence.<sup>23</sup> Instead, there were wide ranges of individual variation in the changes in the depths of the lip curves.<sup>23</sup> From the present study it was appear that the change in midface soft tissue was more dependent on changes in the underlying hard tissue as compared to the lower face soft tissue. But previous study done by Moseling and Woods reported that the midface soft tissue was less dependent on changes in the underlying hard tissues than do the lower face soft tissue.<sup>21</sup>

An important observation that we found from the stepwise regression predictions (table-2) was that only prediction of lower lip curve change following upper first and lower second premolars extraction was good enough with 95.3% explained variance. Although the ANN predicted values for upper and lower lip curvature changes were very close to the actual prediction values obtained from statistical regression analysis, but the mean error was only 29.6% for upper lip and 7% for lower lip as compared to the conventional regression analysis. The major drawback of this present study is that the ANN model was trained with data of only 40 subjects. Thus an ANN model from data of very large samples needs to be prepared to establish an accurate decision making system.

Thus the artificial neural network analysis can be the solution to those problems which cannot be easily solved with traditional methods. Neural network expert systems may be trained with only clinical data

and as such can be used where 'rule based' decision making may not always be possible. So the artificial neural network analysis is a promising tool to produce clinical decision support systems (CDSS) to provide expert support for health professionals. As information technology applications for dental practice developing rapidly and will hopefully contribute to produce clinical decision support systems (CDSS) of orthodontics and in turn impact patient care.

## CONCLUSIONS

The following conclusions were drawn from the present study

1. Extraction and non-extraction treatment had significant effect on the curvature of upper lip change.
2. The ANN model analysis was more accurate for the prediction of lip curvature change following extraction and non-extraction orthodontic treatment as compared to the conventional statistical regression analysis.

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**How to cite this article:** Nanda SB, Kalha AS, Jena AK, Bhatia V, Mishra S. Artificial neural network (ANN) modeling and analysis for the prediction of change in the lip curvature following extraction and non-extraction orthodontic treatment. *J Dent Specialities* 2015;3(2):130-139.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Detection of apoptosis in human periodontal ligament during orthodontic tooth movement

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## ABSTRACT

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Received: 10/01/2015

Accepted: 15/04/2015

## INTRODUCTION

The Mechanical force during tooth movement was reported to create compressed and cell-free areas, so called hyalinized tissue, in the periodontal membrane (Reitan and Rygh 1994). Hyalinized tissues were described as necrotic (Rygh 1972, 1973) or degenerating (Nakamura, Tanaka and Kuwahara, 1996) tissue from ultra-structural observations. The precise mechanism by which periodontal ligament cells disappear at the compressed area during tooth movement remains unclear. In the present study we examined whether periodontal ligament cells undergo apoptosis at the compressed area during tooth movement by using terminal deoxynucleotidyl transferase-mediated dUTP nick end labeling (TUNEL).

**Aim:** To compare distribution of apoptotic cells in the Periodontium following Orthodontic force application, to study the apoptotic index and co-relate with different phases of tooth movement.

**Material and methods:** 100 patients, age 12-20 years, of class II div 1 malocclusion, were randomly divided into Groups I to V, requiring first premolars extraction with fixed Mechanotherapy. After leveling, canine was retracted using closed coil spring (100 gm forces). Surgical extraction of premolar was performed on 0, 3,7,14 & 21 days. Periodontium tissue was processed and apoptosis was evaluated by TUNEL assay. Apoptotic cells were counted from 4 different fields per slide and compared with the basal group.

**Results:** The mean Apoptotic Index increased from day 3 and peaked at day 7 for both compression and tension sides. On tension side, at days 14 & 21 apoptosis wasn't significant indicating earlier recovery. On compression side, there is more gradual decrease in apoptosis with lowest mean values at day 21, though not same as the basal level, indicating that the periodontal tissues require more than 21 days for complete recovery. The overall difference in apoptotic rate was statistically significant for both compression and tension sides.

**Conclusion:** Tissue response is a time-dependant normal physiological process where periodontal cells are cleared by apoptosis. The correlation coefficient value indicates the apoptotic activity increased with force on compression side & increased significantly on tension side too, signaling towards force-dependant direct relation between the two. Cells on tension side showed a more rapid rate of recovery as compared to compression side.

**Keywords:** Periodontium, Orthodontic, Mechanotherapy, Force-dependant

## OBJECTIVES

1. To study the Apoptotic Index in the periodontal tissue clearance during tooth movement.
2. To compare tissue changes in the Periodontium on the 3<sup>rd</sup>, 7<sup>th</sup>, 14<sup>th</sup> & 21<sup>st</sup> day after application of orthodontic force.
3. To correlate the above findings with different phases of orthodontic tooth movement.

## MATERIAL AND METHODS

The study comprised of 100 patients, age 12-20 years, having Class II division 1 malocclusion requiring first premolars extraction to be treated with Fixed Mechanotherapy using Standard edgewise Prescription (0.022"×0.028" slot). Leveling and alignment was done using .016", 018" and .020" stainless steel wires. Sentalloy closed coil springs were attached between canine & first premolars (200 grams force). Ethical clearance was obtained from the Ethics Committee of All India Institute of Medical Sciences, New Delhi with reference number (A-11-6/4/05) dated 8 August 2005. Written consent was obtained from each patient prior to their inclusion in the study. The patients were divided into five groups on the basis of the staging of the premolar extraction with respect to time. (Table 1)

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	DOI: 10.5958/2393-9834.2015.00003.0



1. Group I—no force was applied
2. Group II—force applied for 3 days
3. Group III—force applied for 7 days
4. Group IV—force applied for 14 day
5. Group V—force applied for 21 days

In Group I, the 1<sup>st</sup> premolar teeth were extracted prior to any force application. In the other groups, force was applied prior to 1<sup>st</sup> premolars extraction.

#### Procedure for Extraction of Premolar:

A Crevicular incision was made around the premolar tooth. Two vertical incisions were given on the buccal surface on the mesial and distal aspects of the tooth, followed by placement of two vertical osteotomy incisions with Tungsten Carbide Surgical burs, on the buccal surface in the mesial and distal aspect of premolar. Horizontal osteotomy cut joining the mesial & distal vertical cuts was given. During osteotomy, lingual cortical plate was preserved.

#### Tissue Sample Collection:

The extracted teeth, along with their Periodontium, were collected and were frozen at -70°C and subsequently, fixed with Zambanis fixative solution. The fixed tissues were dehydrated with graded alcohol & embedded in paraffin. Sections of Periodontium, 6µ thick, were then cut & mounted on Polylysine-coated glass slides.

Henceforth, TUNEL assay was carried out to detect apoptosis. The Dead End™ Colorimetric TUNEL System is a non-radioactive system designed to provide simple, accurate and rapid detection of apoptotic cells in situ at single-cell level. The slides were observed under 20 X magnifications. TUNEL-positive cells were counted from 4 different fields on each slide, with 500 cells per field.

The Apoptotic Index, was determined using the formula

$$AI = \frac{\text{Total no. of cells showing apoptotic nuclei} \times 100}{500 \times 4}$$

#### STATISTICAL ANALYSIS

SPSS 12 software was used for all statistical analysis. The control group (group I) & the experimental groups (group II to V) were compared for the mean number of TUNEL- positive cells by applying one way ANOVA and Kruskal Wallis test. Statistically significant value was placed at  $p < 0.05$ . Further the compression site was compared to the tension site in the experimental group by ANOVA test and  $p < 0.05$  was considered statistically significant.

## RESULTS

#### Day 0, (Group I)

On compression side, the Mean Apoptotic Index was found to be  $2.22 \pm 0.76$  with a range of 1.87-2.5 (p value .001). On tension side, the Mean Apoptotic Index was found to be  $1.22 \pm 0.46$  with a range of 1.0-1.4 (p value .014). The Mean Apoptotic Indices on compression & tension sides at day 0 had a direct correlation seen at .47 which was found to be statistically significant (p value .03).

#### Day 3, Group II

On compression side, the Mean Apoptotic Index was found to be  $4.91 \pm 2.5$  with a range of 3.7-6.08 (p value .001). On tension side, the Mean Apoptotic Index was found to be  $2.66 \pm 1.43$  with a range of 1.9-3.3 (p value .001). The Mean Apoptotic Indices on compression & tension sides at day 0 had a direct correlation seen at .63 which was found to be statistically significant (p value .003).

#### Day 7, Group III

On compression side, the Mean Apoptotic Index was found to be  $12.75 \pm 2.9$  with a range of 11.3-14.1 (p value .001). On tension side, the Mean Apoptotic Index was found to be  $6.56 \pm 3.13$  with a range of 5.1-8.03 (p value .14). The Mean Apoptotic Indices on compression & tension sides at day 0 had a direct correlation seen at .19 which was found to be statistically non-significant. (p value .41).

#### Day 14, Group IV

On compression side, the Mean Apoptotic Index  $\pm$  S.D. was found to be  $8.28 \pm 2.9$  with a range of 6.9-9.6 (p value .001). On tension side, the Mean Apoptotic Index  $\pm$  S.D. was found to be  $3.53 \pm 1.77$  with a range of 2.7-4.3 (p value .12). The Mean Apoptotic Indices on compression & tension sides at day 0 had a direct correlation seen at .67 which was found to be statistically significant (p value .001).

#### Day 21, Group V

On compression side, the Mean Apoptotic Index was found to be  $5.47 \pm 1.23$  with a range of 4.8-6.05 (at 95% confidence interval, p value .43). On tension side, the Mean Apoptotic Index  $\pm$  S.D. was found to be  $3.14 \pm 1.03$  with a range of 2.6-3.6 (p value .4). The Mean Apoptotic Indices on compression & tension sides at day 0 had a direct correlation seen at .46 which was found to be statistically significant (p value .04).

The Mean Apoptotic Index on compression side in control group at day 0 as  $2.22 \pm 0.76$ . At day 3, the cell index had increased to  $4.91 \pm 2.5$  which was found to be statistically significant (p value .001). The Mean Apoptotic Count continued to increase and the

highest values were observed on day 7 (12.75±2.9). It decreased thereafter, as observed on day 14 (8.28±2.9) and day 21 (5.47±1.23).

The counts at day 7 & day 14 were statistically significant (p value .001) while the value observed at day 21 did not show a statistically significant difference when compared to day 0, although the count had not reached the observed count at day 0.

The Mean Apoptotic Index on tension side in control group at day 0 was 1.22±0.46. At day 3, the cell index had increased to 2.66±1.43 which was found to be statistically significant (p value < .05). The count continued to increase and the highest values were observed on day 7 (6.56±3.13) and decreased thereafter. The counts observed at day 14 (3.53±1.77) and day 21 (3.14±1.03) did not show any significant difference in their values and the mean indices were almost twice that at day 0 (1.22±0.46).

The cell count at day 7 was statistically significant (p value .001) but at day 14 & 21, no statistically significant difference (p value > .05) was observed when compared to day 0.

The overall apoptotic activity was found to be statistically significant for both compression and tension sides (p value < .05), irrespective of time.

A direct correlation of apoptotic activity between compression side & tension side was seen at day 3 (.63), day 14 (.67) & day 21 (.46), which was statistically significant (p value < .05).

At day7, the correlation had lower positive value (0.19) that wasn't statistically significant (p value > .05).

The overall correlation coefficient (0.73) of apoptotic activity on compression side with tension side was statistically significant (p value .001), signaling a direct relation between the two.

With respect to age and sex, no statistically significant difference in correlation of apoptosis on compression and tension sides was seen. (Table 2)

The apoptosis of periodontal cells on compression side with respect to time was statistically significantly (p value < .05) and on tension side was insignificant.( Fig 1)

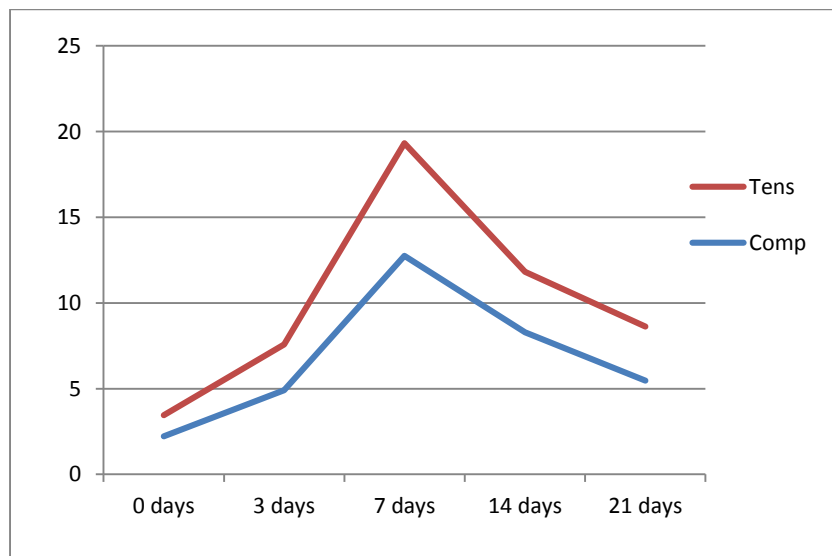
**Table 1: Distribution of sample into 5 groups**

Group	Sample	Mean age	Duration after which force applied
Group I	10 M & 10 F	13.5 years	no force
Group II	10 M & 10 F	16 years	3 days
Group III	10 M & 10 F	14.29 years	7 days
Group IV	9 M & 11 F	14.2 years	14 days
Group V	11 M & 9 F	14.23 years	21 days

M: male, F: female

**Table 2: Trend of average values of apoptotic index during the study on tension & compression sides**

	0 days	3 days	7 days	14 days	21 days
<b>Comp</b>	2.2265	4.91	12.755	8.283	5.4715
<b>Tens</b>	1.2255	2.6605	6.569	3.5385	3.145



**Fig. 1: Trend of average values of apoptotic index during the study on tension & compression sides**

## DISCUSSION

All connective tissues within the body are in a constant state of flux, synthesizing, degrading and reorganizing both the macro and micro molecular components of the matrix to maintain their structural and functional integrity. The state is considered to be of dynamic equilibrium wherein the catabolic and the anabolic processes act in synergy. This is of particular importance in the periodontal connective tissues, since the periodontal ligament is known to have a high cellular turnover rate and is under constant occlusal and non-occlusal loading forces.

The basis of orthodontic movement lies in the very fact that this dynamic equilibrium can be disturbed by the application of orthodontic forces which alter the local environment thus leading to selective areas of heightened cellular activity within the periodontal ligament which further leads to selective remodeling of the supporting alveolar bone. Under normal physiologic conditions, a tooth is considered to be at 'rest' in its socket. Application of light orthodontic force is known to cause direct resorption of the adjacent bone interface as periodontal ligament vitality is preserved, thus allowing the osteoclasts to cause bone resorption from the adjacent vital periodontal ligament-bone interface. Thus, such forces are considered to be more physiologic and efficient in causing tooth movement. Thus, the control of orthodontic forces becomes extremely important and desirable to perform physiologic tooth movement.

One of the important indicators of direct resorption is the presence of apoptotic cells in the adjacent periodontal ligament bone interface. Studies have shown that apoptosis is marker of bone /connective tissue remodeling. Apoptosis plays a crucial role in developing and maintaining health by eliminating old, unnecessary and unhealthy cells without releasing harmful substances into the surrounding area.<sup>1</sup> The cell demise via apoptosis is a genetically controlled energy dependent, and takes place via a coordinated, predictable and predetermined pathway. Jilka et al demonstrated that the missing osteoblasts die by apoptosis and those growth factors and cytokines produced in the bone microenvironment influence this process.<sup>2,3,4</sup> Drugs have also been known to effect apoptosis.<sup>5,6</sup>

In our study, we have tried to evaluate the efficacy of light orthodontic forces in causing direct remodeling of the adjacent bone surface studied by analyzing the number of apoptotic cells in the periodontal ligament of the teeth subjected to light forces at different time intervals, since apoptosis is an indicator of physiologic cell death and thus, would be more closely related to direct bone resorption. It has been already proved by W Zhong that cyclic stretching force induces early apoptosis of periodontal ligament cells.<sup>7</sup>

The main aim of our study was to determine whether apoptosis of periodontal cells occurs during orthodontic tooth movement and when apoptotic activity reaches a maximum level. It was found that significant apoptosis of cells does occur on both compression and tension sides, irrespective of time interval. Noxon et al reported that osteoclasts are at least cleared in part by apoptosis during experimental tooth movement in rats.<sup>8</sup>

As orthodontic force is applied, a signaling cascade ensues causing release of the biochemical molecules in periodontal ligament. These molecules in turn cause a transient inflammatory response and cell death leading to an increase in observed apoptosis. As we applied force over a period of 21 days, cell apoptosis started increasing from day 0 to day 3. It signifies that apoptotic changes start appearing in the early phase of orthodontic tooth movement and this time period varies from 0 to 3 days. Studies by Hamaya et al reveal that osteocytes showed apoptotic morphology at 6 hours, 12 hours and 1 day.<sup>9</sup> At 2 and 4 days, several osteocytes exhibited characteristics of necrosis and destructive images of the surrounding bone matrix. In similar studies by Hatai et al, TUNEL-positive staining of periodontal ligament cells began to appear at the compressed areas 12 hours after tooth movement in mice, being maximum at 24 hours and disappearing at 48 hours, with direct and undermining bone resorption beginning at the same area 72 hours after tooth movement.<sup>10</sup> PGE samples in alveolar bone peaked at 2 & 7 days (Joseph 1986), IL-1 $\beta$  and IL-6 was observed to reach a maximum on day 3 and to decline thereafter (Alhashimi et al, 2001).<sup>11,12</sup>

The biochemical signal molecules can also be detected in GCF during experimental tooth movement, provided plaque and other systemic conditions do not interfere with the cellular responses. The time period when the levels of these biomolecules are raised can be correlated with the onset of apoptosis (0 to 3 days in our study) and its peak activity (day 7 in our study). Of significance acid phosphatase is recognized as an important marker of osteoclast activity and bone resorption, whereas bone-specific alkaline phosphatase has been reported as a biomarker indicative of bone formation. Christenson<sup>13</sup> reported that alkaline phosphatase was observed to peak during the first 3 weeks of treatment, while acid phosphatase was seen to increase over the subsequent 3–6 weeks following initiation of treatment (Insoft *et al*).<sup>13,14</sup> IL-8 concentration in the GCF show gradual increase up to 10 days and declined on day 30 at the compression & tension sites (Tuncer et al).<sup>15</sup> Induction of IFN-gamma at both m-RNA and protein levels was significantly higher on day 3. The signal gradually became stronger on day 7 and remained high on day 10 (Alhashimi et al).<sup>16</sup> CD40 is a cell surface receptor

(expressed on monocytes, dendrite cells, and IL-6 or IL-8 secretion by ligation of endothelial cells, basophiles, epithelial cells, and fibroblasts) which belongs to the tumor necrosis receptor family (TNF-R). The strongest expression of CD40<sup>+</sup> was observed on day 3, decreased on day 7, and reached a low level on day 10 after application of orthodontic force. In contrast, in the treated animals CD40 ligand was expressed on day 3, the expression was enhanced on day 7, and was more pronounced on day 10. CD40L-expressing cells were found predominantly around hyalinized tissue in the resorption zone and the tension areas (Alhashimi et al).<sup>17</sup> Xiaozhe et al assessed the biological relevance between SFRP1 expression and the onset of apoptosis.<sup>18</sup> The number of TUNEL-positive fibroblasts gradually increased in the periodontal ligament 12 hours after the application of mechanical stress, sharply raised at 24 hours and peaked at 2 days. Simultaneously, an increased SFRP1 expression was seen in mice periodontal ligament during force-induced apoptosis. As quoted in the above discussion, it can be seen that the initial phase varies between 0 to 3 days and peak between 4 to 7 days, these findings support our results of beginning of apoptosis and maximum apoptosis observed in our study.

Our study reveals that significant amount of apoptosis occurs at days 3, 7 and 14 on compression side and at days 3 & 7 on tension side. Even Noxon et al, (2005) had reported that significant difference existed in the overall percentage of TRAP/ApopTag-positive nuclei between the control and the treatment groups at 3, 5, and 7 days.<sup>4</sup>

Maximum activity was seen at day 7 for both compression and tension sides. Rana et al suggested that maximum apoptosis occurs approximately 3 days after the insertion of appliance in the periapical tissue but the study was conducted in rats.<sup>19</sup> Though the peak apoptotic activity was usually observed around 2-3 days (as quoted in the above studies), but most of them were conducted in rats. The rate of metabolism varies in rats and humans the morphological changes, which take 2 days in humans to appear, are seen as early as 2hrs in rats. This might explain the variation in the time period of peak apoptosis observed.<sup>20,21</sup>

In our study, though significant apoptotic activity was seen at day 14 on compression side but it had started decreasing when compared to day 7 and as it approached day 21, no significant apoptosis occurred. Whereas on tension side, apoptotic activity had reduced at day 14 & 21, but it wasn't significant. This highlights upon the fact that removal of dead cells and their replacement on tension side begins after 7 days of force application but on compression side it starts after 14 days of force application These findings are supported in the study conducted by Mabuchi et al who investigated the cellular responses of periodontal ligaments during tooth movement and

found that the ratios of PCNA-positive cells on the tension side 3 and 7 days after rubber block insertion were higher than those on the pressure side.<sup>22</sup> The ratios of PCNA-positive cells on the tension side were highest at day 3 after insertion and then decreased during the remainder of the experimental period. On the pressure side, the ratios of PCNA-positive cells increased up to day 10 post insertion, and then decreased from 14 to 28 days. The ratios of TUNEL-positive cells on both the tension and the pressure sides increased throughout the entire experimental period.

The level of activity on both compression and tension sides hadn't reached the basal level at day 21. Even Yijin et al revealed that maximum number of osteoclasts in PDL are seen from 2 weeks to 4 weeks during experimental tooth movement in rats with a positive correlation between the rate of tooth movement and osteoclast numbers, especially in young rats.<sup>23</sup> This clearly indicates that the cells take more time (i.e. >21 days) to recover to their state of physiologic equilibrium. Moreover, it is a well established fact that upon appliance activation, the stressed periodontal tissues need a period of at least 3-4 weeks for recovery. This again supports our findings why the mean apoptotic index could not reach the basal level at day 21.

A direct correlation between compression & tension was observed as increase in apoptotic activity with force on compression side led to its increase on tension side too, signaling towards a force-dependant direct relation between the two.

No correlation of apoptotic activity was seen with respect to age & sex which is in accordance to previous studies.

Present study is based on assumption that the morphology of alveolar bone is same in both the maxilla and mandible and hence, their physiological apoptotic activity will be same, regardless of whether maxillary or mandibular premolar is extracted.

## CONCLUSION

- Orthodontic tooth movement is a physiologic process rather than pathologic that causes remodeling of tissues via apoptosis.
- As force is applied, significant apoptosis does occur with time on both compression and tension sides, with peak activity seen at 7 days.
- As apoptotic activity increased with force on compression side, the apoptotic activity increased significantly on tension side too, signaling towards a force-dependant direct relation between the two.
- The level of apoptosis on tension side starts reducing earlier indicating a more rapid recovery of cells as compared to compression side.

Hence, from our study we can conclude that tissue response to orthodontic tooth movement is a time-dependant normal physiological process; the periodontal cells are cleared by apoptosis.

### Acknowledgement

The authors are grateful to Indian Council of Medical Research for providing grant for the study.

### Financial competing interests:

This project received a grant from Indian Council of Medical Research, New Delhi, India. This organization is not financing this manuscript or the article-processing charge.

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**How to cite this article:** Duggal R, Singh N. Detection of apoptosis in human periodontal ligament during orthodontic tooth movement. *J Dent Specialities*. 2015;3(2):140-145.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Assessment of 4% ocimum sanctum and 0.2% chlorhexidine irrigation as an adjunct to scaling & root planing in management of chronic periodontitis - a randomized controlled trial

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## ABSTRACT

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Received: 05/03/2015

Accepted: 18/08/2015

**Background:** Ocimum sanctum is a plant which is of great medicinal value and has various properties for curing and preventing disease. Hence a study was conducted to determine the effectiveness of Ocimum sanctum on bacterial plaque and its comparison with Chlorhexidine gluconate which is considered as the gold standard.

**Materials and Methods:** 30 chronic periodontitis patients were randomized into two groups. Group A received scaling and root planing plus intra-pocket irrigation of Ocimum sanctum (n= 15) and Group B received scaling and root planing plus intra-pocket irrigation with Chlorhexidine gluconate (n = 15). Clinical parameters including the plaque index, gingival index, pocket probing depth and clinical attachment level were assessed at baseline and 30 days. Statistical analysis was carried out using SPSS version 17. Statistical significance of  $P \leq 0.001$  was considered.

**Results:** Our data showed that Ocimum sanctum was equally effective in reducing periodontal indices as chlorhexidine. Significant reduction in all clinical parameters were observed over a period of four weeks in both the test and the control groups.

**Conclusion:** The results of the present study revealed that subgingival irrigation with 4% Ocimum sanctum may prove to be effective owing to its ability in reducing plaque accumulation, gingival inflammation and bleeding and has no side effects as compared to chlorhexidine.

**Keywords:** Chlorhexidine, Ocimum sanctum, Irrigation, Periodontitis

## INTRODUCTION

Periodontitis is an inflammatory disease which causes pathological alterations in tooth supporting tissues and hence leads to loss of periodontal tissues. Scaling and root planing (SRP) is considered as the effective means of treating periodontitis.<sup>1</sup> However, the failure to gain access to deep pockets or furcations often results in a substantial variation in its effectiveness.<sup>2</sup> To compensate for these technical limitations, use of antimicrobials has been established which prevents early microbial recolonization and ultimately ensures significant chances of clinical improvements.<sup>3</sup> From the past four decades subgingival irrigation has been used as a useful adjunct to scaling and root planing for the treatment of periodontal diseases.<sup>4</sup> Subgingival delivery of antimicrobial agents have been shown to be effective both, in office as well as in home hygiene regimes.

Various compounds have been evaluated for their effectiveness on plaque and gingivitis including bisbiguanides such as chlorhexidine gluconate<sup>5</sup> pyrimidines, quaternary ammonium compounds, essential oils<sup>6</sup> phenolic compounds, oxygenating agents, halogens etc. Among these agents, chlorhexidine is the most studied and effective

antiseptic for inhibition of plaque and gingivitis, when used as mouth rinse twice daily<sup>7</sup>.

Topical treatment with 0.2% Chlorhexidine gluconate (CHX) has been found to be particularly efficacious for the control of supragingival plaque<sup>8</sup> but simple mouthrinses do not allow access of the substance to the subgingival area.<sup>9</sup> It has been recently shown that subgingival irrigation with CHX seems to cause significant changes in both clinical and microbiological parameters in humans<sup>10,11</sup> and animals<sup>12</sup> although some observations contradict these findings.<sup>13</sup>

Medicinal plants are widely used in curing and controlling various diseases in day to day practice. Despite the presence of extracts of herbs, or synthetic chemicals based on herbs in modern day medicine still the natural form offers less side effects and a cheaper alternative to pharmaceutical drugs.<sup>14</sup> Ocimum sanctum is one such natural substance, also known as the "Queen of herbs". In ancient literature, it is considered as a sacred medicinal plant and is frequently mentioned as one of the main pillars of herbal medicine. Tulsi has been renowned as a general tonic and vitalizer, "The Elixir of Life".<sup>14</sup> Oil of O. sanctum contains five fatty acids (stearic, palmitic, linoleic, oleic and linolenic acids) which is considered to be a good source of beta carotene, calcium, vitamin C. Also, it contains various volatile substances (including estragol, eugenol, linalool, methyl chavicol and small quantities of methyl cinnamate, cineole, and other terpenes), tannins, camphor, flavonoids, triterpene, urolic acid. Leaves are diaphoretic and antiperiodic which are used in patients suffering from bronchitis, gastric and hepatic disorders. Decoction of leaves is often recommended

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	DOI: 10.5958/2393-9834.2015.00004.2

for cough, malaise and in cold. It is a good mosquito repellent as well. Oil extracted from flowers can also be used to cure skin diseases and ring worm infections.<sup>15</sup>

Ocimum sanctum seed oil modulates both humoral and cell mediated immune responsiveness as well as it inhibits acute as well as chronic inflammation. The essential oil and seed extract act by the inhibition of cyclo-oxygenase and lipoxygenase pathways.<sup>16</sup> It may be considered as a drug of natural origin which has both the anti-inflammatory as well as the anti-ulcer activity.<sup>17</sup>

As studies related to herbal mouth rinses are lacking and research in this area is necessary to generate the evidence. Hence, this study was planned with the objective to evaluate clinically the efficacy of 4% Ocimum sanctum irrigation in preventing plaque accumulation and gingival inflammation in comparison with commercially available 0.2% chlorhexidine (CHX).

### **MATERIALS AND METHODS**

30 chronic periodontitis patients were selected from the OPD of Department of Periodontology and Oral Implantology, I.T.S Dental College, Muradnagar, Ghaziabad. The experimental procedures were undertaken with the understanding and written informed consent of the patient and the study was approved by the ethical committee of the institution.

A randomized, controlled clinical trial was conducted to compare the efficacy of scaling and root planing plus pocket irrigation with Ocimum Sanctum versus Chlorhexidine in patients diagnosed with chronic periodontitis. Patients of both the sexes between  $\geq 28$  years of age, diagnosed with chronic periodontitis and periodontal pocket measuring  $\geq 5$  mm, patients who were nonsmokers or smoking  $< 5$  cigarettes /day were included in the study. Subjects on antibiotics for last three months and who had undergone periodontal therapy in the past six months, patients with systemic diseases, smokers, alcoholics and patients with less than 8 teeth in the oral cavity were excluded from the study. 30 sites were randomly divided into two groups. In Group A, 15 sites were treated with scaling and root planing plus intra pocket irrigation with Ocimum Sanctum and in Group B, 15 sites were treated with scaling and root planing plus intrapocket irrigation with 0.2% chlorhexidine was done. Each site was irrigated with 2 ml of solution, thrice at 15 minutes of interval.

### **PREPARATION OF EXTRACT**

The extract was prepared as described by Aggarwal et al<sup>18</sup>. The preparation of Ocimum sanctum extract was done in the Department of Pharmacy ITS Dental College Muradnagar.

Leaves of Ocimum sanctum were taken from the institutional nursery and were washed and dried under controlled conditions. The dried leaves were then powdered finely. 300 grams of finely powdered leaves of Ocimum sanctum were then macerated with 100% ethanol for a week in a round bottom flask.

To avoid effect of light on the active ingredients, the flask was kept in dark. Filtration of the extract was done through a muslin cloth for coarse residue and finally through Whatman No. 1 filter paper. To obtain a solid residue of Ocimum sanctum extract, the so obtained filter was reduced at a low temperature  $< 50$  degree Celsius. 18g of residue (extract) was obtained from 300 g of Ocimum sanctum powder dissolved in 1L of ethanol and thus the yield was 6% w/w. A final concentration of 4% (w/v) was obtained after suspending the extract in polyethylene glycol (20% v/v) and sterile distilled water. Flavouring agent 0.005% spearmint oil was also added to the extract (Fig. 1 and 2).

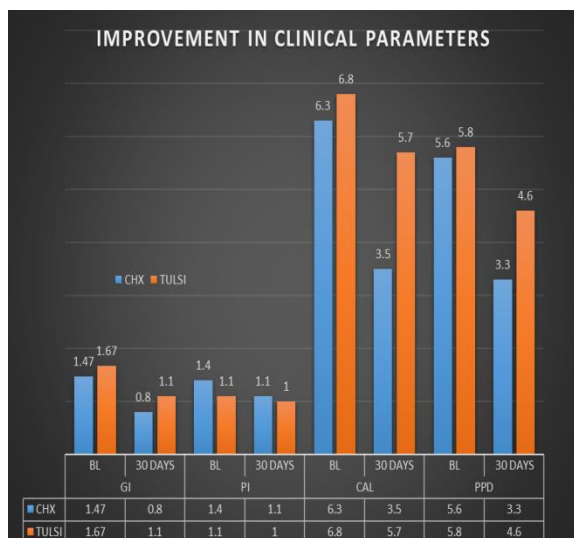
Patients were evaluated after 30 days interval. Periodontal assessments were performed using the Plaque Index using (Turesky Gilmore Glickman modification of Quigley Hein Plaque Index, 1970)<sup>19</sup>, Gingival Index (Loe & Silness, 1963)<sup>20</sup>, Probing Depth and Clinical Attachment Level were measured using UNC 15 probe.



**Fig. 1: Armamentarium for preparation of 4% Ocimum sanctum extract**



**Fig. 2: 0.2% Chlorhexidine gluconate and 4% Ocimum sanctum extract**



Graph 1: Change in clinical parameters at baseline and 30 days between the two groups

Table 1: Change in clinical parameters at baseline and 30 days between the two groups

		0.2% Chlorhexidine	4% Ocimum sanctum	P value
GI	Baseline	1.47 ±0.38	1.67± 0.237	
	30 days	0.875 ±1.13	1.1 ±0.21	< 0.01
PI	Baseline	1.4 ±0.56	1.1 ±0.316	
	30 days	1.1 ±0.316	1.0 ±0.00	<0.331
PD	Baseline	5.6 ±0.576	5.8 ±0.422	
	30 days	3.3 ±0.483	4.6 ±0.576	<0.001
CAL	Baseline	6.3±0.822	6.8±0.422	
	30 days	3.5 ±0.527	5.7 ±0.625	<0.001

### STATISTICAL ANALYSIS

SPSS 17 was used for the results assessment. T test was used to analyze the plaque and gingival index, probing depth and clinical attachment level in the two groups.  $P \leq 0.001$  was considered as statistically significant.

### RESULTS

No statistical differences were observed for baseline variables Table 1. The mean plaque and gingival scores for the Group I, II are depicted in Table 1. T test was used to analyze the reduction in plaque and gingival index, probing depth and gain in clinical attachment level in the two groups. There was a significant decrease in the plaque and gingival index in both the Ocimum sanctum and chlorhexidine groups at 30 days ( $P < 0.001$ ) (Graph 1). Significant reduction was seen in all clinical parameters for both the groups at 30 days, though chlorhexidine group showed better results as compared to Ocimum sanctum group but difference was not statistically significant. The difference in the decrease in plaque and gingivitis between Ocimum sanctum and chlorhexidine groups was not statistically significant. Data showed that there was no significant difference

between Ocimum sanctum and chlorhexidine for any clinical parameters throughout the study.

### DISCUSSION

Our data showed that Ocimum sanctum was equally effective in reducing periodontal indices as chlorhexidine. The results demonstrated a significant reduction in all clinical parameters in both groups over a period of four weeks (Table 1). During the study, Ocimum sanctum reduced plaque formation which may be attributed to the fact that the antibacterial agents present in Ocimum sanctum i.e. Eugenol (1-hydroxy-2-methoxy-4-allylbenzene), Carvacrol (5-isopropyl-2-methylphenol), Linalool (3,7-dimethylocta-1,6-dien-3-ol), Caryophyllene (4,11,11-trimethyl-8-methylene-bicyclo-4-ene), Ursolic acid (2,3,4,5,6,6a,7,8,8a, 10,11,12,13 14-tetradecahydro-1H-picene-4a-carboxylic acid) and Methyl carvicol (also called Estragol: 1- allyl-4-methoxybenzene). Also, the stem and leaves of Ocimum sanctum contain a variety of constituents that forms high molecular weight complexes with soluble proteins in saliva, causes bacterial lysis on the tooth surface and saliva and interferes with bacterial adherence mechanisms on tooth surfaces which may have anti-bacterial activity like the saponins, flavonoids, triterpenoids and tannins.<sup>21</sup>

Our study showed a significant reduction in gingival and plaque scores in Ocimum sanctum, which can be attributed to compounds isolated from Ocimum sanctum extract. Civsilineol, civsimavatine, isothymonin, apigenin, rosavinic acid and eugenol were observed for their anti-inflammatory activity or cyclooxygenase inhibitory activity.<sup>22,23</sup> Singh<sup>24</sup>, Singh and Majumdar<sup>25</sup> in their study reported that the anti-inflammatory effect of Ocimum sanctum may be due to the variable amount of linoleic acid present in the fixed oil which has the capacity to block both the cyclooxygenase and lipoxygenase pathways of arachidonate metabolism. Our results were in accordance with the study done by Gupta et al<sup>14</sup> who stated that Ocimum sanctum mouthrinse may prove to be an effective mouthwash owing to its ability in decreasing periodontal indices by reducing plaque accumulation, gingival inflammation and bleeding and has no side effect as compared to chlorhexidine. However Carlos Alfredo Franco Neto et al<sup>26</sup> revealed no difference in the efficacy of 0.12 to 0.2% chlorhexidine and reported that the former concentration leads to less staining of teeth. Though our study reported no staining of teeth with use of 0.2% chlorhexidine solution. Hosadurga et al<sup>27</sup> used 2% tulsi (Ocimum sanctum) gel in chronic periodontitis and showed significant anti-inflammatory properties for a period of 24-48 hours resulting in reduction of gingival inflammation and reduced pocket depth. Agarwal et al<sup>18</sup> analyzed the effect of various concentrations of the Ocimum sanctum extract ranging from 0.5 to 10%, and it was observed that a 4% concentration of the extract was optimum as an antibacterial agent against bacterial



pathogens of the oral cavity; thus, in the present study, a concentration of 4% was used. Our study also showed significant reduction in pocket depths and gain in the clinical attachment levels over a 30 day period for both the test and the control groups, though there was no significant differences seen when intergroup comparison was done.(Table 1) The results of the study indicated that irrigation with 4 % Ocimum sanctum showed comparable results when compared to 0.2% of Chlorhexidine gluconate.

## CONCLUSION

Both the groups demonstrated reduction in clinical parameters after 30 days from baseline. CHX group depicted better results as compared to Tulsi. However Tulsi can be recommended as a safe herbal alternative for its appreciable clinical results and absence of adverse effects.

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**How to cite this article:** Gaur J, Chandra J, Chaudhry S, Vaish S, Dodwad V. Assessment of 4% ocimum sanctum and 0.2% chlorhexidine irrigation as an adjunct to scaling & root planing in management of chronic periodontitis - a randomized controlled trial. *J Dent Specialities*,2015;3(2):146-149.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Effect of resilient liner on masticatory efficiency and general patient satisfaction in completely edentulous patients

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## ABSTRACT

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Received: 13/09/2015

Accepted: 28/09/2015

**Objectives:** To assess the effect of resilient lined denture on patient masticatory efficiency, general patient satisfaction and denture quality as compare to conventional complete denture over a period of one year.

**Material and methodology:** A total of 28 completely edentulous patients (14 males and 14 females) aged 45 to 60 years, having well-formed ridges were selected following inclusion exclusion criteria. These were divided into two equal groups, i.e. control (provided conventional mandibular complete denture –group 1) and experimental (provided mandibular denture lined with acrylic soft denture liner – group 2). All patients were clinically evaluated to assess the denture quality, and administered questionnaires for masticatory efficiency and patients general satisfaction level at three intervals i.e. one month (T0), 6 months (T1) and 1 year post-insertion (T2).

**Results:** Statistical analysis for individual question for masticatory efficiency showed significantly higher score ( $P < .05$ ) at baseline for experimental group as compared to control. While at six and twelve months time interval, significant differences ( $P < .05$ ) were noted for some questions only. Intra-group analysis showed masticatory efficiency improved significantly over time in controls, while in experimental group masticatory efficiency remained the same ( $p > .05$ ) for almost all the questions. Patient general satisfaction score at different time intervals for each question showed no significant difference ( $P > .05$ ) on inter-group comparison. Time dependant intra-group comparison for patient general satisfaction score also showed no significant difference in scores for almost all the questions for both the groups. Statistical analysis for denture quality showed dentures in experimental group have significantly higher ( $P < .05$ ) scores for denture retention and condition of supporting tissue as compared to control group, while with time denture quality decreased significantly in both the groups.

**Conclusion:** Dentures with soft liner provided better masticatory efficiency while it had no effect on patient's general satisfaction. Denture quality is better for one with soft liners as compare to one without soft liner.

**Keywords:** Edentulism, Masticatory, Efficiency

## INTRODUCTION

Edentulism leads to significant functional impairment, psychological and social changes in the patients.<sup>1</sup> The problems arising from edentulism range from difficulty in chewing, to poor nutrition, unaesthetic appearance, speech impairment, all leading to a physical handicap.<sup>2,3</sup> That finally effect the general health as well.<sup>4,5,6</sup>

Currently there are different treatment modalities available to treat edentulism depending on the oral conditions, patient acceptability, affordability and the clinician's expertise. Conventional complete dentures are used successfully but patients with badly resorbed ridges with atrophic mucosa or sharp residual ridges have difficulty wearing conventional complete

denture and therefore require an alternate treatment modality.<sup>7</sup> Difficulties encountered in such patients can be overcome with either implants or resilient liners.<sup>8,9,10</sup> Although, implants are highly effective, they are not a viable solution for all edentulous patients as bone quality, quantity, medical problem, psychological and financial constraints play an important role in the treatment plan. Resilient liners, on the other hand, have fewer limitations, non-surgical application and low treatment cost. Resilient liners, because of their resilience, act as shock absorbers and distribute functional stress, thus making it comfortable for patient to wear the prosthesis.<sup>11,12,13</sup>

Various studies have evaluated the effect of soft liners on maximum bite force, masticatory performance, electromyography of muscles involved, stress distribution in denture supporting tissues, patient satisfaction and comfort in order to prove their advantages over the conventional heat activated acrylic resin dentures but no definite consensus has been achieved.<sup>14-21</sup>

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	DOI: 10.5958/2393-9834.2015.00005.4

Studies have been undertaken to objectively evaluate masticatory efficiency, but the literature is scanty regarding subjective evaluation of satisfaction with masticatory efficiency and general satisfaction with resilient liner lined (RLL) complete dentures.

Since the success of any prosthesis not only depends upon the quality of prosthesis but also on patient's perceived satisfaction with the prosthesis, measuring the prosthetic outcome by questioning the patient himself regarding his satisfaction seems to be more meaningful and has been undertaken in the present study.

## MATERIAL AND METHODS

After obtaining the ethical clearance (IESC/T-255.01.06.2012), a total of 28 completely edentulous patients aged 45 to 60 years were selected irrespective of gender. Patients having class I jaw relation, edentulous from last 6 months, well-developed edentulous ridges with firm mucosa were selected. Patients suffering from any systemic disorder that influence bone metabolism were excluded.

Computer generated randomization table was used to divide these patients in two equal (N=14) age- and gender-matched groups, on the basis of mandibular denture lined with resilient liner (experimental or Group B) or without (control or Group A). All patients were provided conventional maxillary complete denture.

The bilaterally balanced complete denture was fabricated using standard technique, except one modification at the time of mold packing viz. 2 mm thick heat cure acrylic denture soft liner packed along with heat cure acrylic resin in experimental group.

### Data collection

Subjective evaluation of patient satisfaction with masticatory efficiency was done using modified questionnaire based on index by Pocztaruk and Frasca(22) (Table 2). It consists of ten questions with four responses; 'Totally satisfied', 'Satisfied', 'Not sure', and 'Dissatisfied'.

For evaluation of patients' general satisfaction, denture questionnaire based on index by Wolff et al(23) consisting of seven questions was used (Table 3). Response for each question ranged from 'Excellent', 'Good', 'Fair', 'Poor', and 'Intolerable'. Both questionnaires were administered at three intervals- baseline, 6 months and 1 year (T0, T1 and T2, respectively) by a single evaluator. Mean scores were calculated for each question in both questionnaires for both groups.

All patients were evaluated clinically for the assessment of denture quality (retention, stability, support and occlusion) using rating legend given by Woelfel(24). Two independent, calibrated prosthodontists assessed the denture quality at three

different time intervals i.e. one month after denture delivery (baseline, T0), 6 months (T1) and 1 year post-insertion (T2). One-month time for adjustment to new prosthesis was given to all patients prior to data collection.

### Statistical analysis

Patient generated responses from both the questionnaires were compiled as numeric data. Statistical Package for Social Sciences, Version 13.1 (IBM, Chicago, IL.) was used for all statistical calculations. For both the questionnaires, individual question scores were calculated and represented as mean  $\pm$  standard deviation. For each question, mean score for controls was compared with experimental at all intervals using non-parametric test (chi square test) and p value less than 0.05 was considered statistically significant. Repeated measures analysis of variance was used for intra-group comparison of mean scores at three time intervals for each question (both the questionnaires) in both the groups.

Denture quality score for both groups (intra-group comparison) over a period of 12 months (T0, T1, and T2) were statistically analyzed by using non-parametric test i.e. Mann Whitney U test for intergroup comparison and Friedman test for intra-group comparison.

## RESULTS

### Masticatory efficiency scores

Inter-group analysis for individual question of masticatory efficiency questionnaire (Table 1) showed that at baseline (T0), there was significant differences ( $p < 0.05$ ) in scores for all questions with better scores for Group B which showed patient satisfaction in patients with soft liner.

At 6 month interval (T1), although mean satisfaction scores for Group B were higher than Group A, statistically significant difference was seen only for some questions (Q5, Q6, Q7, Q8, and Q9). It could be inferred that in response to satisfaction with eating habits, chewing difficulty with any particular type of food, and being embarrassed with eating food with others, both the groups had similar experience.

At 12 month (T2) interval, again, the scores were higher for Group B but statistically significant difference ( $p < 0.05$ ) was only seen in response to questions concerned with stability of dentures on eating sticky food, difficulty with denture between meals, force needed to swallow, need for special food preparation and time taken to eat food. Satisfaction scales were better for patients with soft liner for these questions.

Intra-group comparison (Table 1) showed that for Group A, there was statistically significant difference ( $p < 0.05$ ) in scores for most questions over a period of time from baseline to 6 months to 12 months with overall improvement in scores.

For Group B, scores for most of the questions had no significant difference ( $p > 0.05$ ) over time indicating patient's response to masticatory efficiency with soft liner denture remains similar over a period of time except for two questions pertaining to satisfaction with eating habits as well as change on chewing with artificial teeth compared to natural teeth. Scores for both the question improved over time.

**Patient's general satisfaction scores**

Inter-group comparison for each question's score of general patient satisfaction questionnaire at all the three intervals (T0, T1, T2) showed that there was no significant difference ( $p > 0.05$ ) which means similar satisfaction levels between both groups (Table 2). Intra-group comparison (Table 2) for Group A at three intervals showed no significant difference except question regarding comfort of lower denture. Comfort with lower conventional denture in Group A

improved with time from 0- 6 months and remained same from 6-12 months. Intra-group comparison (Table 2) for Group B at three intervals showed no significant difference except question regarding chewing food well with denture. Patients in Group B showed improved satisfaction with chewing food with denture at 6 months compared to baseline.

**Subjective evaluation of denture quality**

The mean score of denture quality for all the parameters decreased in both the groups with time; while a significant decrease was found for mandibular denture retention and tissue support only (Table 3). Inter group comparison for denture quality showed Group B patients had significantly higher mandibular denture retention (at 6 and 12 month periods only) and better lower tissue condition at all the time intervals as compared to group A.

**Table 1: Intra-group and inter-group comparison of mean score for each question of masticatory efficiency questionnaires at three intervals.**

Question	Group A p value (Intra-group)	Group B p value (Intra-group)	T0 (A)	T0 (B)	P value	T1 (A)	T1 (B)	P value	T2 (A)	T2 (B)	P value
Q1 Is there any change on chewing with the artificial teeth compared with your natural teeth; is it better now?	0.00*	0.007*	2.42 ± 0.51	3.35 ± 0.49	0.001*	3.21 ± 0.57	3.71 ± 0.46	0.064	3.21 ± 0.57	3.78 ± 0.42	0.026*
Q2 Are you satisfied with the eating habits with the artificial teeth?	0.008*	0.019*	2.71 ± 0.46	3.28 ± 0.61	0.030*	3.14 ± 0.66	3.57 ± 0.51	0.164	3.14 ± 0.66	3.64 ± 0.49	0.099
Q3 Are you feeling conscious while having meals with the denture?	0.00*	0.082	2.57 ± 0.64	3.42 ± 0.51	0.011*	3.21 ± 0.57	3.64 ± 0.49	0.131	3.21 ± 0.57	3.64 ± 0.49	0.131
Q4 Is there any difficulty in chewing any type of food with artificial teeth?	0.008*	0.336	2.42 ± 0.64	3.28 ± 0.46	0.009*	2.85 ± 0.66	3.35 ± 0.49	0.069	2.85 ± 0.66	3.35 ± 0.49	0.069
Q5 Is there a need for special food preparation for you to make chewing food easier? [e.g. moistening, pureeing, cutting into small parts etc.]	0.010*	0.336	2.42 ± 0.66	3.28 ± 0.46	0.009*	2.78 ± 0.57	3.35 ± 0.49	0.036*	2.92 ± 0.47	3.35 ± 0.49	0.088
Q6 How stable is your denture on eating sticky food?	0.015*	0.233	2.14 ± 0.66	3.42 ± 0.64	0.002*	2.57 ± 0.64	3.50 ± 0.65	0.007*	2.57 ± 0.85	3.57 ± 0.64	0.028*
Q7 Is there any force needed to swallow the food?	0.070	0.336	2.78 ± 0.57	3.42 ± 0.64	0.032*	2.85 ± 0.66	3.50 ± 0.65	0.048*	3.07 ± 0.61	3.50 ± 0.65	0.153
Q8 Have you ever faced any difficulty with the denture between meals?	0.869	0.233	2.85 ± 0.66	3.50 ± 0.51	0.033*	2.92 ± 0.73	3.57 ± 0.51	0.042*	2.85 ± 0.66	3.64 ± 0.49	0.010*
Q9 Compared with others, do you feel you take a longer time for chewing food?	0.021*	0.446	2.35 ± 0.49	3.28 ± 0.46	0.001*	2.71 ± 0.72	3.35 ± 0.49	0.019*	2.78 ± 0.69	3.42 ± 0.51	0.029*
Q10 Are you embarrassed on having food with others?	0.155	0.336	2.71 ± 0.46	3.42 ± 0.51	0.006*	3.00 ± 0.55	3.50 ± 0.51	0.070	2.85 ± 0.66	3.50 ± 0.51	0.033*

T0: Baseline, T1: 6 months, T2: 12 months, \* Significant

**Table 2: Intra- and inter-group comparison of mean score for each question of patients' general satisfaction questionnaire at three intervals**

Question	p value (Intra-group)		T0		P value	T1		P value	T2		P value
	Group A	Group B	Group A	Group B		Group A	Group B		Group A	Group B	
	Q1 Are you satisfied with the appearance of your denture?	0.999	0.999	4.07 ± 0.73	4.14 ± 0.53	0.433	4.07 ± 0.73	4.14 ± 0.53	0.433	4.07 ± 0.73	4.14 ± 0.53
Q2 Does your upper denture stay in place?	0.999	0.999	3.92 ± 0.82	4.00 ± 0.78	0.904	3.92 ± 0.82	4.00 ± 0.78	0.904	3.92 ± 0.82	4.00 ± 0.78	0.904
Q3 Does your lower denture stay in place?	0.999	0.999	3.14 ± 0.86	3.64 ± 0.92	0.528	3.14 ± 0.86	3.64 ± 0.92	0.528	3.14 ± 0.86	3.64 ± 0.92	0.528
Q4 Can you chew your food well with your dentures?	0.336	0.003*	3.21 ± 0.97	4.00 ± 0.78	0.117	3.28 ± 0.91	4.71 ± 0.46	0.001*	3.28 ± 0.91	4.00 ± 0.78	0.172
Q5 Are you satisfied with how well you speak with your dentures	0.999	0.999	3.42 ± 0.85	4.28 ± 0.61	0.055	3.42 ± 0.85	4.28 ± 0.61	0.055	3.42 ± 0.85	4.28 ± 0.61	0.055
Q6 Is your upper denture is comfortable?	0.103	0.165	4.50 ± 0.65	4.78 ± 0.42	0.373	4.70 ± 0.46	4.90 ± 0.26	0.326	4.70 ± 0.46	4.90 ± 0.26	0.326
Q7 Is your lower denture is comfortable?	0.040*	0.999	3.64 ± 0.84	4.07 ± 0.82	0.311	3.92 ± 0.73	4.07 ± 0.82	0.659	3.92 ± 0.73	4.07 ± 0.82	0.659

T0: Baseline, T1: 6 months, T2: 12 months

\* Significant

**Table 3: Inter- and intra-group comparison of denture quality for different parameters.**

	Group 1 (Mean ± SD)	Group 2 (Mean ± SD)	Inter-group P value*
<b>Centric</b>			
Baseline	3.86 ± 0.36	3.93 ± 0.27	0.549
6 months	3.86 ± 0.36	3.93 ± 0.27	0.549
12 months	3.71 ± 0.47	3.79 ± 0.43	0.668
Intra-group P value#	0.135	0.135	
<b>Lower stability</b>			
Baseline	3.71 ± 0.47	3.86 ± 0.36	0.366
6 months	3.57 ± 0.43	3.75 ± 0.38	0.244
12 months	3.50 ± 0.48	3.71 ± 0.38	0.230
Intra-group P value#	0.074	0.174	
<b>Lower retention</b>			
Baseline	3.54 ± 0.60	3.82 ± 0.37	0.131
6 months	3.25 ± 0.58	3.79 ± 0.43	<b>0.011</b>
12 months	3.14 ± 0.41	3.54 ± 0.41	<b>0.027</b>
Intra-group P value#	<b>0.002</b>	<b>0.012</b>	
<b>Lower tissue condition</b>			
Baseline	2.79 ± 0.43	3.86 ± 0.36	<b>0.000</b>
6 months	2.71 ± 0.47	3.86 ± 0.36	<b>0.000</b>
12 months	2.29 ± 0.47	3.43 ± 0.51	<b>0.000</b>
Intra-group P value#	<b>0.002</b>	<b>0.002</b>	

\*Mann Whitney U test

#Freidman test

**DISCUSSION**

Results of the study revealed patients having RLL mandibular denture have better satisfaction with masticatory efficiency at one month after denture insertion. This can be explained by the reflex controlled by the sensory input from the mucosa,

which may stop the closure of mandible to protect the underlying mucosa from excessive pressure and force. Patient wearing RLL mandibular denture, experienced less pain and ulcers on the ridge in initial phase of adjustment, therefore having longer occluding phase of masticatory cycle and could apply

more amount of force, as resilient liners due to their viscoelastic property absorb energy and prevent transmission of forces to the underlying tissues. Other different studies also showed better masticatory efficiency scores (objective evaluation) with RLL complete denture as compare to conventional complete denture.<sup>14,16,17,18</sup>

At 6 months, patients with RLL denture found their masticatory efficiency better than conventional group in few aspects like a need for special food preparation, better stability of denture on eating sticky food, force needed to swallow the food, difficulty with the denture between meals, and time taken for chewing food. For remaining questions, satisfaction level was similar. Previous studies too showed patients with RLL denture have longer occluding phase, can apply more force to chew the food and have better retention and stability.<sup>14,17</sup> At 12 months, patients showed further improvement in masticatory efficiency. This may be due to the development of skills to use the denture and adaptation of the denture with the surrounding tissues.<sup>17</sup>

Comparison of masticatory efficiency scores within the group, over a period of time, revealed that patients wearing conventional dentures showed overall improvement in scores for most questions over a period of 12 months, while patients with RLL dentures showed almost no change in masticatory efficiency with time. This indicates patients having denture without resilient liner require longer adaptation period as compare to those with RLL dentures.

Individual question analysis for general patient satisfaction showed that patients with RLL denture have significant difference only for question relating to chewing ability and comfort. While with regard to esthetics, speaking, and retention of denture, patients of both group had similar experience. This may be due to the cushioning effect that RLL patients experience, leading to less pain and discomfort during the adaptation phase.<sup>14,16,18</sup>

Results of the current study for denture quality showed retention of mandibular denture decreases with time in both the groups but significantly more reduction in controlled group. Similarly, condition of supporting tissues was significantly affected with time in both the groups but it was affected more for control group. These changes may be due to time dependent residual ridge resorption, wearing of teeth and warpage of denture material.<sup>22,23</sup> Fewer changes in RLL denture may be due to their viscoelastic nature- less forces are transmitted uniformly to the underlying hard and soft tissues therefore lead to less changes in underlying supporting tissues.<sup>24,25</sup>

## CONCLUSION

In conclusion, patients wearing dentures with soft liner were more satisfied with the masticatory efficiency achieved than patients wearing conventional complete denture. In regard to general satisfaction with dentures (esthetics, speaking, comfort, retention) both groups' patients had similar experience. Chewing ability was better in resilient liner patients. Denture quality was better in resilient liner group and decreased in both groups with time. Based on the results obtained, further research on a wider representative population needs to be established.

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**How to cite this article:** Mangtani N, Pillai RS, Dinesh Babu B, Jain V. Effect of resilient liner on masticatory efficiency and general patient satisfaction in completely edentulous patients. *J Dent Specialities*, 2015;3(2):150-155.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Computed tomography scan evaluation of adequacy for reduction of zygomatic arch fracture using Gillie's temporal approach

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## ABSTRACT

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Received: 24-10-2014

Accepted: 26-03-2015

**Aim:** The zygomatic bone is the key component of the structural facial aesthetics as it constitutes the prominence of the cheek bone. Also, the most frequent clinical findings in zygomatic arch fracture includes limitation of jaw movement and flattening of cheek. So it is necessary to elevate the arch precisely. Therefore, a prospective study was conducted to evaluate adequacy for reduction of zygomatic arch fracture using Gillie's temporal approach with the help of pre-operative and post-operative CT scan.

**Materials & methods:** 4 patients, who received surgical treatment of zygomatico-maxillary complex (ZMC) fractures at the Department of Oral and Maxillofacial Surgery were examined for displacement of zygomatic arch pre-operatively with CT scan then re-evaluated the same site post-operatively.

**Results:** The pre-operative mean displacement at the zygomatic arch, in millimetres (mm), was M = 2.8, SD = 3.011. After reduction, the post-operative displacement was M = 0.4, SD = 0.699. The percentage of reduction was M = 85, SD = 24.15.

**Conclusion:** Gillie's temporal approach for zygomatic arch fracture reduction is precisely considerable due to its simple and effective method and cosmetically more acceptable.

**Keywords:** Zygomatic fractures, Zygomatico-maxillary complex, Fracture

## INTRODUCTION

Face being the most important part of aesthetic concern in the human body is prone for fractures due to road traffic accidents, physical assaults, sports injuries, industrial accidents and so on. Zygomatic fracture management was revolutionized with the advent of internal fixation with wires in 1942. In 1978, Champy's et al proposed the adaptation osteosynthesis with plate and screw fixation. In the early part of twentieth century, different approaches to the zygomatic bone were established and reduction of the fracture without fixation was described.<sup>1</sup>

Gillie's temporal approach was first reported in 1927 by Gillie, Kilner and Stone. It was frequently used because of the short duration of general anaesthesia and minimal morbidity. The advantages of this closed approach are short duration of anaesthesia, decreased possibility of facial nerve damage, decreased indirect trauma to the globe, absence of visible scar.<sup>2</sup>

## MATERIALS & METHODS

This study was conducted in the Department of Oral and Maxillofacial Surgery at I.T.S. Centre for Dental Studies and Research, Muradnagar, Ghaziabad,

Uttar Pradesh. The study was undertaken for a period of one year and six months i.e. from October 2012 till April 2014. Patients with only Zygomatico maxillary fractures were included. All the cases were treated under general anaesthesia. Pre anaesthetic concern, neurology and ophthalmology opinions were obtained for all the cases. Following inclusion and exclusion criteria was followed:

### Inclusion criteria:

1. Fracture through anterior orbital rim and orbital floor,
2. Postero-lateral wall of maxillary sinus,
3. Zygomatic arch,
4. Zygomatico frontal suture.

### Exclusion criteria:

1. Undisplaced ZMC fractures
2. Comminuted ZMC fractures
3. Medically compromised patients who could not be operated under General Anaesthesia. (ASA III and above) as described by the American Society of Anesthesiologists' (ASA) classification of Physical Health, 2011.<sup>3</sup>

All the patients were sent for pre-operative computed tomography examination which included axial, coronal and sagittal sections with 2 mm slice thickness. A single 3<sup>rd</sup> generation CT machine was used throughout the study for all the radiographic examinations, which had an aperture of 70 centimetres, maximum scan view of 50 centimetres,

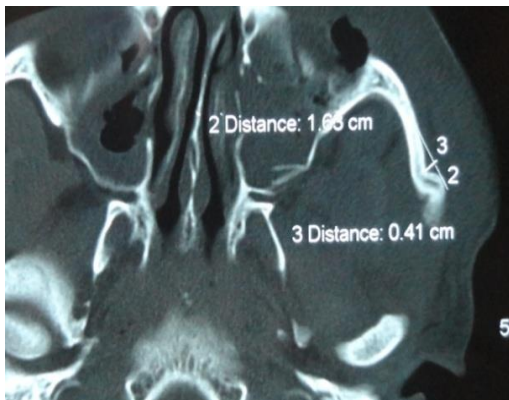
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	DOI: 10.5958/2393-9834.2015.00006.6



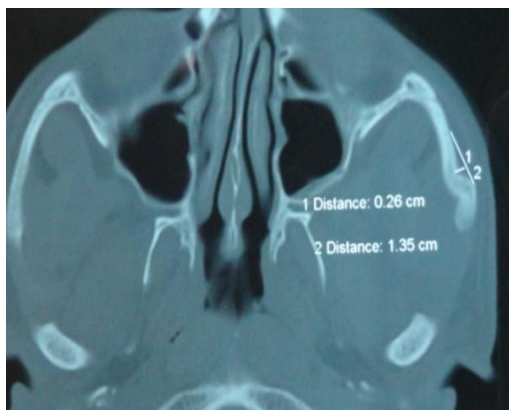
generator power rating of 40 kilowatt and an Ultra Fast Ceramic (UFC) detector

**Gillie’s temporal approach**

After intubation, identification of superficial temporal artery was done, surface markings were carried out with the help of surgical marking pen on temporal region according to Gillie’s technique which describes a temporal incision 2 cm in length, made 2.5 cm superior and anterior to the helix, within the hairline. After local infiltration, short oblique incision was made in the temporal area with the help of 15 numbers B.P. blade above the middle of the zygomatic arch.<sup>4</sup> The incision was dependent to the temporalis fascia and the margins were somewhat undermined. The fascia was incised, taking care not to damage underlying muscle. A suitable instrument, like a Rowe zygomatic arch elevator or a strong periosteal elevator was inserted under the fascia and advanced towards and under the displaced bone fragment to reduce the displaced arch (Figure-15). An audible click and fullness of the cheek together with palpation for normal contour of the zygomatic bone gave an idea about the adequacy of the reduction. The wound was closed in two layers: fascia with Vicryl, and skin with Prolene.<sup>5,6</sup>



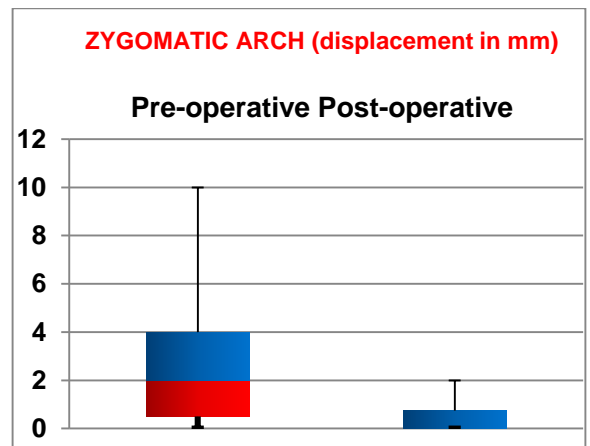
**Fig. 1: Pre-operative CT scan of left zygomatic arch fracture**



**Fig. 2: Post-operative CT scan of left zygomatic arch fracture**

**RESULTS**

The pre-operative mean displacement at the zygomatic arch, in millimetres (mm), was M = 2.8, SD = 3.011, SE = 0.952, MIN = 0 mm, Q1 = 0.5, MED = 2, Q3 = 4, and MAX = 10. After reduction, the post-operative displacement was M = 0.4, SD = 0.699, SE = 0.221, MIN = 0 mm, Q1 = 0, MED = 0, Q3 = 0.75, and MAX = 2. The percentage of reduction was M = 85, SD = 24.15, SE = 7.637, MIN = 50, Q1 = 62.5, MED = 100, Q3 = 100, and MAX = 100. Upon comparison between the two by Wilcoxon Signed-ranks test (two-tailed), it was found that reduction achieved was statistically significant ( $p < 0.05$ ),  $Z = -2.379$ ,  $p = 0.17$ , indicating that the current technique followed gives adequate reduction and fixation of the fracture at the zygomatic arch.



**Fig. 3: Pre-operative and post-operative CT displacement in mm zygomatic arch**

**DISCUSSION**

Zygomatic arch is formed by the temporal process of zygoma and the zygomatic process of temporal bone. The masseter muscle consisting of three superimposed layers which blend anteriorly gains attachment from zygoma and the zygomatic arch. The superficial layer arises from the maxillary process of zygomatic bone and from the anterior two-third of the lower border of the zygomatic arch.<sup>7</sup> The middle layer arises from the deep surface of the anterior two-third of the zygomatic arch. The deep layer arises from the deep surface of the arch. Contraction of this muscle is often implicated as the primary cause of post reduction displacement of the zygoma. Due to the attachment of the temporalis fascia along the superior aspect of the arch, internal fixation is unnecessary even in mildly displaced fractures as the fascia will immobilize the fragments effectively.<sup>7,8</sup>

The transoral (Keen’s) approach provides the most direct access to the zygomatic arch. It allows for an intraoral incision, and therefore does not have the risk of scar alopecia that will result from a temporal (Gillie’s) approach. However, they may result in increased rates of infection by introducing oral flora

into the infratemporal fossa. Gilles *et al.* described the temporal fossa approach in 1927, and this became a very popular method for the treatment of isolated arch fractures<sup>3</sup>. This procedure has advantages in that it leaves no facial scars and is simple to perform. The temporal (Gillie's) approach which is open approach can be considered for the reduction of the zygomatic arch.<sup>8</sup>

The fracture of the zygomatic arch bone can result in restricted mouth opening due to impingement on the coronoid process. Disruption of the zygomatic position also carries psychological, aesthetic and functional significance, causing impairment of ocular and mandibular function. Therefore, for both cosmetic and functional reasons, it is mandatory that zygomatic bone injury is properly diagnosed and adequately managed. Kaastad E, Freng A who also used Gillie's temporal approach and found satisfactory results.<sup>9</sup> Gillie's approach was also the principle technique of reduction used by Balle V et al which is in accordance with our study.<sup>10</sup> Kamath RA et al also used Gillie's procedure for reduction and proved it to be successful for adequate reduction and fixation of ZMC fractures.<sup>11</sup>

The slice thickness of 2mm was kept during CT scanning for every case both pre and post-operative CT scanning. This is in accordance with study done by Zilka A and Chales JS et al who recommended thin slices (2-3mm) because that would decrease the time of scanning and the risk of radiation.<sup>12,13</sup> Cheon SJ et al have stated that Gillie's approach is a promising method as it gives relatively acceptable post-operative facial symmetry and a decrease in the temporal protrusion.<sup>14</sup> The probable reason for good reduction at zygomatic arch region other than the regions involved in zygomatico-maxillary complex fracture is that it has certain advantages, such as direct elevation of the arch with the help of elevator and confirmation of reduction with tactile sensation. Till date Gillie's approach holds the best procedure for the elevation of fractured zygomatic arch.

## CONCLUSION

Thus, we conclude that Gillie's approach for zygomatic arch fracture reduction is precisely considerable due to its simple and effective method and cosmetically more acceptable and CT scan evaluation provides us the vision of best reduction achieved.

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**How to cite this article:** Sonone RM, Kumar S, Kukreja P, Agarwal A, Bhatnagar A, Chhabra V. Computed tomography scan evaluation of adequacy for reduction of zygomatic arch fracture using gillie's temporal approach. *J Dent Specialities*, 2015;3(2):156-158.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Risk of bleeding in patients with cardiovascular disease on aspirin undergoing tooth extraction

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## ABSTRACT

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Received: 20/03/2015

Accepted: 15/06/2015

**Background and purpose:** Aspirin is the most frequently used preventive and therapeutic drug for patients with cardiovascular diseases because of its antiplatelet property, which might lead to the risk of excessive bleeding during the surgery. The purpose of the study is to analyze if there is a need to discontinue low dose antiplatelet therapy before dental extraction.

**Methodology:** The study samples consisted of 25 patients receiving 100 milligrams of aspirin daily and were scheduled to undergo dental extractions. Each patient acted as a control for himself, wherein an extraction was performed on a patient when aspirin was not discontinued and a second extraction after discontinuing aspirin for 72 hours prior the procedure. The bleeding time, clotting time, platelet count and INR were measured preoperatively at both the appointments and the amount of blood loss during the procedure was assessed.

**Results:** The mean blood loss at the first appointment for the patients was 5.78 ml while it was 1.18 ml at the second appointment. The difference was statistically significant with a t – value of 3.2. However, the blood loss in patients during the first appointment was easily managed using local hemostatic measures which prevent any grave bleeding complication.

**Conclusion:** From the observation in this study it can be stated that the low dose aspirin therapy can be continued prior to extraction procedure in the oral cavity without the fear of excessive intra-operative and post operative bleeding.

**Key words:** Cardiovascular Disease, Aspirin, Tooth Extraction, Blood Loss

## INTRODUCTION

In the modern era, a majority of the population in the age group of 50 and above shows a tendency towards developing cardiovascular disease, mainly due to imbalanced diet and a lack of physical activity. These patients are usually on aspirin therapy that helps prevent the thromboembolic events to which these patients are susceptible. Aspirin, Acetyl Salicylic Acid (ASA), irreversibly inhibits the enzyme cyclooxygenase-1 thereby leading to the blockage of the synthesis of thromboxane A2 which is required for platelet aggregation.<sup>1</sup> Thus aspirin exerts its antiplatelet activity by preventing platelet aggregation and thereby avoiding thrombus formation within the blood stream. This prevents episode of thrombosis and vascular ischemic events.<sup>2</sup> The dental management of these patients, who require an extraction of tooth is an issue of concern, as the aspirin may lead to intra operative

and post operative uncontrolled excessive bleeding due to its anti platelet action. But altering the dosage or discontinuing it 7-10 days prior to the procedure may predispose the patient to an increase risk of developing an myocardial infarction or stroke, which is life threatening.<sup>3</sup> Few authors have established that the aspirin therapy in patients with cardiovascular diseases need not be discontinued and dental procedures like simple extractions may be performed without the fear of excessive bleeding intra-operative or post-operatively.

This study intends to evaluate the need to discontinue the low dose aspirin prior to dental extraction in patients with cardiovascular disease by comparing the net blood loss and evaluating the effectiveness of local hemostatic procedures to avoid excessive bleeding during and after the procedure in a patient with and without discontinuation of aspirin.

## PATIENTS AND METHODS

Twenty five patients presenting to the oral and maxillofacial surgery OPD, diagnosed with chronic generalized periodontitis and giving a history of cardiovascular diseases, receiving 100 mg of aspirin daily were included in the study. All subjects were advised for multiple mandibular molar tooth extraction. Written informed consent and physician

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10.5958/2393-9834.2015.00007.8

opinion was taken from every patient prior to their inclusion in the study and ethical clearance was achieved from the national research committee. Each patient acted both as a control as well as a case for the study.

**Inclusion Criterion-**

1. Patients in the age group of 55-75 years were included in the study
2. Tooth included were mandibular molars
3. Extraction of teeth for chronic generalized periodontitis where other restorative procedures were not possible and indicated for extraction.
4. Grade 1 hypertensive patients

**Exclusion Criterion-**

1. Patients on anticoagulants like heparin, warfarin sodium.
2. Patients on any other antiplatelet therapy.
3. Patients on steroids, hormonal therapy and any drug that interacts with antiplatelet drugs.
4. Patients suffering with diabetes mellitus.
5. Anemic patients.
6. Non-alcoholics, Non-smokers.
7. Patients with any other bleeding disorders.
8. Patients having hepatic and renal dysfunction.

Prior to fixing an appointment, the blood pressure was recorded and bleeding time, clotting time, platelet count and INR were assessed. Only after reports obtained were within normal limits, the patients were prescribed antibiotics in accordance to AHA guidelines in order to prevent subacute bacterial endocarditis.<sup>4</sup> (Table 1) the patient was then subjected to extraction of single mandibular molar tooth.

Intra operative bleeding was effectively controlled by local haemostatic procedures such as pressure pack and suture application. The amount of blood loss during the procedure was estimated. Thirty minutes post procedure, the operated site was checked for any ooz or bleed. The patient was prescribed paracetamol 500 mg TID along with prophylactic antibiotics prescribed earlier and was advised to discontinue aspirin for a period of three days and return on the fourth day, for extraction of the other mandibular molar.

The procedure was done by the same operator and the amount of blood loss during the procedure was estimated along with the effectiveness of local hemostatic procedure. A comparison between the blood losses as well as the effectiveness of local hemostatic procedure to prevent bleeding in both appointments was done.

**Surgical Procedure:**

All the extractions were performed by the same surgeon on an outpatient basis under local anesthesia using plain 2% lignocaine hydrochloride. The use of

suction was avoided during the procedure to allow an accurate estimate of the blood loss. The surgical field was kept clear of blood with gauze. Saliva contamination was avoided by placing gauze in the sub mandibular and parotid duct regions.

An electronic weighing scale was used to weigh the surgical gauze pre-operatively. Post operatively, the blood soaked gauze was weighed immediately to avoid the loss by evaporation. It is customarily assumed that 1 ml. of blood weighs 1 gram.[5] Therefore the calculated difference of weight between the gauze preoperatively and post-operatively was converted directly to a volume measurement of blood loss.

A figure of eight suture was placed at the surgical site with 3/0 black braided silk and a pressure pack with a sterile gauze was placed for 30 minutes and reassessed for bleeding. Local hemostatic agents were kept ready to control any untoward bleeding encountered.

On comparing the control of blood loss between both the appointments of a single patient, it was observed that there was no need for an additional local hemostatic measure in the first appointment and bleeding was very well controlled as it was in second appointment wherein the patient was asked to discontinue aspirin intake 72 hours prior to operative procedure. Patients were discharged after giving strict post-extraction instructions. Patients were followed up for 24, 48 and 72 hours after extraction of teeth for possible bleeding episodes and there were no reported bleeding episodes.

**RESULTS**

The mean blood loss at the first appointment for the patients was 5.78; with a standard deviation of 5.46, whereas it was 1.18 with a standard deviation of 1.13ml. The difference was statistically significant with a t – value of 3.21 inferring that a increased amount of bleeding was noted at the first appointment as compared to the second appointment in the same patient. (Table 2)

The mean bleeding time at first appointment was found to be 130.8 seconds with a standard deviation of 17.59 which was slightly increased as compared to the mean bleeding time of 114.6 seconds with standard deviation of 18.11 at second appointment where aspirin was discontinued, which was statistically significant with a t – value of 4.23. (Table 3) The mean INR recorded at first appointment was 1.18 +/- 0.25 in contrast to the mean INR of 1.08 +/-0.10 which was observed in each patient after discontinuing aspirin prior to extraction procedure, which was also statistically significant with a t-value of 3.14. (Table 4)

However, the clotting time and platelet count were within normal range and the difference between both groups was not statistically significant.

**Table 1: AHA guidelines for prevention of subacute bacterial endocarditis**

Situation	Agents	Adult Dosage (Single Dose 30 to 60 min Before Procedure)
Oral	Amoxicillin	2 gram
Unable to take oral medication	Ampicillin OR Cefazolin or ceftriaxone	2 g IM or IV 1 g IM or IV
Allergic to penicillins—oral	Cephalexin OR Clindamycin OR Azithromycin or clarithromycin	2 g 600 mg 500 mg
Allergic to penicillins and unable to take oral medication	Cefazolin or ceftriaxone OR Clindamycin	1 g IM or IV 600 mg IM or IV

**Table 2: Comparison of mean blood loss at both appointments**

	Mean blood loss (in ml)	Standard deviation	Range
Patients on aspirin (1 <sup>st</sup> appointment)	5.78	5.46	3.03- 7.66
Patients discontinued aspirin (2 <sup>nd</sup> appointment)	1.18	1.13	4.03-6.95

**Table 3: Comparison of mean bleeding time at both appointments**

	Mean Bleeding time (in seconds)	Standard deviation	Range
Patients on aspirin (1 <sup>st</sup> appointment)	130.8	17.59	105- 165
Patients discontinued aspirin (2 <sup>nd</sup> appointment)	114.6	18.11	85- 150

**Table 4: Comparison of mean INR at both appointments**

	Mean INR (in seconds)	Standard deviation	Range
Patients on aspirin (1 <sup>st</sup> appointment)	1.18	0.25	1.00- 1.35
Patients discontinued aspirin (2 <sup>nd</sup> appointment)	1.08	0.10	1.00- 1.30

**DISCUSSION**

The management of a patient on aspirin therapy for cardiovascular diseases who have to undergo oral surgical procedures is a topic of concern to the oral surgeon as there is a potential risk for excessive bleeding after a surgical procedure, even if it is an uncomplicated extraction of teeth. This is attributed to the antiplatelet action of aspirin.<sup>5</sup>

Aspirin even at low doses of about 0.5-1mg /kg per day tends to inhibit platelet function for the entire lifespan of the platelet which is approximately 10 days.<sup>6</sup>

This is used to an advantage by a physician to prevent intravascular thrombosis without eliciting the possible side effects of high doses of aspirin.

The decision to continue or discontinue is like weighing the risk of any possible thromboembolic event against the risk of bleeding during the surgical procedure. Few factors such as patient’s inherent risk factors for bleeding, additional ongoing treatment which increases the bleeding risk, invasive potential of the surgical procedure and potential risk of thromboembolic event should be considered before stopping antiplatelet therapy.<sup>7</sup>

In the comparison of the net blood loss during extraction of teeth in a patient in whom extraction

was done without discontinuation of aspirin and after discontinuation of aspirin for a period of three days, it was observed that, the intra-operative blood loss was more in the initial appointment where aspirin was made to continue. Also the bleeding time and INR were slightly increased in the initial appointment as compared to second appointment where the patient was asked to discontinue aspirin intake. During both the appointments, no patient showed any postoperative bleeding episodes. The method of weighing surgical gauze for measuring the intra-operative blood loss during the appointments, though not very accurate is relatively easy and commonly used to calculate blood loss and definitely allows a better assessment of blood loss as compared to suction devices.<sup>8</sup>

Several authors have advocated the practice of discontinuation of aspirin prior to oral surgical procedure to avoid the risk of excessive bleeding intra-operatively and post operatively. While a few authors recommended the discontinuation for seven to ten days prior to the procedure, many other are of the opinion that discontinuation of aspirin three days prior to the procedure is justified.<sup>1</sup> In contrast to this practice it is proposed by a few authors that, the discontinuation of aspirin is unwarranted prior to minor oral surgical procedures, as the aspirin slightly increase bleeding in oral surgical procedure which can be controlled by local haemostatic measures.<sup>9</sup> In our study we observed well controlled bleeding when a patient was on aspirin and when the same patient discontinued aspirin. The results obtained in this study are in concordance with the opinion that the minor oral surgical procedures may be carried out without the discontinuation of aspirin.

It is reported that, extraction of periodontally involved teeth evokes increased bleeding both intra-operatively and post operatively as compared to extraction of carious teeth in a patient on aspirin therapy. This has been attributed to the hyperemic condition of the gingiva along with possible fragility of blood vessels leading to the bleeding.<sup>10</sup> The patient inherent factors such as older age, male gender, systemic conditions like diabetes mellitus and hypertension may be considered as risk factors for increased bleeding.<sup>3</sup> Also the number of teeth to be extracted in such patients in each appointment has a role in the loss of blood and has to be taken into consideration.

The hyper responsiveness of few individuals to aspirin therapy has been demonstrated by Ardekian et al; who observed prolonged bleeding episodes in six patients, 4 patients who continued aspirin and 2 patients who discontinued aspirin after extraction of whom, 10% TAE and antifibrinolytic agents had to be used to bring about a control on the bleeding.<sup>11</sup> These patients were assumed to be hyper responsive to aspirin as compared to other patients on aspirin

therapy taking the same dosage. The identification of these hyper responders to aspirin is essential for which a platelet function testing algorithm that combines preoperative risk factor assessment, template bleeding time and flow cytometry has been proposed.<sup>12</sup>

It is observed in this study that a low dose of aspirin (<325mg/day) need not be discontinued prior to routine oral surgical procedures as the risk of postoperative bleeding is minimal. Extensive surgical procedures may require the discontinuation of aspirin for a period of up to three days prior to the procedure.

## CONCLUSION

This study demonstrated that extraction of teeth in patients on low dose of aspirin did not cause significant intra operative or post operative bleeding. Discontinuation of aspirin increases the risk of thromboembolic events which leads to high morbidity rate of such patients. The cardioprotective benefits of aspirin outweigh the risk of oral bleeding, which can be effectively controlled by local hemostatic measures. Hence it is advisable and safe to continue low dose aspirin therapy (100mg/day) when routine dental extractions are performed.

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**How to cite this article:** Mangalgi A, Aftab A, Mathpathi S, Tenglikar P, Devani S, Ingleshwar N. Risk of bleeding in patients with cardiovascular disease on aspirin undergoing tooth extraction. J Dent Specialities, 2015;3(3):1-3.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Comparative analysis of post operative analgesic requirement in patient undergoing minor oral surgery using buprenorphine with lignocaine versus lignocaine - a double blind study

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## ABSTRACT

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Received: 18/02/2015

Accepted: 10/07/2015

**Aim:** The aim of this study is comparative analysis of post operative analgesic requirement in patient undergoing minor oral surgery using 2% Lignocaine with 1:200000 Adrenaline and Buprenorphine versus 2% lignocaine with 1:200000 Adrenaline.

**Materials and Method:** One hundred patients requiring minor oral surgery were included in the study. The patients were randomized by a third party and allocated to one of the two study groups. This allowed the patients and the operators to remain unaware of the group allocations. 1 ml of Buprenorphine Hydrochloride injection I.V which contains an equivalent of 0.3 mg Buprenorphine was withdrawn into a syringe and injected into a 30 ml vial of 2 % Lignocaine with Adrenaline 1:200000. Thus each ml of local anesthetic contained 0.01 mg of Buprenorphine. This solution was labelled and used for the study.

**Results:** The duration of analgesia in Group I was found to be  $13.71 \pm 7.2$  h and Group II was  $39.58 \pm$  the average consumption of NSAIDs was found to be 2.88 as compared to Group II mean value of 1.29 ( $P=0.0001$ ).

**Conclusion:** We concluded that addition of 0.3 mg of Buprenorphine to 30 ml Lignocaine with Adrenaline 1:200000 for minor oral surgery results in significant improvement in postoperative analgesia up to 39 h and markedly reduces the need for excessive analgesic intake. Thus reducing the adverse effects associated with excessive use of NSAIDs. Further studies needs to be done as there is less literature about Buprenorphine added to local anaesthetist.

**Keyword:** Buprenorphine, Hydrochloride, Analgesia

## INTRODUCTION

Pain is an unpleasant emotional experience usually initiated by a noxious stimulus and transmitted over a specialised neural network to the central nervous system where it is interpreted as such.<sup>1</sup> After noxious stimuli prostaglandins are released from cell membrane through cyclo-oxygenase pathway and they mediate inflammation and inflammatory induced pain. In most cases pain reaction threshold is lowered by fear, apprehension, fatigue and emotional stress. Centuries ago opium was determined to be “*GOD’S OWN MEDICINE*” which produced definite analgesic effect and also eliminated fear, anxiety and suffering. Buprenorphine, first synthesized in 1966, is a semisynthetic, oripavine alkaloid derived from thebaine and binds to all three receptors.<sup>2</sup>

Buprenorphine is highly lipophilic and is better diffused into the perineurium.<sup>2,3</sup> It produces longer effect of analgesia compared to Morphine and sufentanil. It is at least 30 times more potent than Morphine Sulphate and has substantially longer duration of action. This prolonged duration appears to be because Buprenorphine seems to dissociate very slowly from opioid receptors, so the usual duration of action is about eight hours after parenteral administration.<sup>4,5</sup> Few studies have been conducted in past which prove the efficacy of Buprenorphine in Bupivacaine as a post operative analgesic in minor oral surgery.<sup>3</sup> Bupivacaine has longer duration of action itself so it is difficult to analyse whether post operative analgesic effect in minor oral surgical procedure is due to the effect of Bupivacaine or Buprenorphine. Kumar SP and colleagues compared the onset, quality and duration of analgesia produced by Lignocaine Hydrochloride 1:80000 Adrenaline with Buprenorphine versus Lignocaine Hydrochloride with 1:80000 Adrenaline in minor oral surgical procedures e.g. cyst enucleation, alveoloplasty, third molar surgery, incision and drainage of abscess There is paucity of literature regarding the use of combination of Buprenorphine

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	DOI: 10.5958/2393-9834.2015.00008.X



and 2% Lignocaine with 1:200000 Adrenaline in minor oral surgical procedures. In our study we compared onset, quality and duration of post operative analgesia of Buprenorphine along with 2% Lignocaine with 1:200000 Adrenaline versus 2% Lignocaine with 1:200000 Adrenaline in minor oral surgical procedures.<sup>6,7,8,9</sup>

**MATERIALS AND METHOD**

The protocol for the study was approved by the ethical committee of the institutional review board and written informed consent was obtained from every patient. One hundred patients requiring minor oral surgery were included in the study. The patients were randomized by a third party and allocated to one of the two study groups. This allowed the patients and the operators to remain unaware of the group allocations.

**Method of Preparation of the Solution**

1 ml of Buprenorphine Hydrochloride injection I.P which contains an equivalent of 0.3 mg Buprenorphine was withdrawn into a syringe and injected into a 30 ml vial of 2 % Lignocaine with Adrenaline 1:200000. Thus each ml of local anesthetic contained 0.01 mg of Buprenorphine. This solution was labelled and used for the study.

**Study Design**

Double blinding of the operator and patient was achieved by appointing a custodian who was not be a participant in this study in any way .The custodian prepared and dispensed the solution to the operator allocating the patient into two groups, A and B randomly, He maintained a record of the patient details and the solution dispensed in custodian record, a copy of which is attached as Annexure 1.

One of the solutions had 2 % Lignocaine Hydrochloride with 1:200000 Adrenaline Bitartrate along with Buprinorphine 0.3mg and other had 2 % Lignocaine Hydrochloride with 1:200000 Adrenaline Bitartrate for intra oral nerve block to achieve local anesthesia.

**Table – 1: Different minor surgical performed in patients of two groups**

	Solution A/ Group I	Solution B/ Group II
ORTHODONTIC EXTRACTION	32	30
IMPACTION EXTRACTION	6	16
ALVEOLOPLASTY	4	4

**Table – 2: Number of different nerve blocks given in two groups**

	Solution A/ Group I	Solution B/ Group II
INFRA ORBITAL	15	15
INFERIOR ALVEOLAR	18	17
NASO PALATINE	3	1
GREATER PALATINE	18	19
POSTERIOR SUPERIOR ALVEOLAR	6	6
LONG BUCCAL	3	8

**Pain Assessment**

After the surgical procedure, patients were given a self analysis form to evaluate the degree of post-surgical pain. They were instructed to note the intensity of pain and the number of postoperative analgesics consumed during the next 72 hours, at intervals of 2, 4, 6, 12, 24, 36 and 48h, 72h. Patients daily rating of discomfort was done on a 3-point, Numeric Rating Scale; (NPRS scale).

Patients were instructed to document the number of rescue medication consumed and the timing of first analgesic intake during the study period.

3ml of solution was used for every nerve block given in this study.

**Data Analysis**

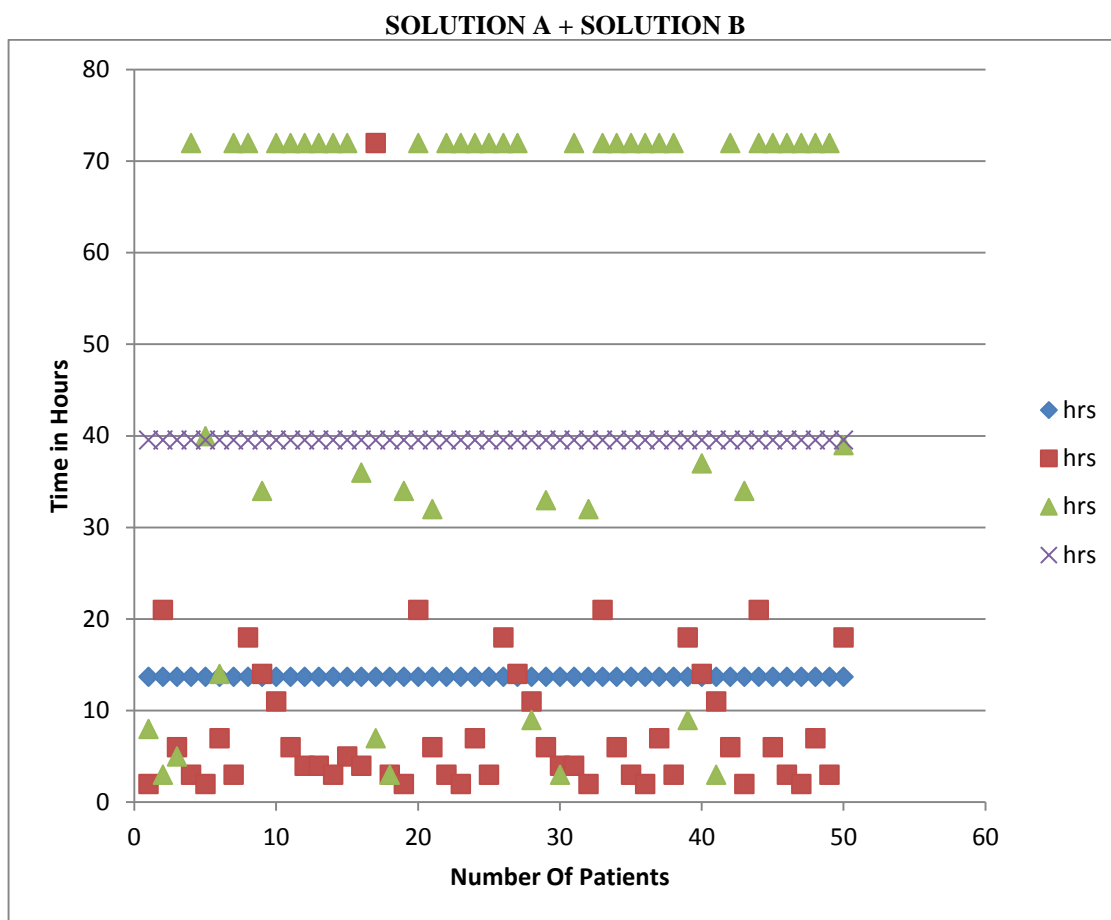
Results were calculated using the mean value and standard deviation for each of the parameters considered and checked for statistical significance using the following:-

1. Descriptive data presented as mean ± SD
2. Continuous data are analyzed by paired / unpaired ‘t’ tests
3. Chi-square test to assess the statistical difference between the two groups.
4. Mann–Whitney U test.
5. Chi square test
6. Wilcoxon test
7. Inter mixed analysis

**RESULTS**

The mean onset of subjective symptoms for Solution A was 42.54 seconds and the mean onset of subjective symptoms for Solution B was 47.79 seconds. On applying t-test the mean difference (5.250) was not significant (p = 0.697) indicating that the mean time of onset for subjective symptoms in solution A and solution B are comparable.

The mean duration of anaesthesia for Solution A was 224.13 minutes, and the mean of duration of anaesthesia for Solution B was 230.17 min. On applying t-test the mean difference (6.041) is not significant as p = 0.727 (p > 0.05) therefore duration of anaesthesia in minutes of solution A and of solution B have no significant difference.

**Table - 3: Time at Which First Rescue Medication Taken (Duration of Analgesia)****GRAPH- 5 Showing Duration of Analgesia in Minutes in Solution A and Solution B**

- △ Each Patient Reading in Solution A
- Each Patient Reading in Solution B
- X Mean Reading in Solution B
- ◇ Mean Reading in Solution A

The mean of total number on analgesic tablets taken for Solution A was 2.88 tablets and the mean of total number on analgesic tablets taken for Solution B in minutes was 1.29 tablets. On applying t-test the mean difference (1.596) is significant as  $p = 0.022$  ( $p < 0.05$ ) indicating that there was a significant difference in the requirement of postoperative pain control for solution A as compared to solution B. The patient who received solution A took more tablets for pain control as compared to those who receive solution B gives more post operative analgesia.

Three patients (6%) in Solution B out of 50 reported of nausea, severe vomiting and dizziness and 3% out of 100 patients reported of side effects.

## DISCUSSION

In recent years, there has been an increase awareness of the importance of effective pain management.

Although the currently available armamentarium of analgesic drugs and techniques is impressive, postoperative pain is not always effectively treated.<sup>10,11,12,13</sup> Routinely the patients undergoing minor oral surgical procedures are prescribed some form of NSAIDs to overcome the sequel of postoperative pain.<sup>14,15,16</sup>

Pain may be described as an unpleasant sensory and emotional experience associated with actual or potential tissue damage.<sup>3,4,17</sup> Pain itself is subject to much inter individual variability with regard to threshold and tolerance and has exceptional and emotional components.<sup>18,19,20</sup>

Hence arises, the need for an agent which reduces postoperative pain and additional intake of NSAIDs which in turn shall help in negating the adverse effects resulting due to excessive use of NSAIDs.<sup>21,22</sup>

Over the past ten years several studies have suggested that addition of certain opiates to the local anesthetic used for block anesthesia may provide effective and prolonged post-operative analgesia.<sup>23</sup> The presence of opioid receptors in peripheral nervous system offers the possibility of providing postoperative analgesia in ambulatory surgical patients.<sup>24,25</sup>

One of major problems in developing countries in the speciality of anaesthesia is the availability of drugs. Buprenorphine is not easily available in country, pethidine<sup>13</sup> and Morphine are other drugs, the availability of which can be problem as both these drugs are subjected to Controlled Drugs Act with only a certain quota released to hospital at variable interval.<sup>26,27</sup> Its low abuse potential, its cardiovascular stability, longer duration of action, and its potential safety in over dosage outweigh its disadvantages especially in major surgery and in situations where shorter acting drugs are not available.<sup>26,28,29</sup>

Buprenorphine is an FDA approved drug that is used to treat opiate dependence and prevent its relapse. It was first synthesized in 1966. Buprenorphine is a semisynthetic, oripavine alkaloid derived from Thebaine. It is long acting, lipid soluble, mixed agonist antagonist opioid analgesic, which is at least 25 to 50 times more potent than Morphine. Buprenorphine was one of the first narcotic analgesics to be studied for its abuse liability in humans<sup>22</sup>. Thus, an intramuscular injection of Buprenorphine 0.3 mg is equipotent to morphine 10 mg, but the analgesia produced by Buprenorphine lasts significantly longer. A ceiling effect for respiratory depression but not for analgesia has been demonstrated in humans.<sup>30,31</sup>

This prolonged duration appears to be because buprenorphine seems to dissociate very slowly from opioid receptors, so the usual duration of action is about 8 hours after parenteral administration.<sup>32</sup> Buprenorphine was initially classified as mixed agonist-antagonist analgesia or as a narcotic antagonist analgesic in most preclinical anti-nociceptive tests; Buprenorphine was shown to be fully efficacious, with an antinociceptive potency 20 to 70 times higher than that of Morphine.<sup>23,27</sup>

Viel et al in 1998 the investigators compared the effect of Buprenorphine with that of morphine added to 0.5% Bupivacaine on the duration of analgesia after supraclavicular brachial plexus block.<sup>11</sup> A study by Romero et al indicated that the mean terminal half-life of intravenously given Buprenorphine (1 mg infused over 30 minutes) was about 6 hours.<sup>33</sup> Kuhlman et al reported a mean terminal half-life of 3.2 hours after single doses of 1.2 mg given intravenously.

Sittl et al in 2006 suggested that Buprenorphine has an antinociceptive potency about 75 to 100 times greater than that of morphine. Buprenorphine has a dose-dependent effect on analgesia with no

respiratory depression. Dahan and colleagues in 2006 demonstrated that Buprenorphine has a ceiling effect on respiratory depression, but not on analgesia. This was demonstrated over a dose range of 0.05 to 0.6 mg Buprenorphine in humans. Buprenorphine shows analgesic effects, but no respiratory depression, at doses up to 10 mg. Therefore, Buprenorphine may have a differential effect on respiration and analgesia.<sup>34</sup> Bazin et al. studied the effect of addition of morphine, buprenorphine and sulfetanil to local anesthetic in brachial plexus block. The results obtained showed that addition of morphine or buprenorphine to local anesthetic produced significant difference in duration of analgesia when compared to the control group, wherein only local anesthetic was used. Similar results were found in our study, where Group I patients had significantly lesser mean pain scores at varying time intervals postoperatively (up to 33± 1.5 h) compared to Group II patients. Mean pain scores obtained at 48 and 72 h postoperatively did not vary significantly in Group I compared to the Group.<sup>11,12</sup>

In the present study, a clinical prospective randomised double blind study was conducted of 100 patients undergoing minor oral surgical procedures. Each patient was anesthetized by using either Solution A or B after taking informed consent and the parameters decided as per the performance recorded. Double blinding of the operator and patient was achieved by appointing a custodian who was not be a participant in this study in any way. The custodian prepared and dispensed the solution to the operator allocating the patient into two groups, A and B randomly. He maintained a record of the patient details and the solution dispensed in custodian record. One of the solutions had 2 % Lignocaine Hydrochloride with 1:200000 Adrenaline Bitartrate along with Buprenorphine 0.3mg and other had 2 % Lignocaine Hydrochloride with 1:200000 Adrenaline Bitartrate for intra oral nerve block to achieve local anesthesia<sup>22</sup>.

The mean ± standard deviation of onset of anesthesia time in seconds of subjective symptoms are (42 ± 12.364 seconds) and (47.79 ± 14.479 seconds) in Solution A and Solution B respectively.

On applying t-test the mean difference (5.250) is not significant as p = 0.697 (p > 0.05) indicating that the mean time of onset of anaesthesia in solution A and solution B are comparable.

The mean ± standard deviation of onset of anesthesia time in seconds of objective signs are (49.88 ± 9.786 seconds) and (53.83 ± 15.262 seconds) in Solution A and Solution B respectively.

On applying t-test the mean difference (3.95) is not significant as p = 0.709 (p > 0.05) indicating that the mean time of onset of anaesthesia in solution A and solution B are also comparable.

The mean  $\pm$  standard duration of surgery in minutes are (8.17  $\pm$  8.579 minutes) and (9.42  $\pm$  8.382 minutes) performed under the effect of Solution A and Solution B respectively.

On applying t-test the mean difference (1.25) is not significant as  $p = 0.813$  ( $p > 0.05$ ) indicating that duration of surgery performed under the effect of both solutions, A and B was similar and statistically not significant.

The mean  $\pm$  standard duration of anesthesia in minutes are (224.13  $\pm$  22.142 minutes) and (230.17  $\pm$  30.792 minutes) in Solution A and Solution B respectively.

On applying t-test the mean difference (6.041) is not significant as  $p = 0.727$  ( $p > 0.05$ ) so we can say that duration of surgery in minutes of solution A and solution B have no significant difference.

The mean  $\pm$  standard of total number of analgesic medication taken per day until follow up after 72 hours were (2.88  $\pm$  1.424 tablets) and (1.29  $\pm$  1.922 tablets) for Solution A and Solution B respectively.

On applying t-test the mean difference (1.596) is significant as  $p = 0.022$  ( $p < 0.05$ ) indicating that there was a significant difference in the requirement of postoperative pain control for Solution A and Solution B.

Three patients (6%) in Solution B out of 50 reported of nausea, severe vomiting and dizziness and 3% out of 100 patients reported of side effects.

The mean  $\pm$  standard of post surgical analgesia was (13.71  $\pm$  7.95 hours) and (39.58  $\pm$  1.922 hours) for Solution A and Solution B respectively. On applying t-test the mean difference (2.587) was significant as  $p = 0.028$  ( $p < 0.05$ ) indicating duration of analgesia differed significantly for Solution A and Solution B.

We concluded that addition of 0.3 mg of Buprenorphine to 30 ml Lignocaine with Adrenaline 1:200000 for minor oral surgery results in significant improvement in postoperative analgesia up to 39 h and markedly reduces the need for excessive analgesic intake. Thus reducing the adverse effects associated with excessive use of NSAIDs. Further studies needs to be done as there is less literature about Buprenorphine added to local anaesthetist.

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**How to cite this article:** Thukral H, Singh S, Aggarwal A, Kumar S, Mishra V, Anand KR. Comparative analysis of post operative analgesic requirement in patient undergoing minor oral surgery using buprenorphine with lignocaine versus lignocaine - a double blind study. J Dent Specialities, 2015;3(2):164-169.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Assessment of collagen and elastic fibres in various stages of oral submucous fibrosis using Masson's trichrome, Verhoeff van Gieson and picrosirius staining under light and polarizing microscopy

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## ABSTRACT

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**Background:** Oral Submucous Fibrosis (OSMF) is a collagen related disorder seen in habitual betel-quid chewers. This is a high risk precancerous condition which clinically presents vertical palpable fibrous bands in buccal mucosa, generalized fibrosis of oral soft tissues with restricted mouth opening. Present study was undertaken to ascertain the changes occurring in collagen type I & III and elastic fibres in OSMF in relation to orientation, density and thickness.

**Study Methods:** The study was performed on 15 cases in each group such as Stage I OSMF, Stage II OSMF, Stage III OSMF and normal oral mucosa (NOM). The biopsied samples were routinely processed for paraffin embedding; stained with Hematoxylin and Eosin as well as special stains like Masson's Trichrome (MT), Verhoeff Van Gieson (VVG) and Picrosirius red (PSR) and examined under light and polarized microscope respectively. MT stain demonstrated all types of collagen fibers collectively while PSR stain under polarized microscopy demonstrated collagen type I and type III separately with enhanced birefringence. VVG stain demonstrated very fine black colored elastic fibers, thus changes taken place could be accurately ascertained with progression of the disease.

**Results:** Change in the orientation of collagen type I has been observed in stage II and stage III of OSMF from haphazard to parallel in relation to surface epithelium, while no change was noted in type III collagen fibres as well as elastic fibres in any stage of OSMF, and remained haphazardly arranged. Increased density of type I collagen was observed with increasing stage of OSMF from moderately dense to dense, while decrease in density of type III collagen was noticed in stage III than in stage II OSMF from moderately dense to sparse. The density of elastic fibres was decreasing from dense in stage I to sparse in stage III. Thickness of collagen type I was increasing with increasing grades while type III collagen and elastic fibres remained unchanged.

**Conclusion:** The alterations in orientation, density and thickness of collagen fibres and density of elastic fibres in various grades of OSMF contribute to the clinical presentation of trismus with progression of the disease.

**Key Words:** Collagen type I, Collagen type III, Elastic fibres, Masson's trichrome stain, Verhoeff Van Gieson stain, Picrosirius red stain

Received: 24-10-2014

Accepted: 26-03-2015

## INTRODUCTION

Oral submucous fibrosis (OSMF) is a chronic debilitating disease of oral mucosa characterized by generalized fibrosis of the oral soft tissues which

tend to present itself clinically as palpable fibrous bands.<sup>1</sup> The most common initial symptoms of OSMF are burning sensation of oral mucosa aggravated by spicy food, followed by either hypersalivation or dryness of the mouth.<sup>2</sup> It may also be preceded by ulceration or pain.<sup>1</sup> The hallmark of OSMF is that it affects most parts of oral cavity, pharynx and upper third of esophagus leading to dysphagia and progressive trismus due to rigid lips and cheeks.<sup>3</sup>

The overall prevalence rate of OSMF in India is about 0.2% to 0.5% and prevalence by gender varying from 0.2 to 2.3% in males & 1.2 to 4.57% in

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	DOI: 10.5958/2393-9834.2015.00009.1

females. The age range of the patients with OSMF is wide which ranges between 20 to 40 years.<sup>4</sup>

The disease is most commonly found in youth as they are more attracted to commercially available areca nut products.<sup>5</sup> The alkaloids and flavonoids from arecanut stimulate proliferation of fibroblasts and collagen synthesis.<sup>6</sup> OSMF fibroblasts synthesize large amount of collagen compared to normal fibroblasts.<sup>7</sup> Thus in OSMF connective tissue changes are characterized by deposition of dense collagen fibers.<sup>1</sup> Moreover hyaline degeneration, fragmentation and elastic degeneration are characteristic observations with the progress of the disease.<sup>8</sup>

About 26 types of collagen fibers are identified so far depending on molecular structure. Of these collagen; type I is most abundant interspersed by type III in connective tissue.<sup>9</sup> Routine Hematoxyline and Eosin (H&E) and Masson's Trichrome stain (MT) demonstrate all types of collagen collectively. However Picrosirius red (PSR) stain under polarized microscopy demonstrate collagen type I and type III separately with enhanced birefringence. Collagen type I appear as closely packed thick fibers with intense birefringence of yellow / orange to red color and correspond to collagen fibers. However collagen type III appear as loosely packed thin fibrils which display a weak birefringence of green to greenish-yellow color that could be identified as reticular fibers. Thus characterization of collagen becomes specific and reliable with variable thickness and different color intensities of birefringence.<sup>10, 11</sup>

Normal mucosa is elastic, flexible and resilient. Elastic fibers are the major insoluble extracellular matrix assemblies that endow resilience to connective tissue permitting long range deformability.<sup>12</sup> However in OSMF oral mucosa shows reduced elasticity and flexibility with progress of disease because of deposition of excessive collagen.

Thus the purpose of this study was to ascertain the importance of orientation, density and thickness of collagen type I and type III and elastic fibers in various stages of OSMF.

### MATERIALS AND METHODS

The present study included 15 NOM and 45 OSMF subjects which were divided equally in three groups as stage I, II and III following clinico-functional classification by Haider et al (2000) after obtaining written consent of the patient and institutional ethical committee clearance.

Further incisional biopsy was performed from buccal mucosa for the selected cases, fixed in 10% neutral buffered formalin and processed for paraffin embedding. 4 µm thick sections were obtained using semiautomatic microtome, stained with MT, VVG and PSR stains based on standard protocol, and observed under light and Polarized microscope respectively.<sup>13</sup> Thickness of collagen and elastic fibers was measured with the help of LYNX software (Lawrence & Mayo) in 10 randomly selected fields per sample without overlapping.

### RESULTS

Present study revealed following results -

#### Orientation of collagen and elastic fibres:

The collagen fibres (MT stained) [Fig-1] and type I collagen (PSR stained) exhibited haphazard arrangement in NOM and stage I OSMF, while its orientation was changed and appeared parallel to the surface epithelium in stage II and III OSMF. However type III collagen (PSR stained) and Elastic fibers (VVG stained) did not show any alteration in various stages of OSMF from NOM and appeared haphazard (Table-1) [Figure-2]

**Table-1: Pattern of Orientation of Collagen & Elastic fibers in relation to the surface epithelium in NOM and OSMF**

	NOM (15)	STAGE I (15)	STAGE II (15)	STAGE III (15)
<b>COLLAGEN IN MT</b>	Haphazard	Haphazard	Parallel	Parallel
<b>COLLAGEN TYPE I IN PSR</b>	Haphazard	Haphazard	Parallel	Parallel
<b>COLLAGEN TYPE III IN PSR</b>	Haphazard	Haphazard	Haphazard	Haphazard
<b>ELASTIC FIBERS IN VVG</b>	Haphazard	Haphazard	Haphazard	Haphazard

**Density of collagen and elastic fibres:**

Type I collagen fibers (PSR stained) appeared moderately dense in NOM and stage I OSMF, while its density increased in stage II & stage III OSMF. [Figure-2]

Similarly density of Type III collagen fibers (PSR stained) appeared moderate in NOM, stage I & stage II OSMF but it was sparse in stage III OSMF. [Figure-2]

Moreover dense elastic fibers (VVG stained) were observed in NOM and stage I OSMF, which showed decrease in density with progress of OSMF and appeared moderately dense in stage II OSMF and sparse in stage III OSMF. (Table 2) [Figure-3]

**Table-2: Comparison of density of Collagen & Elastic fibers in NOM and OSMF**

DENSITY OF FIBERS	NORMAL (15)	STAGE I (15)	STAGE II (15)	STAGE III (15)
COLLAGEN TYPE I IN PSR	MOD DENSE	MOD DENSE	DENSE	DENSE
COLLAGEN TYPE III IN PSR	MOD DENSE	MOD DENSE	MOD DENSE	SPARSE
ELASTIC FIBERS IN VVG	DENSE	DENSE	MOD DENSE	SPARSE

**Thickness of collagen and elastic fibres:**

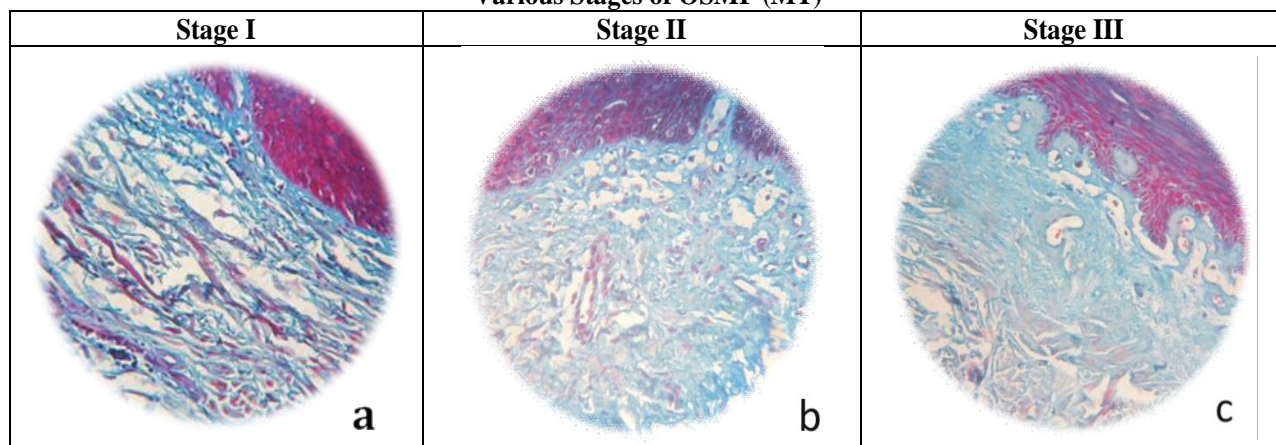
Measured thickness of collagen fibres (MT stain) [Fig-1] and type I collagen (PSR stained) was more in OSMF than NOM. [Fig-2] Moreover progressive increase in thickness was noticed with advancement of OSMF.

Type 3 collagen fibres [Fig-2] and Elastic fibres [Fig-3] showed little variation in thickness in NOM and various stages of OSMF. (Table 3)

**Table-3: Comparison of thickness of Collagen fibres, Collagen type I, Collagen III & Elastic fibers in NOM and OSMF in µm**

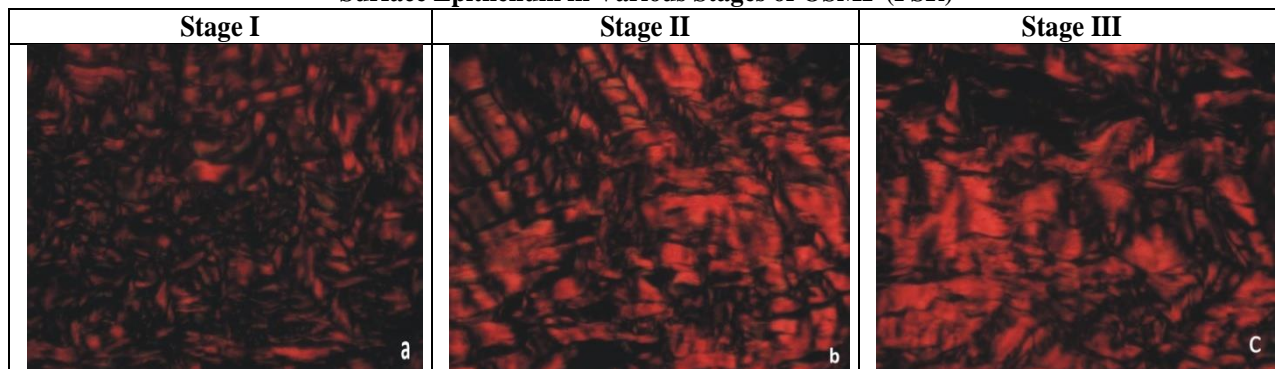
THICKNESS OF FIBERS	NORMAL (15)	STAGE I (15)	STAGE II (15)	STAGE III (15)
COLLAGEN FIBRES IN MT	1.1	2.5	3.9	8.7
COLLAGEN TYPE I IN PSR	1.9	4.1	7.1	11.7
COLLAGEN TYPE III IN PSR	1.8	1.9	2.0	1.68
ELASTIC FIBERS IN VVG	1.2	1.2	1.1	1.2

**Figure-1: Photomicrograph Showing Orientation of Collagen Fibers In Relation To the Surface Epithelium in Various Stages of OSMF (MT)**

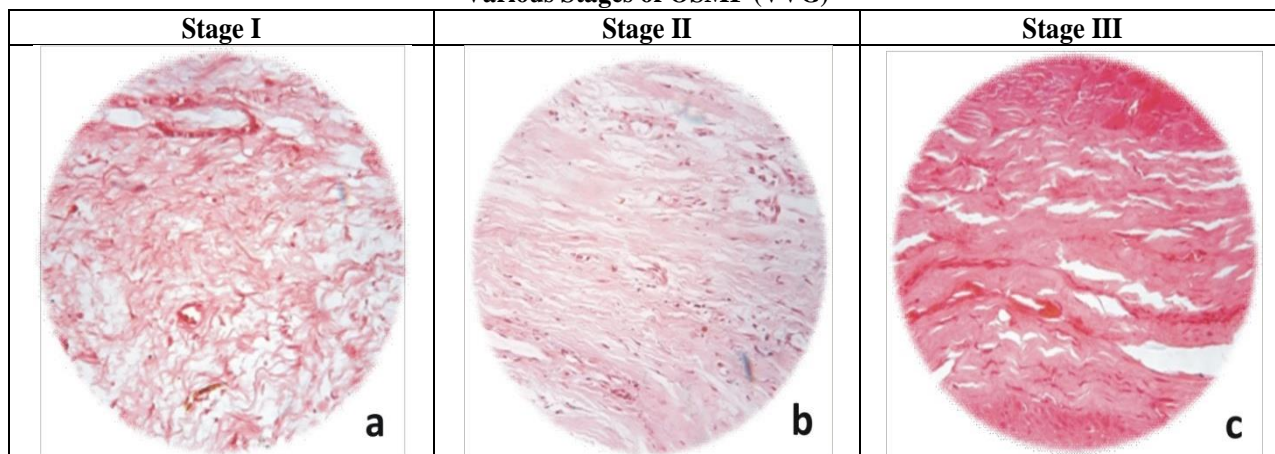




**Figure-2: Photomicrograph Showing Orientation of Collagen Type I & Type III Fibers In Relation To the Surface Epithelium in Various Stages of OSMF (PSR)**



**Figure-3: Photomicrograph Showing Orientation of Elastic Fibers In Relation To the Surface Epithelium in Various Stages of OSMF (VVG)**



## DISCUSSION

OSMF is a chronic disease and a well-recognized potentially malignant condition of the oral cavity characterized by inflammation and a progressive fibrosis of the lamina propria and deeper connective tissue. Various authors have agreed that pathological alteration in OSMF begin in the lamina propria and the epithelium responds only secondarily. Fibrosis and hyalinization extends into muscle bundle zone resulting into atrophy of the muscles. MT is a special stain which offers a simultaneous contrast color to the collagen fibers along with muscle fibers facilitating better visual discrimination between them.<sup>8</sup>

Collagen is the major structural element of the connective tissue which contributes to the stability and maintains structural integrity. It contributes to the entrapment, local storage and delivery of growth factors and cytokines and play an important role during organ development and tissue repair. So far 26 genetically distinct collagen types have been

described. Type I collagen fibers form the bulk of subepithelial collagen while type III is intermixed with it.<sup>9</sup> PSR is the special stain for connective tissue especially for differentiating collagen subtypes.<sup>11</sup> It works on the principle that sulfonic group of sirius red- a strong cationic dye reacts with the basic groups present in collagen molecules. The elongated dye molecules are attached to collagen fibers in such a way that their long axis is parallel. This parallel relationship between dye and collagen molecules results in enhanced birefringence. The role of picric acid is to prevent the indiscriminate staining of non collagenous structures by sirius red.<sup>2</sup>

Enhanced birefringence of the fibers could be demonstrated by polarizing microscopy. Various colors exhibited by different types of collagen provide information regarding the type of the collagen with respect to its physical aggregation and morphological appearance. Thus these polarizing colors help in grading the severity of the disease.

Moreover it may serve as an excellent adjunct to electron microscopic study.<sup>10</sup>

Present study revealed haphazard orientation of collagen fibres as well as type I collagen in NOM and stage I OSMF, while in stage II and stage III most of them were arranged parallel to the surface epithelium. Type III collagen fibers showed haphazard orientation in NOM and all stages of OSMF. Contrasting to these findings Parveen S et al (2013) observed parallel orientation of thin (type III) and thick (type I) collagen fibers to the epithelium in all grades of OSMF and stated that the cause for these unidirectional or parallel alignments may be due to -

- Chronic stimulation of oral mucosa by irritation or as sequence of mechanical stress.
- Due to force generated by cell mediated gel contraction.
- Due to changes in the extracellular matrix imbalance production and degradation.<sup>1</sup>

Moreover Smitha BR et al (2013) explained that parallel orientation of collagen fibers to the epithelium in 68% in buccal mucosa and 78% in labial mucosa of OSMF subjects was due to their deposition in the direction of opening and closing movement of mouth.<sup>2</sup>

Density of collagen type I and type III appeared moderate in NOM as well as in stage I OSMF, however collagen type I appeared denser in stage II and stage III OSMF. Collagen type III appeared moderately dense in NOM and stage I and stage II OSMF, while they were sparse in type III OSMF. These findings show increased density of collagen type I with increasing stages of OSMF and was found to be statistically significant ( $p < 0.05$ ), while density of type III collagen appeared same in NOM and stage I & II OSMF, and reduced in type III OSMF. These findings are consistent with Parveen S et al (2013), Kamath VV et al (2013), Ganganna K et al (2012) and Ceena DE et al (2009).<sup>1,11,14,15</sup> Kamath VV et al has further explained the reduction in type III fibres to be on the basis of the compaction (removal of extracellular matrix substance) during progressive maturation of the fibres.<sup>11</sup>

In the present study average thickness of collagen fibers in stage I, II and III OSMF was  $2.52 \mu\text{m} \pm 0.19$ ;  $3.96 \mu\text{m} \pm 0.50$  and  $8.7 \mu\text{m} \pm 1.5$  respectively while  $1.11 \mu\text{m} \pm 0.43$  in NOM. Further assessment of average thickness of type I collagen under polarizing microscope revealed  $4.15 \mu\text{m} \pm 0.86$ ;  $7.18 \mu\text{m} \pm 0.83$  and  $11.7 \mu\text{m} \pm 1.0$  in stage I, II and III respectively

and  $1.90 \mu\text{m} \pm 0.72$  in NOM. This demonstrates that there is great increase in thickness of type I collagen with increasing stages of OSMF and further it can be stated that polarized microscopy after PSR staining gives more precise measurement due to different pattern of birefringence. Ganganna K et al (2012), Ceena DE et al (2009) and Kamath VV et al (2013) too observed increase in thickness of collagen fibres with increasing grades of OSMF.<sup>11,14,15</sup> Moreover in the present study average thickness of type III collagen in NOM, stage I and II OSMF appeared nearly same with slight reduction in stage III OSMF. However Kamath VV et al (2013) observed variable results for type III collagen.<sup>11</sup>

The normal lining mucosa shows elastic fibers interlacing in all directions and provide elasticity. A VVG special stain demonstrates very fine black colored elastic fibers. The changes taken place in elastic fibers thus could be accurately ascertained by VVG staining.<sup>13</sup>

The present study demonstrated haphazard orientation of elastic fibers in all directions in NOM and all stages of OSMF which was statistically significant (Kruskal- Wallis Test).

Moreover the density of elastic fibres in NOM and stage I OSMF appeared more, which was moderate in stage II and sparse in stage III OSMF. These findings demonstrated that density of elastic fibers decreases with progress of disease and results were statistically significant ( $p < 0.05$ ).

However observed average thickness of elastic fibers in stage I, II and III OSMF was  $1.20 \mu\text{m} \pm 0.08$ ,  $1.19 \mu\text{m} \pm 0.07$  and  $1.2 \mu\text{m} \pm 0.08$  respectively while in NOM it was  $1.2 \mu\text{m} \pm 0.08$ ; which suggests that there is no much change in thickness of elastic fibres in OSMF when compared to NOM.

From these observations an assumption can be made that though thickness and orientation of elastic fibres remain almost same in all stages of OSMF as NOM the decreased density of elastic fibers could be playing significant role in reduction of elasticity of mucosa leading to decreased mouth opening.

## CONCLUSION

It can be inferred that collagen fibers and elastic fibers show minimal alternation in early stages. Once the disease progress from early stages and patients continues with arecanut chewing habit the fibrotic changes in connective tissue accelerates in severity. Unfortunately even after cessation of the causative habit, all the clinical and histologic features of the disease persists. Moreover collagen fibers change

their orientation and become unidirectional and arranged parallel to the epithelium which can be correlated with the direction of force.

Further polarized microscopic study strongly suggests that type I fibers represented predominantly as orange red- red colored fibrils and are deposited in excess as severity of disease increases whereas type III collagen fibers appear fine and show weak greenish yellow birefringence.<sup>14</sup> These fibers decrease with increase in severity which can be explained as removal of extracellular matrix substance during progressive maturation of fibers.<sup>1</sup>

However elastic fibers reduce with increase of severity of disease. This can be correlated further with decrease or loss of elasticity of mucosa with progression of disease.

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**How to cite this article:** Mishra NSS, Wanjari SP, Parwani RN, Wanjari PV, Kaothalker SP. Assessment of collagen and elastic fibres in various stages of oral submucous fibrosis using Masson's trichrome, Verhoeff vangieson and picosirius staining under light and polarizing microscopy. *J Dent Specialities* 2015;3(2):170-172.

**Source of Support:** NIL

**Conflict of Interest:** NIL

# Bacterial colonization at implant – abutment interface: a systematic review

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## ABSTRACT

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Received: 18/01/2015

Accepted: 08/06/2015

**Background:** Although implants have shown to have a high success rate, clinicians are also called upon to encounter numerous complications and failures. Among the numerous reasons of failures, peri-implantitis is reported to account for 10% of the failures. As the oral cavity provides a natural habitat for various micro-organisms due to its non-shedding surface, there is some evidence that gram-negative anaerobic rods colonize around the implant leading to peri-implantitis. This colonization is dependent on various factors such as the micro-gap at the implant-abutment interface, the precision of fit, degree of micro-movement and applied torque.

**Aim and Objective:** The aim of this article is to provide an overview of current literature on bacterial colonization on the implant surface and the influence of different implant-abutment designs on bacterial colonization.

**Material and Methods:** An electronic search was conducted using the PubMed (Medline), PubMed central and Google scholar to identify articles published on bacterial colonization at the implant-abutment interface. The following search words were used: microleakage at implant-abutment interface, surface characteristics/roughness of implants, bacterial adhesion on dental implants, bacterial colonization at implant abutment surface. The articles included in the review comprises of in vitro studies, in vivo studies, review abstracts and review articles.

**Results:** The total number of articles for the key words” microleakage at implant-abutment interface” were 29 and for the key words” bacterial colonization at implant abutment interface“ were 17. After considering the inclusive and exclusive criteria, case report, case series and review articles were excluded. 11 articles were considered eligible based on their relevance to the subject.

**Conclusion:** Although micro-gap formation inevitably occurs at the implant-abutment interface. The current literature highlights that the formation of this micro-gap is influenced by the type of implant-abutment design used. Though the results are insignificant, recent in vivo and in vitro studies have proved that external hexagon results in higher micro leakage compared to other connections used. Morse-taper connections shows the least amount of microbial leakage.

**Key words:** Implant-abutment interface, Microbial leakage, Bacterial colonization

## INTRODUCTION

Implant failures can be divided into early and late failures.<sup>1,2</sup> Early failures are described as failures which have occurred before the abutment connection and are generally caused by inadequate osseointegration. Studies have shown correlation between age, gender, insertion site, fixture length, smoking and success of an implant.<sup>3-4</sup> Late failures occur after occlusal loading of the implant and has been associated with plaque induced peri-implantitis. Since two-stage implant systems are frequently used they result in a micro-gap at the implant-abutment junction, this hollow space provides a favourable site

for bacterial colonization and leads to inflammatory process at implant-abutment interface.<sup>5-6</sup> This infiltration of bacteria is a major contributory factor leading to periimplantitis.<sup>1</sup>

Peri-implantitis is a progressive disease of implant involving hard and soft tissues resulting in bone resorption, decreased osseointegration, pocket formation and purulence. Bone resorption may be induced by bio mechanical stress, bacteria, or a combination of both. However bacteria may be the primary factor, anaerobic bacteria have been observed growing in the micro-gap present at the implant-abutment interface and in the peri-implant sulcus.<sup>7</sup> The infiltration of the bacteria at implant abutment interface has been shown to depend on the type of implant-abutment connection and their sealing capacity.<sup>8</sup>

The frequently used abutments in different implant systems are internal hexagon, external hexagon, cylinder hex, conical, octagonal, spline cam, cam tube, pin/slot.<sup>9</sup> The hexagon design is oldest and was the most commonly used design, however it had

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	DOI: 10.5958/2393-9834.2015.00010.8

shortcomings like screw loosening and compromised rotational and lateral stability.<sup>9</sup> Therefore to overcome the shortcomings different designs of abutments were developed, out of the designs mentioned conical abutments have gained popularity as it provides mechanically sound, stable self-locking interface.<sup>10,11</sup> Since it provides a friction lock, it minimizes the micro-gap present at implant-abutment interface. It has been suggested that conical connection reduces bacterial infiltration at implant abutment interface.<sup>12</sup>

## MATERIAL AND METHODS

An electronic Search was conducted using the PubMed (Medline), PubMed central and Google scholar to identify articles published on bacterial colonization at the implant-abutment interface. The following search words were used: microbioleakage at implant-abutment interface, surface characteristics/roughness of implants, bacterial adhesion on dental implants, bacterial adhesion on implant abutment surface. Literature covering both in vivo, in vitro studies and review articles were included.

## RESULTS

The total number of articles for the key words” microbioleakage at implant-abutment interface” were 29 and for the key words “bacterial colonization at implant abutment interface” were 17.

After considering the inclusive and exclusive criteria case report, case series and review articles were excluded. 11 articles were considered eligible based on their relevance to the subject.

The articles were categorized with respect to the current literature on microbial leakage at implant-abutment interface, influence of torque values, roughness, and type of abutment connections which influences the microbial colonization at the interface. To highlight the important aspects and to give a clear overview of the literature, the articles have been described in various headings.

## ABUTMENT DESIGNS

Implant-abutment connections can be categorized into internal and external connection. The distinctive feature which separates the two is the presence and absence of geometric feature extending on the coronal surface of the implant.

This can be categorized as a slip-fit joint where a space exist between the implant – abutment interface or a frictional fit where there is minimal space at the interface. This geometry can be of following types octagonal, hexagonal, cone screw, cone hex, cylinder hex, sline cam, cam tube and pin / slot.<sup>9</sup>

There has been various in vivo and in vitro studies which have evaluated the micro-gap present at the interface of the different designs and the microbial leakage at the interface.

## IMPLANT-ABUTMENT INTERFACE-THE MICROBIAL LINK

Two piece implant system consists of the endosteal part (implant) which is placed during the first surgical phase and the mucosal part (abutment) which is attached after osseointegration. Screwing the abutment to the implant results in gap between the two components. It has been reported that this micro-gap measures around 40-60µm, due to this gap there is micro-movement during function which in turn enhances microbial leakage.<sup>13</sup> Presence of gap near the alveolar crest is also responsible for 1mm of bone loss during the first year of functional loading.<sup>14</sup>

The colonization of the bacteria at the implant-abutment interface depends on factors like the precision at the implant-abutment interface of different implant system and their marginal fit, the closing torque values also alters the sealing ability of the abutments.<sup>15</sup>

To demonstrate the microbial leakage at implant-abutment interface an in vitro study was carried out on implant-abutment assemblies using blood serum media inoculated with micro-organism. The serum was incubated in anaerobic condition for 7 days with the implants partially and completely immersed in it. The micro-organisms from the implants were collected and incubated in blood agar plates in anaerobic conditions. The result of this study showed presence of micro-organisms in both the assemblies indicating bacterial leakage.<sup>16</sup>

Bacterial leakage have also been observed after functional loading of implants, it has been shown that chewing reduces component stability which favours bacterial colonization at the micro-gap. When the implants are subjected to functional loads there is exchange of fluids between internal and external environment which increases the bacterial infiltration at the peri-implant area.

Therefore implant-abutment interface plays a vital role in bacterial colonization, different connections have been compared to evaluate their stability under loading conditions.

Comparison between internal and external abutment connections of different implants systems have demonstrated that internal connections provide better marginal fit at the interface, thus minimizing the microbial leakage.

In vivo and in vitro studies have demonstrated that among various connections used, Morse taper connections achieved higher seal as it has frictional lock system and thus reduced the bacterial infiltration at the implant-abutment interface. Also conical abutments showed superiority in terms of torque maintenance and abutment stability which in turn minimized the bacterial colonization.<sup>17</sup> Though external hexagon are one of the oldest and commonly used abutment connections, they are considered to be

inefficient in preventing microbial leakage at the implant-abutment interface.

An in vivo study was done on bacterial colonization at the peri-implant sulcus and inside the implant connection after 5 years of functional loading, significant difference between connection type and total bacterial counts was noted. Connections types compared in the study were external hexagon, internal hexagon with external collar and conical. Bacteria belonging to the red and orange complex were evaluated, these included *Aggregatibacter actinomycetemcomitans* (Aa), *Porphyromonas gingivalis* (Pg), *Tannerella forsythensis* (Tf), *Treponema denticola*(Td), *Prevotella intermedia* (Pi), *Peptostreptococcus micros* (Pm), *Fusobacterium nucleatum* (Fn), *Campylobacter rectus* (Cr), *Eikenella corrodens* (Ec), and *Candida albicans* (Ca). Significant results were observed as the conical connection showed least amount of red complex bacteria as compared to external hexagon, and internal hexagon with external collar.<sup>17</sup>

An in vitro study was also performed to evaluate the bacterial leakage at the implant-abutment interface and the sealing efficiency of implants when they were subjected to in different torque values. The torque values used was 20N.cm and 30N.cm. Higher contamination was observed with implants in which 20N.cm torque was applied.<sup>15</sup>

## DISCUSSION

Microbial penetration through the micro-gap invariably exists at the implant-abutment interface. This gap has shown to be a potential source of microbial infiltration and peri-implantitis leading to implant failure, as it offers a welcoming environment for the bacteria to colonize.

Though conical connections have shown a better sealing ability, micro-gap invariably exists at the interface, therefore it can be stated that no connection has completely eliminated the micro-gap formation or has led to a sterile environment inside the implant connection.

Type of connection used is one of the important factor influencing bacterial adhesion, however other factors should also be given prime importance when implants are used. Factors such as surface roughness of implants, the amount of torque used, the variability or the changing oral micro flora has to be considered. As it been shown that rapid biofilm formation occurs at the implant surface which is difficult to clean. There is a need to optimize the implant-abutment connections in order to achieve better outcomes.

## CONCLUSION

After analysing the current literature, it could be concluded that bacterial colonization depends on multiple factors and certain modifications should be always undertaken to minimize the factors which

promote bacterial infiltration at the implant-abutment interface. Current implant systems cannot safely prevent microbial leakage and bacterial colonization of the inner part of the implant. There is a need for modifications to seal the implant-abutment contact area.

Use of conical implants can be promoted as it has better sealing abilities compared to other systems. Manufacturers and clinicians must be aware of the problem of microbial leakage, since it is likely that microbial colonization of the marginal gap and the inner part of the implant can result in soft tissue inflammation leading to implant failure.

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**How to cite this article:** Lakha T, Kheur M, Kheur S, Sandhu R. Bacterial colonization at implant – abutment interface: a systematic review. *J Dent Specialities*, 2015;3(2):176-179.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Revascularization of a necrotic, infected, immature permanent molar with apical periodontitis: a case report

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## ABSTRACT

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The traditional techniques of chemo-mechanical instrumentation and disinfection of the root canal system used in mature teeth are limited by the immature tooth's anatomy. The open apex is difficult or impossible to seal with conventional root filling methods because of the absence of an apical stop. Furthermore, the arrested development of the dentinal walls at the time of pulp necrosis leaves a weak tooth with thin dentinal walls that are susceptible to fracture. The purpose of the paper is to present the case of a patient wherein revascularization of the necrotic infected pulp space of an immature permanent mandibular molar was induced by stimulation of a blood clot from the periapical tissues into the canal space. The treatment approach can help rescue infected immature teeth by physiologically strengthening the root walls.

**Key words:** Pulp revascularization, Immature apex, Apexification.

Received: 17/02/2015

Accepted: 06/07/2015

## INTRODUCTION

Pulpal necrosis of an immature permanent tooth poses many potential complications. Rapidly progressing dentinal caries or traumatic injuries in the permanent teeth of young patients lead to pulp inflammation and / or necrosis and apical periodontitis, which subsequently interrupt the development of the incompletely formed roots. The presence of an open apex and thin fragile dentinal walls presents a problem that complicates the clinical management of pulp and periapical disease.<sup>1</sup>

The traditional techniques of chemo-mechanical instrumentation and disinfection of the root canal system used in mature teeth are limited by the immature tooth's anatomy.<sup>2</sup> The mechanical cleaning and shaping of a tooth with blunderbuss canal are difficult, if not impossible. The thin, fragile lateral dentinal walls can fracture during mechanical filing and the large volume of necrotic debris contained in a wide root canal is difficult to completely disinfect. Many blunderbuss canals with flaring walls cannot be obturated and sealed by orthograde methods and might require apical surgery and retrograde sealing of the canal.<sup>3</sup>

Many techniques have been suggested for induction of apical closure in pulpless teeth to produce more favorable conditions for conventional root canal filling. These techniques include surgery and retrograde sealing, calcium hydroxide - induced apical closure and placement of apical plug of mineral trioxide and gutta percha obturation but because of the thin dentinal walls, there is a high incidence of root fractures in teeth after apexification. Thus the concept of revascularization was introduced by Ostby in 1961. Nygaard- Ostby hypothesized that laceration of the periapical tissues until bleeding occurred might produce new vital vascularized tissue in the canal. He suggested that this treatment 'may result in further development of the apex'.<sup>4</sup> In 1966 Rule and Winter documented root development and apical barrier formation in cases of pulpal necrosis in children.<sup>5</sup> Since then there has been an ongoing research in this field. This case report add another example to dental literature supporting this treatment modality as a successful alternative to conventional procedure undertaken to treat necrotic, infected and immature permanent teeth.

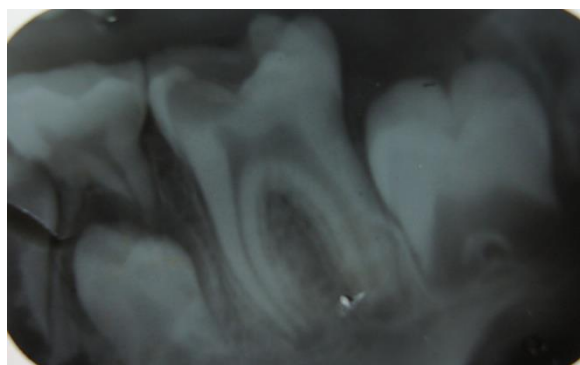
## CASE REPORT

A 8 year old female patient reported to the department with complaint of pain in mandibular left posterior tooth. Clinical evaluation revealed carious 36. Radiograph interpretation showed carious lesion approaching the pulp with open apices.(Fig 1) The tooth did not respond to cold testing with CO<sub>2</sub> ice, heat test, the tooth was tender on vertical percussion. The tooth was diagnosed with necrotic pulp. Access was obtained to the pulp space, where a necrotic pulp was confirmed clinically. The canal was instrumented

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	DOI: 10.5958/2393-9834.2015.00011.X



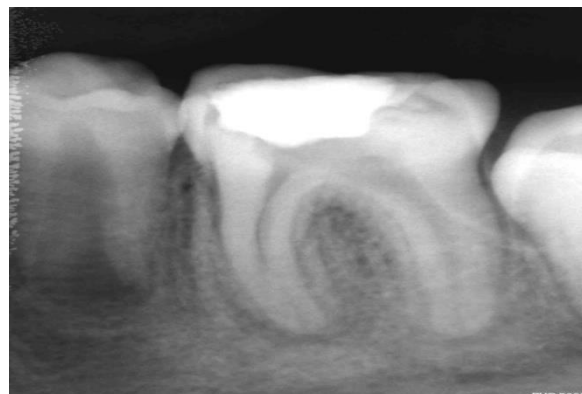
and irrigated copiously with 1.25% sodium hypochlorite and dried with sterile paper points. A creamy paste of equal proportions of metronidazole, ciprofloxacin and cefclor mixed with sterile water was applied to canal space. The access cavity was closed with cotton pellets and intermediate restorative material. The patient was asymptomatic when he returned for follow up treatment. The antibiotic paste was intact in the canal space and was irrigated away using 1.25% NaOCl and sterile water. No instrumentation of the canal space was performed. The apical tissues beyond the confines of the root canal were stimulated with sterile endodontic file to induce bleeding into the canal space. The blood clot was allowed to reach a level that approximated the cemento enamel junction. A cotton pellet moist with sterile water was applied over the blood clot. After this procedure permanent restoration with Glass Ionomer Cement was placed. At the 3- and 6 month follow- up evaluation, the patient was asymptomatic. (Fig 2) One year from the time of blood clot induction the tooth remained asymptomatic, with normal limits for percussion, palpation, pocket probing depths, and mobility. Radiographs revealed normal periapical structures with continued root development, and thickening of lateral aspects of dentinal walls of the root canals, reinforcing and strengthening the root. (Fig 3)



**Fig. 1: Preoperative radiograph showing carious 36, with open apices.**



**Fig. 2: 6 month follow- up showing continued root development.**



**Fig. 3: Radiograph at 12 months showing continued root development with apical constriction.**

## DISCUSSION

This report demonstrates the potential of non-vital infected teeth to undergo the procedure of revascularization and the same should be undertaken to avoid the undesired results of the conventional treatment options available. The open apex is difficult or impossible to seal with conventional root filling methods because of the absence of an apical stop. Furthermore, the arrested development of the dentinal walls at the time of pulp necrosis leaves a weak tooth with thin dentinal walls that are susceptible to fracture.<sup>(2)</sup> Bunchs and Trope in 2004 demonstrated the advantages of this treatment modality, which resulted in a radiographically apparent normal maturation of the entire root versus an outcome of only a calcific barrier formation at the apex after conventional calcium hydroxide- induced apexification.<sup>6</sup>

The rationale of revascularization is that if a sterile tissue matrix is provided in which new cells can grow, pulp vitality can be reestablished.<sup>3</sup> It is known that the infection control of microbial contamination from the root canal system is a precondition for successful root canal treatment and that the primary goal should be reduce the microbial load to a low level where tissue healing can occur.<sup>7</sup> Various combinations of topical antibiotics have the ability to disinfect carious dentin and necrotic, infected root canals. One combination that is effective against the bacteria commonly found in infected root canals is the use of ciprofloxacin, metronidazole and cefaclor.<sup>8</sup> But contradictory findings had been reported by Bezerra da Silva LA et al who evaluated in vivo the revascularization and the apical and periapical repair after endodontic treatment using 2 techniques for root canal disinfection (apical negative pressure versus apical positive pressure irrigation plus triantibiotic intracanal dressing) suggesting that the use of intra canal antibiotics may not be necessary.<sup>7</sup>

Different mechanism could be attributed to continued development of root: remnants of vital pulp cells at

the apical end of the root canal, presence of multipotent dental pulp stem cells,<sup>9</sup> stem cells from periodontal ligament which can proliferate within the root canal,<sup>10,11</sup> stem cells from apical papilla,<sup>12,13</sup> and presence of blood clot which being a rich source of growth factors could play an important role in regeneration.<sup>14</sup> The elongation of the root occurs by apposition of newly generated cementum – like tissue termed “intracanal cementum”. The generation of this tissue may occur despite the presence of inflammatory infiltration at the apex or in the canal.<sup>15</sup> There are several advantages of revascularization as observed from this as well as from the past studies. It requires a shorter treatment time, after control of infection, it can be completed in a single visit. It is also very cost- effective, because, because the number of visits is reduced and no additional material is required. Obturation of the canal is not required unlike in calcium hydroxide induced apexification, with its inherent danger of splitting the root during lateral condensation. However the biggest advantage is that of achieving continued root development and strengthening of the root as a result of reinforcement of lateral dentinal walls with deposition of new dentin/ hard tissue.<sup>3</sup>

The procedure is simple and may in near future replace the traditional treatment options including hard tissue barrier via calcium hydroxide or an artificial hard tissue barrier of MTA. We need to be constantly in touch with current concepts of advancements, take maximum advantage of the same, improve the standard of our specialty and serve the community in a better way.

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**How to cite this article:** Vashisth P, Vatsala V, Naik S, Singh MG. Revascularization of a necrotic, infected, immature permanent molar with apical periodontitis: a case report. *J Dent Specialities.* 2015;3(2):180-182.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

## Incidental finding of dentigerous cyst - a case report

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### ABSTRACT

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Received: 19/01/2015

Accepted: 20/05/2015

In the jaws, the most common type of developmental odontogenic cyst is dentigerous cyst, mostly affecting the impacted mandibular third molars and permanent maxillary canines. They are often noted as an incidental finding on radiographs as unilocular radiolucency with well-defined sclerotic border which encircles the crown of an unerupted tooth as most of these dentigerous cysts are clinically asymptomatic. Long standing cases of dentigerous cysts can progress to either ameloblastoma or squamous cell carcinoma or mucoepidermoid carcinoma. Henceforth, an early clinical and radiographic detection of the cyst plays a vital role so that apt treatment modalities can be carried out which will prevent or decrease the morbidity. With this above background, we hereby report an enticing case of dentigerous cyst which was incidentally observed in conventional radiographs and to evaluate further extension and nature of lesion, a conebeam computed tomography (CBCT) of jaw was taken.

**Key words:** Dentigerous cyst, Impacted mandibular third molars, Incidental finding, Cone beam computed tomography

### INTRODUCTION

In the jaws, the most common type of developmental odontogenic cyst is dentigerous cyst and it encompasses for about 20-24% of all epithelium-lined cysts of the jaws.<sup>1,2,3</sup> In the general population their incidence has been estimated at 1.44 cysts for every 100 unerupted teeth.<sup>4</sup> Dentigerous cysts occur in a wide range of age group with a peak frequency of 2nd to 4th decades of life.<sup>5</sup> The exact etiopathogenesis dentigerous cysts remain unknown, but most of the authors suggest a developmental origin from the tooth follicle.<sup>6</sup> They are often noted as an incidental finding on radiographs as unilocular radiolucency with well-defined sclerotic border which encircles the crown of an unerupted tooth as most of the dentigerous cysts are clinically asymptomatic. Diagnosis of a dentigerous cyst is straight forward in majority of the cases, but radiographically a 'typical' dentigerous cyst should be differentiated from a keratocystic odontogenic tumour (KCOT) [an odontogenic keratocyst] and unicystic ameloblastoma.<sup>7</sup> Dentigerous cysts over a period of time can progress to ameloblastoma or squamous cell carcinoma or mucoepidermoid carcinoma.<sup>8,9,10,11</sup> Therefore, an early clinical and radiographic recognition of the cyst plays a vital role

so that apt treatment modalities can be carried out which will prevent or decrease the morbidity.

### CASE REPORT

A middle aged female patient (30 years) reported with a chief complaint of pain in the lower front tooth region since one month to the department of oral medicine and radiology. Pain was insidious in onset, mild, intermittent and dull aching type. On examination all vital signs were within normal limits and no gross asymmetry of the face was noted. On intraoral examination gingival recession; gingival bleeding on probing and periodontal pocket was present in relation to 31 and 41 and hard tissue examination revealed no abnormality. Based on history and clinical findings a working diagnosis of chronic generalized gingivitis with localized periodontitis in relation to 31, 41 was made and subsequently patient was subjected to routine radiographic investigations.

Intraoral periapical radiograph revealed alveolar crestal bone loss in relation to 31 and 41. Digital panoramic radiograph revealed presence of well-defined radiolucency with sclerotic border surrounding crown of the unerupted tooth in relation to 38 at cemento-enamel junction level. The radiolucency appeared oval in shape extending antero-posteriorly from distal root of 36 to the crown of 38 and supero-inferiorly extending from 5mm below the alveolar crest in relation to 37 till lower border of mandible. Based on these imaging findings, a radiographic diagnosis of dentigerous cyst in relation to 38 was given and differential diagnosis of unicystic ameloblastoma and keratocystic odontogenic tumor were considered.

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	DOI: 10.5958/2393-9834.2015.00012.1

Based on radiographic diagnosis which was obtained through preliminary radiological examination patient was subjected to CBCT of jaw to evaluate further extension and nature of lesion of mandibular left third molar region. Additional finding revealed lingual expansion with severe thinning and perforation of the lingual cortical plate. The buccal cortex appeared intact with mild expansion. The mandibular canal outlines were lost along the lesion with the canal displaced inferiorly along the mandibular base. No evidence of root resorption was noted in relation to distal root tip of 36 and the roots of 37 appeared within the lesion. The CBCT findings were suggestive of a dentigerous cyst in relation to 38. All the parameters were within normal limits on routine hematological investigations. After obtaining patient's consent the cyst was treated by surgical enucleation along with the removal of impacted tooth under local anesthesia and specimen was subjected to histopathological examination. H & E section revealed a dense connective tissue stroma with proliferating fibroblasts, numerous blood vessels lined by endothelial cells and few inflammatory cell infiltrate. We arrived at final diagnosis of dentigerous cyst with all the radiographic and histopathological findings.



Fig 1: Intraoral view



Fig. 2: Orthopantomogram (Pre-operative)

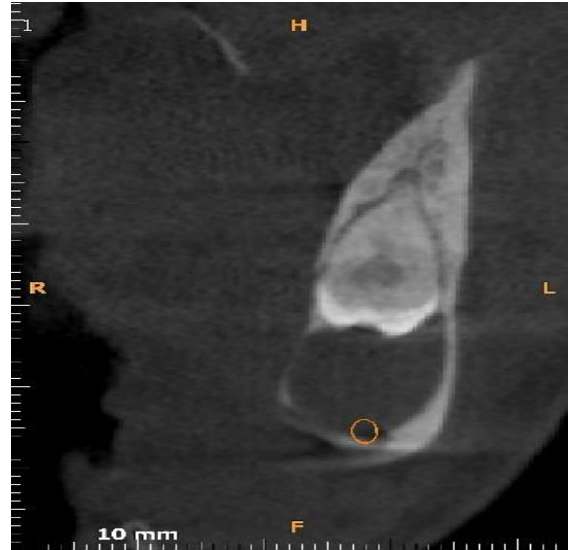


Fig. 3(a);

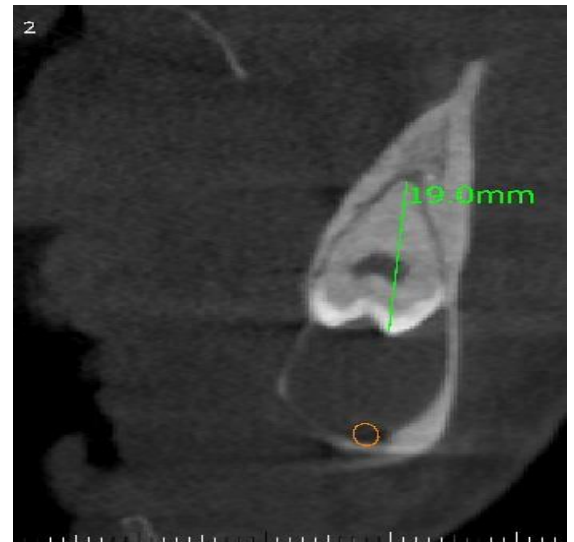


Fig. 3(b);

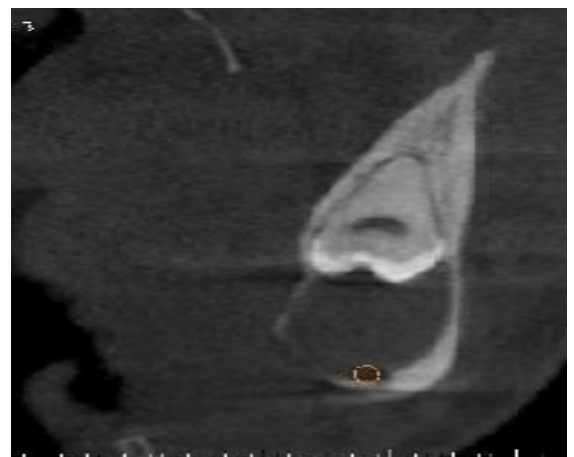


Fig. 3(c)

Fig. 3(a); 3(B); 3(C): CBCT- Cross Section along the Long Axis of 38 – Fused and Conical Root



Fig. 4(a)



Fig. 5: CBCT- Axial Section

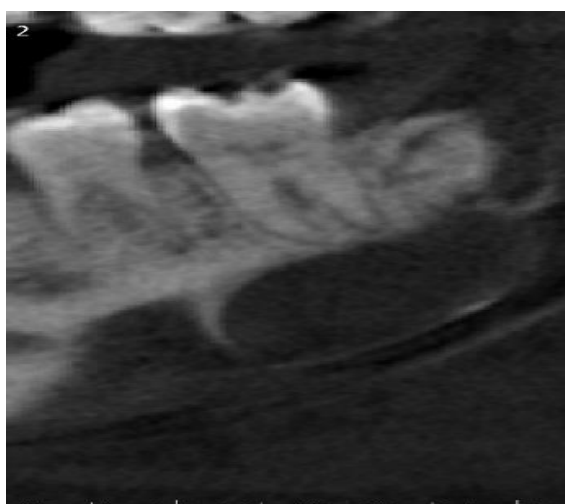


Fig. 4(b)

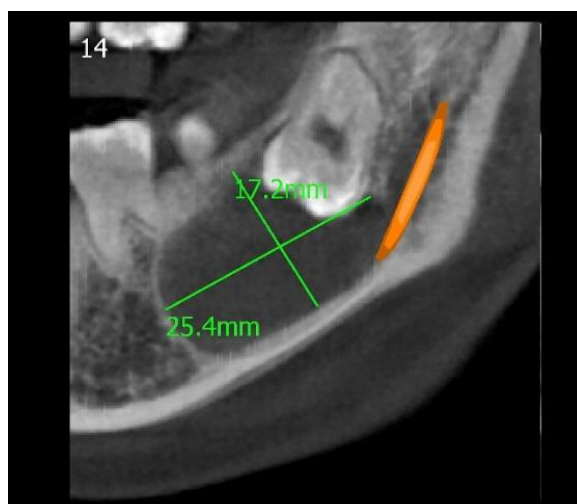


Fig. 6: CBCT- Bucco-Lingual Section



Fig. 4(c)

Fig 4(a); 4(b); 4(c): CBCT- Sections along 36, 37 Reveal Intact Root with No Evidence of Resorption

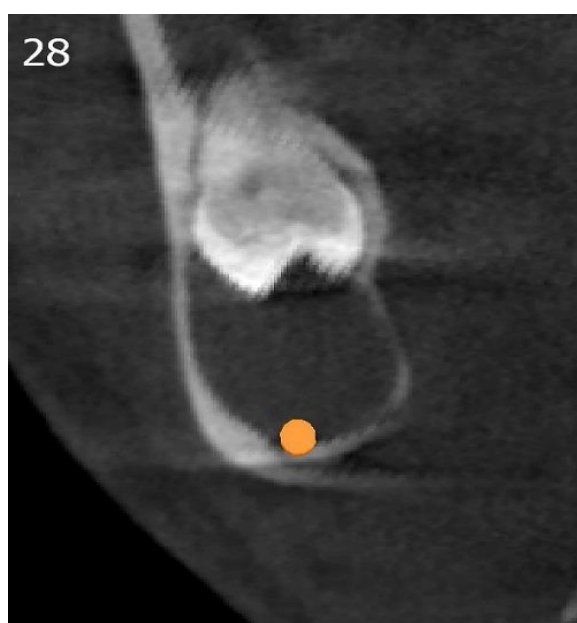
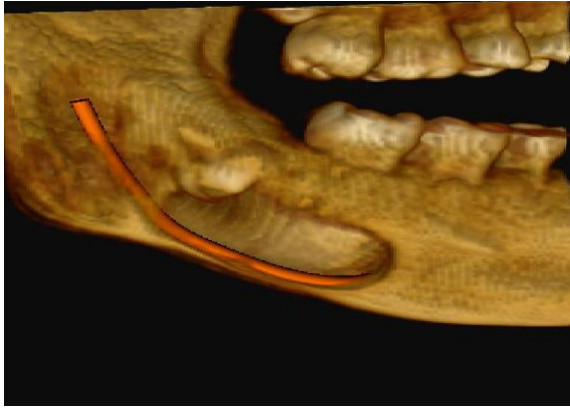


Fig. 7: CBCT- Cross Section of 38



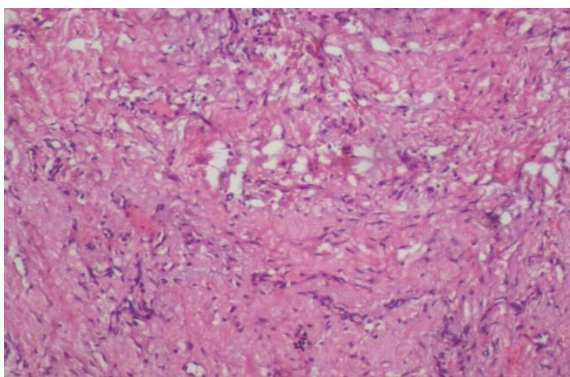
**Fig. 8: CBCT- 3 D reconstruction**



**Fig. 9: Surgical enucleation**



**Fig. 10: Orthopantomogram (Post-operative)**



**Fig. 11: Photomicrograph 4X**

## DISCUSSION

In the jaws, the most common type of developmental odontogenic cyst is dentigerous cyst and it encompasses for about 20-24% of all epithelium-lined cysts of the jaws.<sup>1,2,3</sup> Worldwide, incidence has been estimated at 1.44 cysts for every 100 unerupted teeth.<sup>4</sup> The exact etiopathogenesis of dentigerous cysts remain unknown, but most of the authors suggest a developmental origin from the tooth follicle<sup>6</sup>. The development of dentigerous cyst is due to fluid accumulation between the epithelium and the crown of an unerupted tooth.<sup>2,3,12</sup>

Dentigerous cysts occur in an assorted range of age group with a peak frequency of 2<sup>nd</sup> to 4<sup>th</sup> decades of life and in the current case it occurred in the 3<sup>rd</sup> decade.<sup>5</sup> Generally mandibular third molars are the most frequently affected, which was seen in our case, followed by the maxillary canine, mandibular second premolar and maxillary third molar.<sup>5</sup> Most of these follicular cysts are asymptomatic consequently they are often noted as an incidental finding on radiographs as in the present case.<sup>7</sup>

Radiographically it may show unilocular radiolucency in association with the crowns of unerupted teeth, having a well-defined sclerotic margins as seen in our case. Trabeculations are seldom seen and may give a false impression of multilocularity. Dentigerous cyst show three different types of radiological variations; which are as follows: central, lateral and circumferential type. The crown is enveloped symmetrically in central variety. The lateral type of dentigerous cyst is a radiographic appearance as a result of dilatation of the follicle on one aspect of the crown. Ultimately in circumferential dentigerous cyst entire tooth appears to be enveloped by cyst. Present case showed central variety of dentigerous cyst.<sup>13</sup>

The differential diagnosis may also include keratocystic odontogenic tumour and unicystic ameloblastoma. A keratocystic odontogenic tumor is less likely to resorb teeth which may attach farther apically on the root instead at the cemento-enamel junction. Significantly KCOT does not expand the bone to the same degree as a dentigerous cyst. It is a challenge to differentiate dentigerous cyst from a small unicystic ameloblastoma if there are no internal structure. There may be evidence of one or several locules although these are few and tend to remain faint or poorly calcified. Unicystic ameloblastoma may show knife edge pattern of root resorption of the apical one third of the adjacent erupted second or first molar. On axial CT scans, most of the dentigerous cysts typically expand in only one direction, usually buccal cortical plate because bone is thinner at this site. With more extensive ameloblastomatous change, expansion may be toward buccal as well as lingual

cortical plates and small locules at the margin of the lesion are suggestive of ameloblastomatous change.<sup>14</sup>

Many dentigerous cysts show evidence of acute and chronic inflammation in their walls. Moreover, the passage of desquamated epithelial cells and inflammatory cells into the cyst cavity may contribute to increased intracystic osmotic tension and thus leads to further expansion of the cyst. As the cyst expands, there may be some compensatory epithelial proliferation to cover the greater surface area of connective tissue according to Browne (1975). Moreover, Stenman et al (1986) also have shown that dentigerous cyst epithelium has little capacity for invitro growth which are also found in our case.<sup>13</sup>

The main treatment modality for dentigerous cyst is enucleation and also removal of the associated tooth which was done in our case. Marsupialization is performed in case of large dentigerous cysts to avoid neurosensory dysfunction and pathological fracture. Untreated dentigerous cysts can evolve into ameloblastoma or squamous cell carcinoma or mucoepidermoid carcinoma.<sup>8,9,10,11</sup> Many of these dentigerous cyst can attain substantial size without any notice to the patient hence, an early intervention in terms of clinical and radiographic detection of the cyst plays a vital role to implement appropriate treatment strategies thereby, to prevent or decrease morbidity.

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**How to cite this article:** Sushma P, Sowbhagya MB, Balaji P, Mahesh Kumar TS. Incidental finding of dentigerous cyst - a case report. *J Dent Specialities*,2015;3(2):183-187.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Management of root resorption in maxillary first molar- radectomy

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## ABSTRACT

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Received: 17/02/2015

Accepted: 20/05/2015

## INTRODUCTION

The tooth, its pulp, and its supporting structures must be viewed as a biological unit. The interrelationship among these structures influence each other during health, function and diseases.<sup>1</sup>

Pulp tissue succumbs to degeneration by way of a multitude of insults, such as caries, restorative process, chemical and thermal insults, trauma and periodontal disease. When products from pulp degeneration reach the supporting periodontium, rapid inflammatory responses can ensure that are characterized by bone loss, tooth mobility and sometimes sinus tract formation.

Periodontal disease by contrast, is a slowly progressive disease that may have a gradual atrophic effect on dental pulp resulting from dental plaque accumulation on external tooth surface.<sup>2</sup>

Simultaneous existence of pulpal problems and inflammatory periodontal disease can complicate diagnosis and treatment planning and affect the sequence of care to be performed.<sup>3</sup> The relationship between the periodontium and the pulp was first discovered by Simring and Goldberg in 1964.<sup>4</sup>

Preservation of tooth is one of the major goals of an Endodontist. This goal can be acquired either by non surgical or surgical approach. Root resection is one of the surgical approaches for preservation of molars with furcation involvement. This procedure results in a unique environment which is dictated by the contours of the remaining roots and the residual furcation between them. Root resorption is a viable treatment option to salvage and retain a part of multirrootedteeth. This case report illustrates prognosis of root resection after completion of endodontic therapy for managing a case of root resorption. This case shows external root resorption of the distobuccal root of right maxillary first molar. Due to strategic value of maxillary first molar, it was decided to employ root resection. After completion of endodontic therapy root resection was carried out. After 6 months, the absence of periradicular radiolucent lesions, periodontal pocket, pain, and swelling indicated a successful outcome of root resection.

**Keywords:** Endodontist, Multirrooted teeth, Periradicular, Distobuccal, Resorption

Periodontium is anatomically interrelated with the dental pulp by virtue of apical foramina and lateral canals create pathways for exchange of noxious agents between the two tissue compartments. Lesions of the periodontal ligament and adjacent alveolar bone may originate from infections of the periodontium or tissues of dental pulp.<sup>5</sup>

Resorptive processes involving the root surface, and treatment measures aimed at managing periodontal disease enhance this potential as the accompanying exposure of dentinal tubules establishes passage across the body of the tooth structure. Hence, inflammatory symptoms often seen as typical of periodontal disease including deep periodontal pockets with or without swelling and supuration of the marginal gingiva, increased tooth mobility and angular bony defects may also represent symptoms of a pathological condition present in the root canal system of the affected tooth.<sup>6</sup>

The management of molar teeth exhibiting furcation involvement has always been a challenge to the dentist and usually involves combining restorative dentistry, endodontics and periodontics so that the teeth are retained in whole or in part.

Root resection has been widely used successfully to retain teeth with furcation involvement as well as roots exhibiting resorption and loss of periodontal apparatus. It is important to consider the factors such as angulation of the tooth, length and curvature of roots, bone support of retained roots/root before deciding to undertake any root resection procedure.<sup>6</sup>

In this case report amputation of distobuccal root of maxillary first molar is presented. Root resection

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	DOI: 10.5958/2393-9834.2015.00013.3



therapy is said to be a treatment option for molars with periodontal, endodontic, restorative or prosthetic problems. It is mentioned that commonly sighted indications for root resection are severe bone loss, class II or class III furcation involvement, severe recession or dehiscence, inability to fill a canal, root fracture, root resorption, and root decay. In a maxillary molar, root resection therapy can be used when attachment loss, caries or a fracture involving furcation area.<sup>7</sup>

Root resection can be an alternative treatment in a molar tooth having endodontic-periodontal problem such as true combined lesion where root resection may allow changing the root configuration of the part of the tooth to be saved.<sup>8</sup>

### CASE REPORT

A 26 year old female patient reported to the department of Conservative dentistry and Endodontics, Seema Dental College and Hospital, Rishikesh, with the chief complaint of food lodgment and pain in right maxillary posterior teeth. On examination it was found that gingival recession was present in relation to distobuccal root of left maxillary first molar, along with furcation involvement.

Detailed history revealed that patient used abrasive tooth powder for cleaning teeth for last four years which resulted in gingival recession and periodontal involvement causing bone loss. Tooth was nonvital and did not show any response to thermal and electrical pulp vitality tests.

On radiographic examination (Fig-1), root resorption was visible in case of distobuccal root of maxillary and (periodontal) bone loss was visible all around the distobuccal root where the mesiobuccal root and palatal root were healthy. Grade I mobility was seen in maxillary first molar.

Phase I therapy was carried out which included thorough scaling, curettage, root planning. The tooth was prepared for endodontic treatment. After administering local anesthesia rubber dam application was done. Access cavity was prepared, working length was established and biomechanical preparation was carried out after locating the two mesiobuccal, distobuccal and the palatal canal. After complete disinfection of the root canal system, obturation was carried out in the mesiobuccal and palatal canals. This was followed by post endodontic restoration of silver amalgam.

After 10 days of completion of root canal treatment under coverage of local anaesthesia, a full mucoperiosteal flap was raised in relation to maxillary right molar. (Fig-2)

The furcation area was cleaned and identified by passing a needle through the buccal trifurcation and distobuccal root was resected by making horizontal cut (from distal part up to the furcation area).

Resection of distobuccal root was carried out using vertical cut method.<sup>9</sup> (Fig-3) Furcation area was slightly trimmed to ensure that no residual debris remained. Contouring was done to make it a self cleansing area. The occlusion was checked to eliminate any discrepancy and minimize the occlusal load. (Fig-4,5)



**Fig. 1: Preoperative**



**Fig. 2: Flap reflection**



**Fig. 3: Root Resection**



**Fig. 4: Resected Distobuccal Root**



**Fig. 5: Postoperative**

## DISCUSSION

The terms “root amputation” and “hemisection” are collectively called as “root resection”.<sup>10</sup> Root resection involves removing one or more roots of the tooth to maintain the functioning of the rest of the tooth. Root resection is dependent on selection of the tooth. According to Newell the advantage of the resection is the retention of some or the entire tooth.<sup>11</sup> Success of root resection procedures depends, to a large extent, on proper case selection. It is important to consider the factors such as angulation of the tooth, length and curvature of roots, bone support of retained root and feasibility of endodontics and restorative dentistry in the root/roots to be retained; before deciding to undertake any of the root separation and resection procedures.<sup>6</sup>

Root-resection therapy is a treatment option for molars with periodontal, endodontic, restorative, or prosthetic problems.<sup>12</sup> Because root resection is very technique sensitive and complex, proper case selection is essential.<sup>13</sup> The prognosis of root resection has been well documented in previous studies. According to the standardized reports on 11 root resection of Buhler, 89% of root resected teeth survived over a 7-year period. However, Carnevale et al reported a 6.9% failure rate over a 10- year period. In a limited meta-analysis using common denominators of time of observation and criteria of failure as 12 defined by Langer et al, Buhler reported that the failure rate for teeth treated by root-resection, over a seven-year observation period, was 11%.

Root resection has been used successfully to retain teeth with furcation involvement. The disadvantage being the root surfaces in the furcation area become more susceptible to caries. Often a favorable result may be negated by decay after treatment, failure of endodontic therapy due to any reason and occlusal discrepancies involving the prosthesis to name a few. The prognosis of root resection is same as for routine endodontic therapy provided that the root resection is of acceptable design. With recent advancement in endodontics, periodontics and restorative dentistry, root resection has received renewed acceptance.

Traditional wisdom was based on the concept of trying to save the tooth by all means necessary. However with inception of dental implants, a completely new avenue has been opened in the treatment planning process.

This has created a new debate. Some advocate the traditional approach while others have adopted a more aggressive approach and prefer to extract and replace a compromised tooth with an implant restoration.

## CONCLUSION

Root-resection therapy is still a valid treatment option for molars with furcation involvement and severe bone loss. Root resection should be considered as

another weapon in the arsenal of the dental surgeon, determined to retain and not to remove the natural teeth.

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**How to cite this article:** Singh A, Aeran H, Dixit S, Arora A, Chaoudhary A. Management of root resorption in maxillary first molar- radectomy. J Dent Specialities,2015;3(2):188-191.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Occlusal guiding flange prosthesis for management of hemimandibulectomy- a case report

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## ABSTRACT

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Received: 02/03/2015

Accepted: 14/08/2015

Surgical resection of the mandible due to presence of benign or malignant tumor is the most common. Depending upon the location and extent of the tumor in the mandible, various surgical treatment modalities like marginal, segmental, hemi, subtotal, or total mandibulectomy can be performed. Mandibular discontinuity defects present a major challenge to the rehabilitation team and to maxillofacial prosthodontist. Discontinuity of mandible after resection destroys balance and symmetry which leads to altered mandibular movements and deviation of the residual fragment towards the defective side. Variety of materials and techniques have used for the construction of prosthetic replacement of the acquired surgical defects.

This case report describes prosthodontic management of a patient who has undergone hemi-mandibulectomy with mandibular guide flange prosthesis. To aid in moving the mandible normally without deviation during functions like speech and mastication.

**Keywords:** Hemimandibulectomy, Guiding flange, Maxillofacial prosthesis

## INTRODUCTION

Variety of materials and techniques have used for the construction of prosthetic replacement of the acquired surgical defects. The cosmetic, functional, and psychosocial results of oral cancer treatment may affect variety of functions, including speech, deglutition, management of oral secretions, and mastication. Thus, maxillofacial prosthetic rehabilitation helps to restore the head and neck cancer patient's oral functions and cosmetics following surgery.<sup>1</sup> Acquired defects of the orofacial structures must be analyzed as to the specific cause and the consequent objectives of rehabilitation. Mandibular discontinuity defects present a major challenge to the rehabilitation team and to maxillofacial prosthodontist. Discontinuity of mandible after resection destroys balance and symmetry which leads to altered mandibular movements and deviation of the residual fragment towards the defective side. This would hamper the aesthetic and psychological comfort along with masticatory function<sup>2</sup>.

A ram or guide plane to maxillary teeth that oppose the non resected side of mandible helps patient to achieve consistent closure to an intercuspal position. Guide flange prosthesis (GFP) is a mandibular conventional prosthesis designed for the patient who has undergone hemimandibulectomy and able to

achieve an appropriate mediolateral position of the mandible but is unable to repeat this position consistently for adequate mastication<sup>2</sup>. Guiding Flange made of acrylic polymers which lacks the principles of Removable Partial Denture design may affect the longevity of the remaining teeth. This case report describes prosthodontic management of a patient who has undergone a hemimandibulectomy<sup>2</sup>.

## CASE REPORT

A 39 year old male reported to the Department of prosthodontics with a chief complaint of difficulty in mastication and speech. He had a unilateral discontinuity mandibular defect on the right side due to surgery for squamous cell carcinoma. The surgery was performed 8 months back followed by radiation. Extraoral examination showed facial asymmetry with mandibular deviation to the right side (Fig-1,2). Clinical examination revealed severe deviation of the mandible towards the resected side, with lack of proper contact between the maxillary and the mandibular teeth. Intra oral examination showed missing teeth in the right side of mandible.

The mandibular defect was classified as Cantor and Curtis Class VI i.e. resection of the lateral portion of the mandible without subsequent augmentation to restore form and function<sup>3</sup>. A maxillary and mandibular impression was made by using irreversible hydrocolloid. The casts were poured with Type III dental stone (Fig-3). A maxillomandibular record was made by manually assisting the mandible into the centric occlusion. The maxillary and mandibular cast was mounted on a articulator.

The prosthesis was fabricated on the non defect (left) side. The design included the guidance flange on the buccal side and the supporting flange on the lingual side. The retention was provided by the interdental

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	DOI: 10.5958/2393-9834.2015.00014.5

clasp, engaging the premolars and the molars (Fig-4). The guide flange extended superiorly and diagonally on the buccal surface of the molars and the premolars, allowing the normal horizontal and vertical overlap of the maxillary teeth (Fig-5). The guide flange was sufficiently blocked out, so that it would not traumatize the left maxillary teeth and the gingiva when the patient closed his mouth. Care should be taken to preserve the buccal-surface indentations of the opposing maxillary teeth which were guiding the mandible in a final definite closing point during mastication. The flange height was adjusted in such a way that it guided the mandible from large opening position (in practical limits of the height of the buccal vestibule) to the maximum intercuspation in a smooth and unhindered path. The prosthesis was delivered and post-insertion instructions were given.



**Fig. 3: impressions of the remaining mandibular teeth**



**Fig. 1: front profile of patient**



**Fig. 4: guiding flange appliance with retentive clasp**



**Fig. 2: lateral profile of patient**



**Fig. 5: buccal extension of GFA**

## DISCUSSION

Complete rehabilitation of a hemi -mandibulectomy case is a challenging task, especially due to the lack of bony foundation on the surgical side. Loss of mandibular continuity causes deviation of remaining mandibular segment(s) towards the defect and rotation of the mandibular occlusal plane inferiorly. Mandibular deviation toward the defect side occurs primarily because of the loss of tissue involved in the surgical resection.<sup>2</sup>

When a segment of the mandible is removed, immediate reconstruction is usually recommended to improve both facial symmetry and masticatory function. Although techniques for reconstructive surgery and prosthodontic rehabilitation have advanced, more than 50% of reconstructed head and neck cancer patients still report impaired masticatory function. The GFP can be regarded as a training type of prosthesis. If the patient can successfully repeat the mediolateral position, the GFP can often be discontinued.<sup>4</sup>

Support for the GFP is no different from that of any other removable prosthesis, the natural teeth and the residual alveolar ridge being the primary sources. Multiple retentive clasps in widely distributed areas of the arch would be the best approach, but actual placement would be determined by the position of the teeth. Retentive elements should be no more rigid than necessary, but they require a more rigidity with a decreasing number of teeth.<sup>4,5</sup>

## CONCLUSION

Our main aim was to fabricate interim training device to guide mandible to unassisted maximum occlusal contacts. The success of hemimandibulectomy rehabilitation depends on the nature of surgical defect, patient's cooperation and prosthetic management with early physiotherapy program. The presence of teeth in both the arches creates a better proprioceptive sense and the prosthesis which re-educates the mandibular muscles to re-establish an acceptable occlusal relationship will control the opening and closing of the mandibular movements adequately and repeatedly.

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**How to cite this article:** Pathak S, Deol S, Jayna A. Occlusal guiding flange prosthesis for management of hemimandibulectomy - a case report. J Dent Specialities, 2015; 3(2):192-194.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Odontogenic keratocyst of the angle and ramus of the mandible - a case report

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## ABSTRACT

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Received: 17/02/2015

Accepted: 05/06/2015

The Odontogenic Keratocyst (OKC), first described by Phillipson in 1956, has been reclassified as odontogenic neoplasm and has been renamed as Keratocystic Odontogenic Tumor (KCOT) as reported in WHO classification of head and neck tumors in 2005. Odontogenic keratocysts are benign intraosseous tumors of odontogenic origin that occur most commonly in the jaw. In particular, they have a predilection for the angle and ascending ramus of the mandible. The recurrent rate of odontogenic keratocyst is 25 – 30 percent. A case of odontogenic keratocyst in 60 years old patient is presented involving mandibular third molar ramus area which was recurred after 3 years.

**Keywords:** Keratocyst, Odontogenic, Molar, Ramus

## INTRODUCTION

Tooth development involves complicated, multistep interactions between the oral epithelium and the underlying mesenchymal tissue. Ectopic teeth can arise when these tissue interactions during development are affected by developmental disturbances, iatrogenic activity, or pathological conditions, such as the presence of a tumor or a cyst.<sup>1</sup> Odontogenic keratocysts (OKC) have high recurrence rates, mitotic counts and epithelial turnover rates, and are the most aggressive of the odontogenic cysts in the oral cavity. In addition, unlike most cysts, usually thought to grow solely due to osmotic pressure, the epithelium in the OKC appears to have innate growth potential, which is consistent with a benign tumor.<sup>2</sup> Given these features, not observed in common cysts, such as radicular and dentigerous cysts, the World Health Organization reclassified OKC as a keratocystic odontogenic tumor (KCOT) in 2005. We chose the term OKC instead of KCOT in this report, because most of references yet contain the former term.<sup>1</sup>

The clinical and radiographic features of OKC are unspecific: while some may be associated with pain, swelling, or drainage, most are asymptomatic, and radiography reveals a well-defined radiolucent area, which is also characteristic of dentigerous cysts,

radicular cysts, or residual cysts. Thus, while the clinical and radiographic features can often be highly suggestive, they are not diagnostic. This means that OKC is often misdiagnosed as an ordinary cyst and is therefore undertreated, resulting in unnecessary recurrences.<sup>2,3</sup>

## CASE REPORT

A 60 year old female patient reported to the department with chief complaint of swelling in the left lower back teeth region since 15 days. History of present illness revealed that the swelling was initially smaller in size but it gradually increased to present size. There was also the history of swelling in the same teeth region 3 years back for which she got surgery done with eventful extraction of teeth in left lower back teeth region. Now patient again noticed swelling 15 days back. There was no history of any trauma or any discharge. No history of any difficulty in chewing the food. Past medical history revealed that there was no systemic illness present. Personal history revealed that patient was vegetarian in diet and there was no history of any deleterious habit like smoking, tobacco or betel nut chewing, alcohol etc. Extraoral examination revealed that there was a diffuse swelling on left lower side of face i.e approx. 2.5 X 3 cm in size extended anteriorly from line joining left commissure of lip upto angle of mandible posteriorly. Superiorly it extended from ala tragus line inferiorly upto lower border of mandible. The colour of swelling was same as that of surrounding skin. On palpation it was soft to firm in consistency, non-tender, non-compressible, non-fluctuant and afebrile to touch. (Fig.1)

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DOI:  
10.5958/2393-9834.2015.00020.0

Intraoral examination revealed that there was obliteration of buccal vestibule wrt 35, 36 teeth region. Overlying surface was of same colour as that of surrounding mucosa. On palpation it was soft to firm in consistency, non-tender and no discharge was present (Fig. 2). Teeth were missing wrt 16,27,33,34,35,36,46 and generalized calculus & stains were present. On aspiration straw coloured fluid was present.

With the above clinical findings, provisional diagnosis of generalized chronic periodontitis and odontogenic keratocyst wrt 35, 36 was given with differential diagnosis of unicystic ameloblastoma.

Intraoral periapical radiograph (IOPA) was taken, which showed a radiolucency wrt 35, 36, 37 teeth region that extends anteriorly from 35 tooth region posteriorly upto mesial aspect of 37 tooth region. Superiorly it extends from alveolar ridge corresponding to 35, 36 teeth region and inferior limits are not appreciated (Fig. 3). Mandibular occlusal topographic radiograph was taken which revealed normal anatomic landmarks and missing teeth wrt 33, 34, 35, 36 (Fig. 4). OPG was taken which showed a well-defined radiolucency was present wrt left lower molar – ramus area which was oval in shape with well-defined corticated borders on its anterior aspect, superior aspect, inferior aspect and no posterior aspect not well appreciated. Internal septae was present giving it a multilocular appearance (Fig. 5) Radiographic diagnosis of odontogenic keratocyst was given with differential diagnosis of unicystic ameloblastoma, odontogenic myxoma, simple bone cyst.

After taking the informed consent of the patient marsupialization was done under local anesthesia. Histopathological specimen revealed 8-10 cell thick parakeratinized stratified squamous epithelium lining a thin fibrous connective tissue wall. The epithelial- connective tissue interface was flat. The luminal surface showed flattened parakeratotic epithelium which exhibited a corrugated appearance. The basal layer was composed of palisaded layer of cuboidal cells with hyperchromatic nucleus. At places the cyst epithelium was detached from underlying fibrous connective tissue wall (Fig. 6)

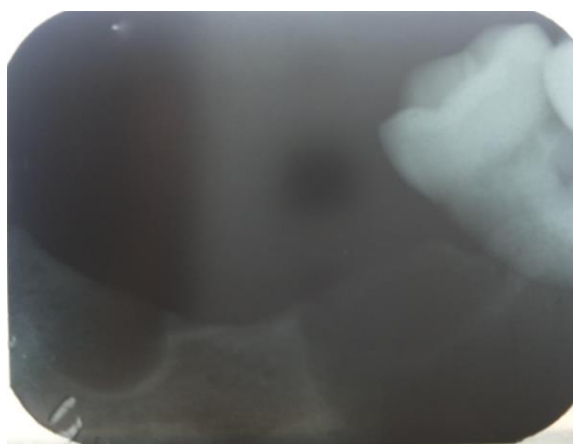
The overall features were suggestive of odontogenic keratocyst. So final diagnosis of odontogenic keratocyst wrt left lower molar – ramus area was given. The patient was followed up after one month and the healing was found to be satisfactory with no tendency for recurrence.



**Fig. 1:** Extraoral picture showing swelling on left lower side of face



**Fig. 2:** Intraoral picture showing obliteration of vestibule wrt 35, 36 region



**Fig. 3:** IOPA wrt 35, 36, 37 which showed a radiolucency that extends anteriorly from 35 tooth region posteriorly upto mesial aspect of 37 tooth region

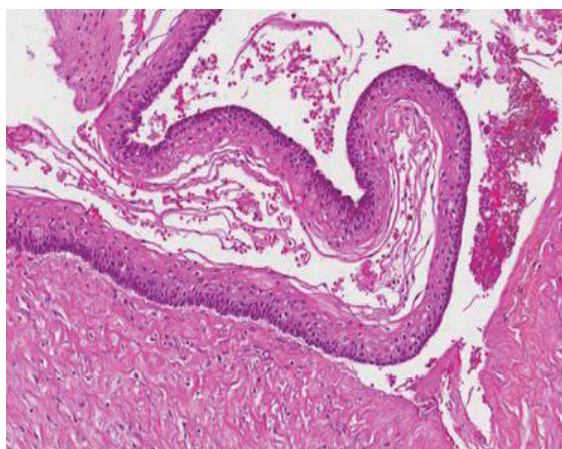




**Fig. 4: Mandibular occlusal topographic radiograph which revealed normal anatomic landmarks and missing teeth 33,34,35,36**



**Fig. 5: OPG which showed a well-defined radiolucency was present wrt left lower molar – ramus area which was oval in shape with well-defined corticated borders and internal septae was present giving it a multilocular appearance**



**Fig. 6: Histopathological picture showing epithelial lining has a hyperchromatic and palisaded basal cell layer, is 8 to 10 cells thick, has a corrugated parakeratotic surface, and is detached from the connective tissues.**

## DISCUSSION

The odontogenic keratocyst (OKC) is a well-known pathologic lesion of the jaws derived from rests of the dental lamina. It represents approximately 10 percent of all jaw cysts and may occur in a wide age range of patients. About 70 percent or more cases involve the mandible, especially in the molar, angle and ramus regions.<sup>2</sup> The present case also involve mandibular molar - ramus area.

Symptoms such as pain, swelling and drainage may be present, especially with larger lesions. However, at least half of all lesions are discovered as incidental radiographic findings. Due to the propensity of OKCs to grow within the medullary bone, they have the potential to become extremely large without causing any clinical signs or symptoms.<sup>3,4</sup> In the present case there was no pain and discharge was present.

Radiographically, the OKC presents as a well-defined radiolucency with thin corticated margins. The majority of these are unilocular, but larger lesions may be multilocular. Approximately 20-40 percent of OKCs are associated with an unerupted tooth and can be identical in appearance to a dentigerous cyst. Root resorption is relatively uncommon.<sup>5</sup> The present case showed a well-defined radiolucency with thin corticated margins and internal septae was present giving it a multilocular appearance.

The histopathologic findings of the OKC are highly specific. Diagnostic features include a uniform cyst lining, hyperchromatic and palisaded basal cells, wavy parakeratin production and a flat interface between the epithelium and connective tissue wall which was similar in the present case. Importantly, these classic microscopic features are often completely lost when the cyst is inflamed, presenting an obvious diagnostic challenge which can lead to an incorrect diagnosis.<sup>6</sup>

If multiple OKCs are present in a patient, a diagnosis of nevoid basal cell carcinoma syndrome (NBCCS or Gorlin syndrome) should be suspected. NBCCS is an inherited genetic condition caused by mutation of the PTCH1 gene.<sup>6</sup> Other manifestations of the syndrome include palmar and plantar pits, bifid ribs, calcified falx cerebri and multiple basal cell carcinomas of the skin. Unlike traditional basal cell carcinomas, the lesions associated with NBCCS tend to be less aggressive, hence the designation “nevoid,” or having biologic behavior more similar to a nevus.<sup>6,7</sup>

Differential diagnosis include dentigerous cyst (in odontogenic keratocyst the cyst is connected to the tooth at a point apical to cemento-enamel junction), ameloblastoma (usually multilocular, no straw coloured fluid on aspiration), traumatic cyst (unilocular with scalloped margins, rarely show cortical expansion), giant cell granuloma (usually in anterior region of jaw), odontogenic myxoma.<sup>5</sup>

Unlike most other odontogenic cysts, OKCs have a striking tendency for recurrence (25-30 percent), with

most recurrences developing during the first 5-7 years after therapy. Unfortunately, no practical instruments or techniques are available to surgeons to help predict which lesions will recur and which will not. The recurrence of OKC, which is usual, is thought to be based on great mitotic activity and growth potential found in epithelium, furthermore other sources of recurrences such as remnants of dental lamina and epithelial islands have also been proposed. Suspected causes of recurrence are incomplete removal of the original cyst lining, growth of a new lesion from residual epithelial islands or genotypic variations between lesions.<sup>8</sup> For these reasons, the treatment of OKCs continues to be controversial. The challenge for the treating clinician is to minimize both the risk of recurrence and patient morbidity. Each case should be managed individually, considering factors such as the age and health of the patient, size of the lesion and risk of damage to adjacent structures.<sup>5,8</sup>

Marsupialization and decompression are conservative therapies generally used for large lesions in order to preserve bone, teeth and other vital structures, as well as reducing the possibility of pathologic fracture. They are particularly promising treatment modalities for OKCs in children or patients who are poor surgical candidates. Both procedures rely on the principle of reducing the osmotic pressure of the cyst by exposing it to the oral cavity. This results in bone formation at the periphery of the lesion and a gradual decrease in the size of the cyst. Marsupialization is a one-step, definitive procedure in which the cyst lining is directly sutured to the surrounding oral mucosa, with eventual total resolution.<sup>3,5</sup>

Decompression is a two-step procedure involving the placement of a surgical drainage tube, followed by enucleation at a later date once the cyst has shrunk to a more manageable size. Exteriorization causes the nature of the cyst lining to evolve into one that is more similar to oral surface epithelium and therefore easier to remove in one piece. Probably the greatest disadvantage to marsupialization and decompression is that they require extensive cooperation from the patient and/or family members. The area must be irrigated with saline and chlorhexidine daily, usually for several months depending on the size of the original cyst. The recurrence rate for marsupialized lesions is approximately 40 percent.<sup>2,5</sup>

Enucleation is the complete and intact removal of a lesion by surgically husking it from the surrounding tissues. Clinicians often report difficulty in enucleating OKCs due to their thin, friable epithelial lining and tendency to adhere to the surrounding bone (or soft tissues in the case of cortical perforation). Application of Carnoy's solution is another type of adjunctive therapy that destroys cyst remnants by means of chemical cautery. Enucleation

combined with adjunctive treatment decreases the potential for recurrence to 18 percent or less.<sup>7</sup> Resection refers to the surgical removal of a section of the involved jaw. Marginal resections leave behind a rim of uninvolved bone, while a segmental resection removes an entire portion of the jaw without maintaining continuity.<sup>7,8</sup>

## CONCLUSION

In conclusion, a biopsy specimen examination and accurate clinical, radiographic, trans-surgical observation along with follow up are essential to avoid recurrence.

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**How to cite this article:** Garg S, Sunil MK, Trivedi A, Singla N. Odontogenic keratocyst – a case report. *J Dent Specialities*, 2015;3(2):195-198.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Over denture using access post system: an alternative solution for increasing retention

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## ABSTRACT

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Received: 28/07/2015

Accepted: 03/09/2015

One of the most common problems encountered by edentulous patients is lack of retention and stability of prosthesis with decreased masticatory efficiency. An overdenture treatment is one of the inevitable solutions for this condition. This case report highlights the use of an "Access post over denture system" which is more advantageous over the conventional tooth supported overdentures. The access post overdenture fabricated was well retentive and esthetic serving as a conservative approach to root preservation.

**Keywords:** Access post system, Complete denture, Overdenture, Ridge resorption, Stud- attachment.

## INTRODUCTION

An overdenture can be described as any removable dental prosthesis that covers and rests on one or more remaining natural teeth, the roots of natural teeth, and/or dental implants.<sup>1</sup> An overdenture offers several advantages over conventional dentures; to name the few are, retaining the residual tooth structure while maintaining its proprioception, preservation of the alveolar bone, and additional support to the dentures apart from the mucosa.<sup>2</sup> Its acquisitions also include its effectiveness and versatility in restoration and improvisation of facial contour.<sup>3</sup> Improvisation in the retention in overdenture can be attained by using various attachment systems which would ultimately contrive in the patient's acceptance.

## CASE REPORT

A 64 year old male patient reported to the department of prosthodontics, Maratha Mandal dental College,

Belgaum with the chief complaint of missing teeth, and in ability to chew food. On intra-oral examination, it was found that that upper arch is completely edentulous and partially edentulous lower arch. Teeth found in the lower arch were 33, 43 (Fig. 1). Treatment plan was formulated as a conventional denture in the maxillary arch and an access post retained over denture with access posts in the 33, 43 teeth.

Scaling and root planning followed by intentional root canal treatment of existing teeth no.33 & 43 was done. Teeth no.33 & 43 were reduced in height to a level just 1 mm above the marginal gingiva so as to provide the necessary space for Access ball post. The optimum sizes of the posts were selected by placing them on the undistorted pre-operative IOPA radiographs.

Once the appropriate size of the post was selected post space was prepared in both the mandibular canines using a sequence of Gates Gidden drills followed by the colour coded primary reamer supplied in the Essential Dental Systems Access post overdenture kit which exactly correlates to post size (Fig. 2). Following the radicular preparation in both the mandibular canines the post space was irrigated with saline to remove any debris and then dried up using paper points. The access posts were placed in the post space of both the mandibular canines to check the initial fit and then verified by taking an

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	DOI: 10.5958/2393-9834.2015.00015.7

IOPA radiograph and then, these posts were luted with type-I Glass Inomer cement (Fig. 3).

Routine prosthodontic procedures involved in the fabrication of complete dentures in both upper and lower arches were carried out. These include alginate impressions, border molding, final impressions with addition silicone material followed by facebow transfer and recording of jaw relations, try-in and processing of the dentures (Figs 4,5).

Finally the chair side procedure was carried out to fit the nylon caps in the intaglio surface of the lower denture. The nylon caps with rubber bands were placed on the male part of the posts (Fig. 6). Markings were made on the intaglio surface of the mandibular denture using a disclosing paste and the area was trimmed and sufficiently relieved enough to allow the denture to passively seat over the nylon caps. A small amount of petroleum jelly was applied on the marginal gingiva of the 33 and 43 regions. These nylon caps were picked into the denture directly in the patient's mouth by placing a doughy mixture of self-cure acrylic resin in to the relived space. Patient was instructed to bite in centric occlusion so as to keep it in position until the acrylic is hardened (Fig. 7). Finally the excess amount of acrylic was removed and the denture were finished and polished. The post-operative results can be appreciated in the Fig. 8.



Fig. 3



Fig. 4



Fig. 1



Fig. 5



Fig. 2



Fig. 6



Fig. 7

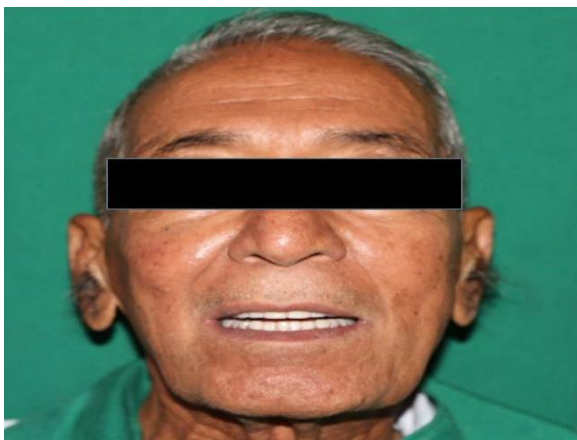


Fig. 8

## DISCUSSION

Preventive prosthodontics lays emphasis on any procedure which can delay or eliminate future problems. The basic concept of an overdenture is the preservation of hard and soft tissues in the oral cavity.<sup>4,5</sup> The phenomenon of residual ridge resorption (RRR) following removal of teeth is well observed and documented in the literature.<sup>6</sup> It was stated that the bone loss following removal of the teeth is rapid, progressive, irreversible and inevitable. While it was equally observed that it was well maintained around standing teeth and implants.<sup>7</sup> Bone maintenance is the most significant advantage of a tooth-borne overdenture, because of the maintenance of the bone volume and vertical height which can produce increased prosthetic retention and stability while providing the patient with better comfort and control over mastication due to proprioception.<sup>8</sup> Over denture attachments have demonstrated a significant positive influence on retention, stability and tissue response.<sup>9,10</sup> Selection of an attachment is important and it depends upon the available inter-arch space, position of the abutments, and amount of retention required, opposing dentition, clinical experience, personal preference and cost.<sup>11</sup> Access post over denture system has a parallel sided passive post with a thick walled hollow tube design. This design provides the strength of a solid shank post and easy retrievability to have an access to the apex of the root in case on a failed root canal. Hollow tube design

allows venting of hydrostatic pressure during cementation. It is basically a stud attachment which occupies a small vertical space and doesn't require parallelism when placed in different roots, and also allows the rotation of the denture. Standard nylon caps provided with this system provides retention of 3-5 pounds and can be easily replaced at a low cost as and when required<sup>8</sup>.

## CONCLUSION

In spite of many advances in dental implantology, the conservative approach of root preservation is still valid. Proper case selection and treatment planning is of utmost importance in over denture therapy. However patient maintenance is also important part of overdenture treatment to avoid failures resulting from dental caries and periodontal diseases.

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**How to cite this article:** SivaKumar V, Hallikerimath RB, Patil A, Sethi M. Over denture using access post system: an alternative solution for increasing retention. J Dent Specialities, 2015;3(2):199-201.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Total mandibulectomy in a patient with verrucous carcinoma turning into squamous cell carcinoma of the oral cavity: a rare case report

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## ABSTRACT

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Received: 08/04/2015

Accepted: 05/07/2015

Verrucous Carcinoma is a rare type of low grade, well differentiated squamous cell carcinoma. The author herein reports a case of squamous cell carcinoma arising within verrucous carcinoma of mandible. A 65-year old women reported to hospital with the history of swelling over the gums of lower jaw since 1yr. Her swelling was painless and gradually had spread to the whole mandible. Incisional biopsy and histopathologic examination revealed verrucous carcinoma which was treated with total Mandibulectomy.

**Keywords:** Verrucous Carcinoma, Total Mandibulectomy, Squamous Cell Carcinoma

## INTRODUCTION

Oral Verrucous Carcinoma is characterized by predominantly Exophytic overgrowth of well differentiated keratinizing epithelium having minimal atypia and with locally destructive pushing margins at its interface with underlying connective tissue. It is distinct in its slow growth and ability to become locally aggressive if not treated appropriately. However, even with local tumors progression, it is intriguing that regional or distant metastasis is rare. Oral Verrucous Carcinoma has unique histopathological features.<sup>1</sup>

An accurate pathological diagnosis is challenging and is facilitated by an adequate tumor sample for study and more importantly, a close collaboration between the clinician and the pathologist. The 19th and 20th century reflect the development of head and neck oncology in the era of science based medicine. Almost all of our current understanding of head and neck oncology, our diagnostic methods and treatment

strategies have been developed in these two centuries.<sup>2</sup>

The prognosis of verrucous carcinoma is generally good since nodal metastases does not occur. However, in 20% of cases, verrucous carcinoma co-exists with conventional squamous cell carcinoma with a consequent reduced prognosis.<sup>3</sup>

We report a case of squamous cell carcinoma arising within oral verrucous carcinoma of mandible which was treated with total Mandibulectomy and reconstruction of a total mandibular defect that involved the entire mandible.

## CASE REPORT

A 65 year old female patient (Fig.1) reported to the hospital with a history of swelling since 6-8 months, the lesion was extended from left premolar area to right premolar area (Fig.2). Patient was not ready for treatment. She was taking ayurvedic medicine for 6 months .Patient however reported 6 months later with swelling involving entire mandible including condyle bilaterally and with pathological fracture at right side of condylar neck (Fig.3). Submandibular and submental Lymph nodes were enlarged and tender on palpation.

Incisional Biopsy was taken. The general histopathological characteristics of the specimens revealed acanthosis, hyperkeratosis of the epithelium with keratin plugging. There was minimal atypia or

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	DOI: 10.5958/2393-9834.2015.00016.9

mitotic activity. Verrucous carcinoma was diagnosed following histopathological examination.

For definitive diagnosis, the entire masses with their surrounding tissues had to be excised. Operative procedure was planned under general anaesthesia with nasal intubation. Bilateral Apron flap was taken with midline split from left corner of mouth, layer by layer dissection was done.

The supra-omohyoid neck dissection-The skin flap was raised in sub platysmal layer up to inferior border of the mandible anteriorly and to tip of mastoid process posteriorly. The inferior flap was also raised taking care of anterior jugular vein. The venous perforators going to platysma were cauterized, the lower level of dissection ended inferior to the intersection of sternocleidomastoid and superior belly of omohyoid muscle. The posterior border of the sternocleidomastoid was dissected free from adjoining fibrofatty tissue. The external jugular vein was ligated. The spinal accessory nerve, anterior border of sternocleidomastoid was dissected till its exposed entire length. The sternocleidomastoid was separated from all the attachments. The sternocleidomastoid was skeletonised and retracted posteriorly. The carotid sheath was opened, middle thyroid and common facial veins were ligated. After the entire fibrofatty tissue was separated along with the embedded lymph nodes, the superior belly of omohyoid was defined. The fibro fatty tissue and lymph nodes between omohyoid and anterior aspect of internal jugular vein were mobilized enblock from base of carotid triangle to the level of digastric muscle. Then, the dissection was carried in the posterior triangle. The skeletonised spinal accessory nerve, internal jugular vein common carotid artery was retracted. The cutaneous branch of c3 and c4 roots were lifted block and were divided. The spinal accessory nerve up to sternocleidomastoid and the fibro-fatty tissue around were dissected. The dissection then goes superiorly to parotid gland which was palpated and lifted carefully and the lymph nodes were excised. The dissection was then carried anteriorly and the retromandibular vein was ligated. Tumor mass was defined first on right side from midline to condyle and sparing all the muscles of speech and mastication on buccal as well as lingual side. Same way dissection was carried out in the left side from midline to condyle. After the excision of the specimen, the margins were found clear. In the neck submandibular and submental nodes were hypertrophic, and were excised separately.

Disarticulation of mandible was done first on the left side with thorough separation of tumor from the normal tissue, disarticulation of right condyle was also done in same fashion. In this way total mandible was resected (Fig.4).

The complete mandibular reconstruction plate prosthesis (Fig.5) which was planned by using the patient's x-rays was used for reconstruction purpose. However, minor adjustments were still required to place the prosthesis in harmony with maxilla.

All muscles of mastication and the tongue were sutured back to the reconstruction plate in place (Fig.6). Three layer closure was done from intraoral to extraoral site with placement of bilateral suction drain. (Fig.7)

Post resection specimen was sent for histopathological evaluation and the details of which are as follows:

**Histopathological report:** (Fig 8 a,b,c)

The section shows hyperplastic stratified squamous epithelium showing mild to moderate dysplasia. There is hyperparakeratinization with formation of keratin plugging. Rete ridges are bulbous invading deep into connective tissue. Pattern of invasion is of pushing type. Connective tissue is infiltrated with sheets of squamous epithelial cells with lots of keratin formation. Little nuclear pleomorphism is seen. Number of mitosis seen is 0-1 per high power field. There is scanty connective tissue with moderate amount of chronic inflammatory cell infiltration. Bony flakes are present at some places.

Histopathology of lymph node shows normal architecture. Lymph nodes are negative for metastasis.

**Diagnosis:** Well-differentiated squamous cell carcinoma. (Bryne's grade I type).<sup>8</sup>

Postoperative course was uneventful and patient was disease free even after six month follow up period. (Fig: 9 a, b)



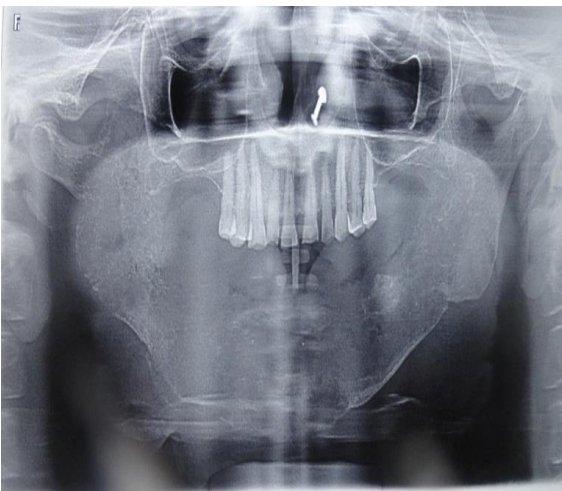
Fig. 1: Preoperative extraoral view of patient



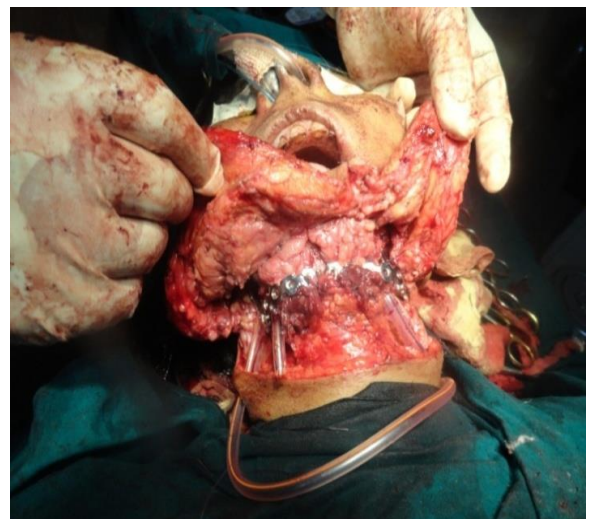
**Fig. 2: Preoperative intraoral view**



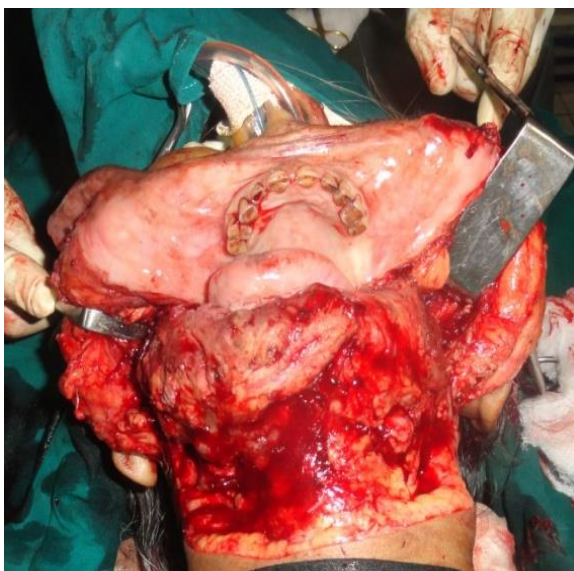
**Fig. 5: Mandibular reconstruction plate**



**Fig. 3: Radiograph reveals a lytic lesion in the mandible extending bilaterally towards condyles**



**Fig. 6: Reconstruction plate in position**

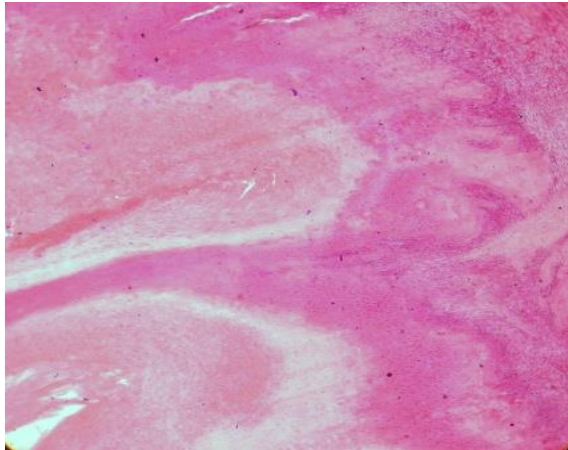


**Fig. 4: Showing Resected Mandible**

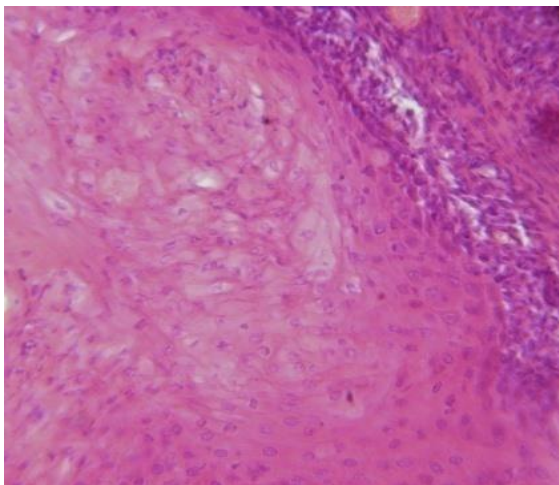


**Fig. 7: Flaps sutured and placement of drains**

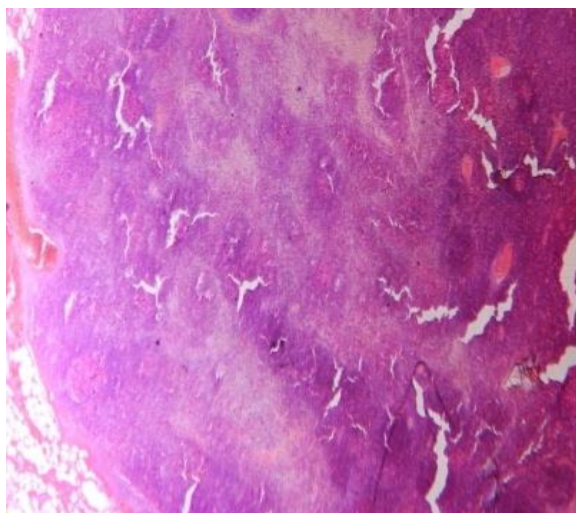




**Fig. 8 (a):** Photomicrograph showing Islands of epithelial cells with parakeratin pluggings. (H and E, 10x)



**Fig. 8 (b):** Photomicrograph showing epithelial cells with mild dysplasia (H and E, 10x)



**Fig. 8 (c):** Photomicrograph of lymph node showing normal architecture (H and E, 4x)



**Fig. 9:** Postoperative patient view after 6 months

## DISCUSSION

The etiopathogenesis of Oral Verrucous Carcinoma is unclear, however, studies have shown strong associations with tobacco use, including inhaled as well as smokeless tobacco, alcohol, and opportunist viral activity associated with human papilloma virus (HPV). More recently, studies have further confirmed the association between HPV and Verrucous Carcinoma by detecting HPV-DNA types 6, 11, 16, and 18 by polymerase chain reaction (PCR), restriction fragment analysis, and DNA slot-blot hybridization. Surgical excision with adequate margins of resection seems to be the clear preference for treatment.

Verrucous carcinoma tends to destroy bony structures such as the mandible, on a broad front, eroding with a sharp margin rather than infiltrating the marrow spaces.<sup>1</sup> In our case there was associated pathological fracture of right condylar neck of mandible. The prognosis of verrucous carcinoma is generally good since nodal metastases do not occur. However, in 20% of cases, verrucous carcinoma co-exists with conventional squamous cell carcinoma with a consequent reduced prognosis.

Preoperative diagnosis of mandibular invasion by squamous carcinoma is not accurate for early lesions. A combination of clinical examination, plain radiographs, and CT imaging will provide the most information. Among patients treated with some form of mandibular resection because of suspected Squamous Cell Carcinoma invasion (excluding cases of clear gross involvement), less than half (39% to 45%) are proved to have histologic invasion of the cortex. Therefore, conservative mandibular surgery will not jeopardize complete tumor excision for most patients with “suspected” but not proven carcinoma in the mandible.<sup>4</sup> Buccal squamous cell carcinoma has traditionally been treated surgically, with postoperative radiation therapy reserved for patients with high-risk histopathologic findings, such as perineural invasion, lymphovascular invasion, bone invasion, extracapsular spread, or close margins.<sup>5</sup>

Reconstructive options includes Vascularized osseous free tissue transfer for mandibular reconstruction. The long-term excellent functional and aesthetic outcomes of this technique have recently been reported. The most commonly used osseous free flaps for mandibular reconstruction are the fibula, iliac crest, and scapula. Each of these typically accepts endosseous implants improving functional outcomes. The use of mandibular reconstruction plates and coverage with a soft-tissue flap is a reconstructive option for selected patients. The latest refinements in technique include temporary intraoperative external fixation, the use of periosteal free flaps and development of biodegradable biopolymer scaffolds for mandibular defects.

In our reported case, the whole mandible along with both condyles was removed. As verrucous carcinoma demonstrated transformation of the lesion in to squamous cell carcinoma in depth of resected mandible. Loss of mandibular continuity results in alteration in speech, swallowing and mastication, and in the appearance of the patient. The restoration of a defect that involves the entire mandible is a rare and challenging problem for surgeons after ablation of malignant and aggressive tumors.<sup>6</sup> The purpose of reconstruction is mainly to rehabilitate the patient esthetically by improving the contour of the mandible, thereby minimizing facial deformity from the defect. The patient is rehabilitated functionally and the occlusal disturbance is minimized.<sup>7</sup>

## CONCLUSION

It is mandatory to rule out hybrid carcinoma including Verrucous Carcinoma and conventional squamous cell carcinoma. But, in any scenario, timely and correct diagnosis of the lesion and appropriate surgical management is of extreme importance to minimize postoperative morbidity and to improve quality of life of the patient.

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**How to cite this article:** Bande CR, Mohale D, Thakur M, Lambade P. Total mandibulectomy in a patient with verrucous carcinoma turning into squamous cell carcinoma of the oral cavity: a rare case report. *J Dent Specialities*,2015;3(2):202-206.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Platelet rich fibrin: a panacea for lost interdental papilla

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## ABSTRACT

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Received: 24/08/2015

Accepted: 20/10/2015

**Introduction:** Loss of interdental papilla marks phonetics, functional and esthetic problem. Surgical techniques are diverse, but none have given predictable results.

**Aim:** The purpose of this case report is to present reconstruction of papilla by using platelet rich fibrin membrane in maxillary anterior region.

**Methodology:** 30yr old male patient reported with an unesthetic smile due to loss of interdental papilla in the maxillary left central and lateral incisor region since 6 months. The treatment was planned for reconstruction of lost interdental papilla using PRF. A pouch was created with a semilunar incision, PRF was prepared and inserted into the pouch and the entire gingivopapillary unit was displaced coronally.

**Conclusion:** Optimal fill was noted at 1, 3 and 6 months postoperatively with excellent esthetic outcome. Use of PRF and proper technique may thus be the panacea for interdental papilla augmentation.

**Keywords:** PRF, Interdental papilla, Esthetics, Maxillary anterior, Black triangle

## INTRODUCTION

From the time known, dentistry has just been a restricted field but now dentistry has expanded its horizons. Today as we head towards modernization and urbanization esthetic demands in dentistry have increased rapidly, driven by an enhanced awareness of beauty and esthetics. The ultimate goal in modern dentistry is to achieve “white” and “pink” esthetics. “White esthetics” are the natural dentition or the restoration of dental hard tissues with suitable materials. “Pink esthetics” refers to the surrounding hard and soft tissues, which can enhance or diminish the esthetic result.

Today, in majority of the adult population with a history of periodontal disease, open gingival embrasures are a common problem resulting in “black triangles”. A black triangle or an open gingival embrasure occurs as a result of a deficiency or loss of papilla beneath the contact point. Periodontists have attempted to reconstruct this lost papilla by numerous surgical methods like free gingival grafting, coronally positioning of the papilla from the palatal side, subepithelial connective tissue graft with apically positioning of the papilla.

A recent innovation in dentistry is the preparation and use of platelet-rich fibrin (PRF), a concentrated suspension of the growth factors found in platelets derived from centrifuged blood. Platelet rich fibrin (PRF) is a type of platelet gel; a matrix of autologous fibrin, which has scored over platelet rich plasma by virtue of its properties, easier preparation, and cost effectiveness. It promotes wound healing, wound sealing and hemostasis.<sup>1</sup> The purpose of this case report is to present the use of platelet rich fibrin (PRF) in the reconstruction of papilla in the maxillary anterior region of a 30 years old man.

## CASE REPORT

A 30 year old male patient reported to the Department of Periodontics, A.M.E's dental college & hospital with a chief complaint of gap and black appearance in upper front teeth. On Clinical examination it was observed that class 1 papillary loss (Fig. 1). The distance between the contact point to the bone crest was 6 mm. No facial recession was evident on 11, 12, and 21. The distance between the contact point of adjacent teeth and the existing papilla was 4 mm. The surgical procedure was explained and informed consent was obtained.

**Preparation of PRF:** Before the start of the surgery the preparation of PRF was carried out as per the protocol developed by Choukron *et al.* in milliliter of intravenous blood (antecubital site) was collected in sterile 10 ml tubes without the addition of an anticoagulant and centrifuged at 3000 revolutions ( $\approx 400 \times g$ ) per minute for 10 minutes. PRF settles down between the platelet poor plasma (PPP) at the top and the red blood cells (RBC) at the bottom of the

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	DOI: 10.5958/2393-9834.2015.00017.0

tube. Platelet rich fibrin at the center with platelet poor plasma at the top and red blood cells at the bottom of the test tube.<sup>2</sup>

### SURGICAL PROCEDURE

Intraoral antiseptis was performed by rinsing with 0.2% chlorhexidine digluconate for 30 seconds. Adequate local anesthesia was achieved with 2% lignocaine hydrochloride (HCL). A split thickness semilunar incision was given about 1 mm coronal to the mucogingival junction in the interdental region of 21,22(Fig. 2).<sup>3</sup> Through the semilunar incision towards the interdental papillae, the split thickness flap was continued to create a pouch in the interdental area (Fig. 2). The prepared PRF was removed using sterile tweezers and trimmed with scissors and transferred on to sterile gauze (Fig. 3). A thick fibrin membrane was obtained by squeezing the serum out of the PRF clot. A curette was used around the necks of 21 and 22 to free the tissue attachment from the root surface, facilitating the displacement of gingivopa-pillary unit coronally.<sup>4</sup> This membrane was eased in to the pouch and pushed coronally, enabling to fill the bulk of the interdental papillae (Fig. 4). The incisions were secured with 4-0 non-resorbable sutures (Fig. 5). The surgical area was protected with a light cured periodontal dressing. Analgesics were prescribed along with chlorhexidine digluconate (0.2%) rinse twice daily for 10 days. Patient was abstained from brushing at the surgical area and was asked to clean the tooth surface with the cotton pellet dipped in the 0.2% chlorhexidine mouthwash for 10 days. Postoperative healing was uneventful with minimal pain. Review of the patient on 10<sup>th</sup> day revealed partial fill of the interdental region. The patient was then evaluated for 1 month, 3 months & 6 months (Fig. 6).



**Fig. 2: Semilunar incision taken 1 mm coronal to mucogingival junction & pouch created through the semilunar incision**



**Fig. 3: Prepared PRF**



**Fig. 1: pre-operative picture of lost interdental papilla irt 21 and 22**



**Fig. 4: coronally displaced pouch with PRF**



**Fig. 5: sutures placed**



**Fig. 6: post-operative view after 6 months**

## DISCUSSION

The loss of gingival embrasures occurs due to several factors including periodontal disease, length of embrasure area, root angulations, interproximal contact position, changes in papilla during orthodontic alignment and triangular-shaped crowns. Also deficiency of the papillae might be a consequence of post periodontal surgery.

An assortment of surgical procedures has been tried out in papilla reconstruction. Shapiro et al. advocated use of repeated curettage to stimulate the regrowth of interdental papillae in necrotizing ulcerative gingivitis.<sup>5</sup> The roll technique and the use of pedicle graft with coronal displacement of the gingivopapillary unit and subepithelial connective tissue grafting has been presented.<sup>6,7</sup> Interpositional subepithelial connective tissue grafting and use of buccal and palatal split thickness have been tried out.<sup>8</sup> Interdental papilla augmentation along with reconstruction of interdental bone to create appropriate support for gingival papilla has been reported.<sup>9</sup>

This technique using PRF flap offers a reliable solution as PRF membrane has both mechanical adhesive properties and biologic functions like fibrin glue; it maintains the flap in stable position, enhances neoangiogenesis, reduces the necrosis and shrinkage of the flap and stabilization of the gingival flap in the highest covering position.<sup>10</sup> The PRF is easy to procure, not expensive and can be prepared in few minutes. PRF provides ideal healing properties. This fibrin matrix inclusive of its platelets, leucocytes, and cytokines allow remodeling of interdental papilla to occur. It has been found PRF organized as a dense fibrin scaffold with a specific release of growth factors (TGF-1 $\beta$ , PDGF-AB, and vascular endothelial growth factor (VEGF) and glycoproteins (thrombospondin -1) during  $\geq 7$  days, is critical for the “take” of the grafted PRF membrane.<sup>11</sup>

Platelet cytokines, platelet derived growth factors (PDGF)- $\alpha$  and (PDGF)- $\beta$ , transforming growth factor beta (TGF)- $\beta$  and insulin-like growth factor-1 (IGF-1) are gradually released, aiding the process of healing. Advantages of using PRF is that the need for donor site is eliminated, making the technique less invasive, lessens postsurgical discomfort, promotes rapid soft tissue healing with less edema compared to connective tissue graft and enamel matrix derivative technique. Thus, it is easy to prepare and lacks biochemical handling of blood, which makes this preparation strictly autologous.

## CONCLUSION

The reconstructed papilla was examined at 1, 3 & 6 months post-operatively (Fig.8,9,10). Clinically it shows the coverage of the defect (Fig. 11,12). By this it can be concluded that this technique improves the esthetics of the patient and it is one of the simple and easy procedure for the reconstruction of the lost papilla. However, studies with a longer duration are required to determine the success rate and predictability of this procedure.

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**How to cite this article:** Aspalli S, Nagappa G, Jain AS. Platelet rich fibrin: a panacea for lost interdental papilla. *J Dent Specialities*, 2015;3(3):1-3.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Creating smiles- the holistic way!! – orthodontic- surgical correction of bimaxillary protrusion

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## ABSTRACT

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Often many patients cannot be treated by orthodontics alone, and need the combined efforts of orthodontics and orthognathic surgery. Such patients are treated in three phases- a phase of pre surgical orthodontics that involves basically decompensating the dentition, followed by the surgery, which is then finished with final detailing of the occlusion. This article is a case report of a skeletal bimaxillary protrusion patient, who was treated with bi- jaw surgery.

**Keywords:** Surgical Orthodontics, Bimaxillary protrusion, Bijaw surgery, Prosthetic rehabilitation.

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Received: 24-10-2014

Accepted: 26-03-2015

## INTRODUCTION

It has been estimated that the want towards facial normalcy is one of the main reasons patients ask for orthodontic treatment, which causes profound psycho social effects.<sup>1</sup> But often, it is found that just orthodontic treatment does not suffice to reach the optimum soft tissue goals for a patient, and that the aid of orthognathic surgery has to be taken. The dentition has been shown to compensate, so to speak, for the underlying skeletal malformation, which has to be decompensated before any sort of surgical alteration can be thought of following adequate decompensation, surgery is carried out, following which final finishing and detailing of the occlusion is done.<sup>2</sup>

Also, as in this case, many cases present to the orthodontist with compromised dentition, and appropriate prosthetic replacement has to be planned beforehand, keeping in mind the molar and canine relations, and ideal smile esthetics.<sup>3</sup>

## CASE REPORT

A 22 year old male patient reported to us with a chief

complaint of forwardly placed upper front teeth. He had no significant medical history. He gave a history of extraction of a carious upper left pre molar.

On extra oral examination, he was seen to be brachycephalic, leptoprosopic with a convex profile, consciously competent lips, and a vertical growth pattern. (Fig 1 to 3)

On intra oral examination, he presented with a Class I canine and molar relationship bilaterally, missing 24, anterior open bite of 6mm and an overjet of 7mm. (Fig 4 to 8)

The pre- treatment lateral cephalogram (Fig 9) revealed a reduced nasolabial angle, retrognathic mandible, proclined upper and lower anteriors, and a vertical growth pattern (Table 1)

Using the above diagnostic information, the diagnosis was arrived to be Class II skeletal base with vertical growth pattern, anterior open bite with proclination, and protrusive lips.

The treatment plan was decided to be a non-extraction orthodontic- orthognathic surgical one. This included:

### Pre surgical orthodontics:

- Non extraction Leveling and aligning

### Surgical Plan:

- LeFort I Osteotomy with differential impaction.
- Mandibular advancement rotation (anticlockwise).
- Advancement genioplasty.

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	DOI: 10.5958/2393-9834.2015.00018.2

**Post Surgical Orthodontics**

- Settling of occlusion

The presurgical phase started with bonding of MBT 0.022” prescription brackets. Initial levelling and aligning was achieved with sequential Ni Ti wires, till the final working wire of 19x 25 S.S was in place. This phase lasted for 8 months, following which the patient was posted for surgery. (Fig 10,11,12)

The surgeries done were LeFort I Osteotomy with differential impaction, Mandibular advancement rotation (anticlockwise) and Advancement genioplasty. The surgical phase involved overcorrection of the malocclusion into a class III pattern. Due to the mandibular anti clockwise rotation there was an apparent uprightening of the lower incisors. Also in case of maxilla due to differential impaction there was a decrease in SNA angle and an apparent increase in the maxillary anterior proclination. Following surgery, the patient was put on intermaxillary fixation for a period of 2 weeks. After this, settling elastics were prescribed for a month. Post debond, the patient was referred to the Department of Prosthodontics for replacement of the missing 24. The patient was put on clear thermoformed retainers immediately after debond, as well as, a new set after the prosthesis delivery, for a period of 12 months.

The entire treatment from pre surgical orthodontics to post debond prosthetic replacement lasted for a period of 17 months. The self- confidence and self-perception of the patient improved considerably, and the decided treatment plan resulted in satisfactory facial balance and esthetics, coupled with excellent occlusion. (Fig 13 to 20)

The post treatment cephalogram (Fig 21) (Table 1) showed drastic changes in the maxillary prognathism, lip balance, and incisor proclination, indicative of a successful treatment.

**Table: 1**

Cephalometric Values	Pre Treatment	Post Debond
SNA	83°	76°
SNB	76°	79°
WITS	5mm	2.5mm
N-A-Pg	16°	-9°
Upper Incisor to NA	23° / 6mm	36°/17mm
Lower Incisor to NB	45° / 19mm	38° / 15mm
Lower incisor to Mand. plane	110°	90°
Inter-incisal Angle	105°	109°
Nasolabial Angle	97°	105°
Upper lip to E line	6mm	-3mm
Lower lip to E line	12mm	-2mm
Upper lip to S line	9mm	1mm
Lower lip to Sline	15mm	3mm



**Fig. 1: Pre Treatment Extra Oral Images**



**Fig. 2: Pre Treatment Extra Oral Images**





**Fig. 3: Pre Treatment Extra Oral Images**



**Fig. 6: Pre Treatment Intra Oral Images**



**Fig. 7: Pre Treatment Intra Oral Images**



**Fig. 4: Pre Treatment Intra Oral Images**



**Fig. 8: Pre Treatment Intra Oral Images**



**Fig. 5: Pre Treatment Intra Oral Images**



**Fig. 9: Pre Treatment Lateral Cephalogram**



**Fig. 10: Pre Surgical Images**



**Fig. 14: Post Treatment Intra Oral Images**



**Fig. 11: Pre Surgical Images**



**Fig. 15: Post Treatment Intra Oral Images**



**Fig. 12: Pre Surgical Images**



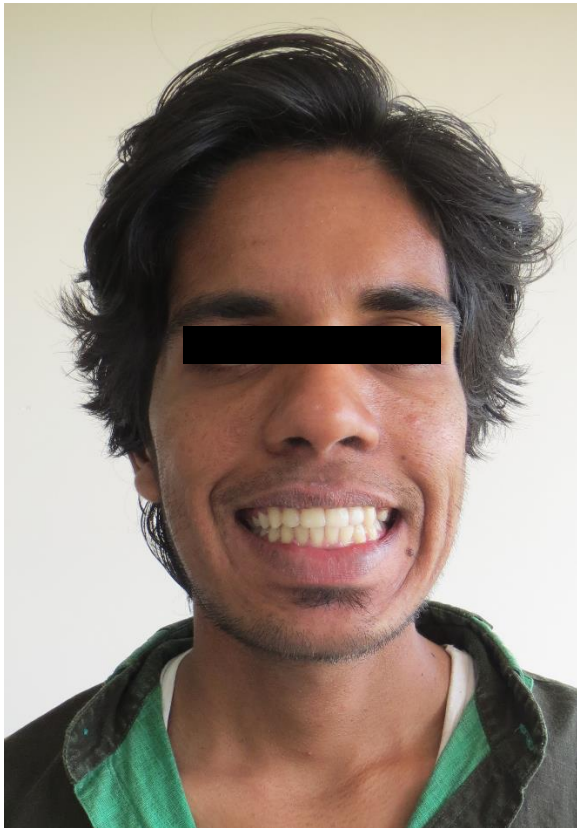
**Fig. 16: Post Treatment Intra Oral Images**



**Fig. 13: Post Treatment Intra Oral Images**



**Fig. 17: Post Treatment Intra Oral Images**



**Fig. 19: Post Treatment Extra Oral Images**



**Fig. 21: Post Treatment Extra Oral Images**



**Fig. 20: Post Treatment Extra Oral Images**



**Fig. 22: Post Treatment Cephalogram**

## **DISCUSSION**

Taking into consideration the cephalometric variables, coupled with the clinical examination, it was clearly evident that the patient needed a surgical intervention to address his chief complaint. This particular patient was ready for surgery, but if not for surgery camouflage alternatives would have to be considering it as a bimaxillary protrusion case and treat with extraction of pre molars and intrusion of the maxillary posteriors, with accompanying auto rotation of the mandible. However, this would lead to compromised esthetics, and highly prone to relapse.<sup>4,5</sup> As far as retention protocol was concerned, we felt that the best method would be one that covers the entire dentition, giving retention to all the teeth, and hence we gave the patient clear thermoformed retainers.<sup>6</sup>

## **CONCLUSION**

In this case, i.e a bimaxillary protrusion, adequate non extraction pre surgical orthodontics, followed by bijaw surgery gave satisfactory results.

The change in the patient's self-esteem and self-image drastically improved, indicating the psychosocial impact of Orthodontic- Orthognathic Surgery.

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**How to cite this article:** Shetty A, Basu P, Bhaskar B, Nayak USK. Creating smiles- the holistic way!! – orthodontic surgical correction of bimaxillary protrusion. *J Dent Specialities*, 2015;3(2):211-216.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.

# Bonded ceramic inlays or full coverage crowns? – a review and case report

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## ABSTRACT

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Received: 24-10-2014

Accepted: 26-03-2015

The esthetic demands of the patient have to be combined with conservative treatment procedures to deliver functional restorations for endodontically treated teeth. Ceramic inlays, fabricated in lithium disilicate material, satisfy both these requirements as post-endodontic restorations.

This paper demonstrates a simple, esthetic and conservative alternative to full coverage crowns for the restoration of endodontically treated teeth.

**Keywords:** Esthetic, Ceramic, Inlay

## INTRODUCTION

Significant loss of the tooth structure is a common clinical problem following dental caries and endodontic treatment. This compromises the structural integrity of the tooth and increases its chances of fracture. Traditionally, a full coverage restoration is used to restore a tooth functionally and esthetically. However, a full coverage crown has been known to lead to secondary caries and fracture of the underlying tooth.<sup>1</sup> Over the last few years due to increased esthetic demands and the need for conservative procedures, there is an increased interest in all ceramic inlays for the restoration of endodontically treated teeth.<sup>2</sup>

In the past, inlays were used for restoration of mutilated and carious teeth. The materials commonly used were base metal alloys and gold alloys. The wedging effect and the unesthetic appearance of the metal inlays and the high cost of the gold alloys led to the emergence of all ceramic inlays as the material of choice. The advantages of ceramic inlays are their high esthetic value and the ability to bond to the teeth.<sup>3,4,5</sup>

IPS Empress II system (IVOCLAR VIVADENT, SCHAAN, LIECHTENSTEIN) introduced to the world of dentistry in the early nineties was previously

used for the fabrication of ceramic inlays. However studies have shown that this material has limited physical properties and flexural strength<sup>6</sup>. IPS E.MAX material (IVOCLAR VIVADENT, SCHAAN, LIECHTENSTEIN) which is made up of lithium disilicate glass ceramic and supplemented with a universally applicable nano-fluorapatite glass-ceramic to veneer all the IPS E.MAX system components is now being used in place of IPS Empress II ceramic material as a common all-ceramic material.<sup>7</sup>

This article describes a case report of the use of a ceramic inlay instead of a full coverage crown to restore the function of an endodontically treated tooth.

## CASE REPORT

A 23 year old female patient was referred to the department of Prosthodontics at M.A. Rangoonwala Dental College and Research Centre from the Department of Conservative Dentistry and Endodontics for post endodontic restoration of the maxillary left second premolar tooth. (Fig: 1) The clinical examination of the tooth showed that there were intact facial, lingual and mesial walls following endodontic treatment. The distal wall of the tooth was missing due to caries. The tooth had a short clinical height. The patient desired an esthetic restoration and it was decided to place a ceramic inlay instead of a porcelain fused to metal crown to restore the tooth keeping in mind the short clinical crown height and the esthetic demands of the patient.

The tooth preparation for the ceramic inlay was performed using diamond burs. (DIA-BURS, MANI, INDIA) as per the protocol mentioned by Swift et al.<sup>8</sup> (Fig: 2) Care was taken so that the preparation was as

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conservative as possible and an intact enamel border was available at the cervical floor of the preparation. The final impression of the tooth preparation was made using addition silicone material. (3M EXPRESS™ VPS IMPRESSION MATERIAL, 3M ESPE, USA)

The final restoration was fabricated in IPS E.MAX lithium disilicate material (IVOCLAR VIVADENT, SCHAAN, LIECHTENSTEIN). (Fig: 3) The restoration was checked for fit and accuracy. It was etched with hydrofluoric acid (IVOCLAR VIVADENT, SCHAAN, LIECHTENSTEIN) for 20 seconds and a silane coupling agent (RelyX™ Ceramic Primer, 3M ESPE, USA) was applied.

The final restoration was bonded to the tooth using RelyX™ U200 cement (3M ESPE, USA). (Fig: 4) The occlusion was adjusted and it was polished using diamond burs, polishing disks and strips. The restoration was examined and scored according to the modified United States Public Health Service (USPHS) criteria of Ryge.<sup>9</sup>

The authors have successfully treated numerous patients using this conservative protocol and are awaiting results of a clinical trial.



**Fig-1: Pre treatment presentation**



**Fig-2: Tooth preparation**



**Fig-3: Lithium disilicate inlay on model**



**Fig-4: Bonded inlay in situ**

## DISCUSSION

Determination of the optimum type of post endodontic restoration depends on the residual tooth structure and the functional requirements of the tooth.<sup>10</sup> With recent advances in adhesive systems, the concept of minimal intervention dentistry has been introduced to preserve sound tooth structure. Adhesive restorations have higher ability to transmit and distribute functional stresses through the bonding interface to the tooth which helps to reinforce the remaining tooth.<sup>11</sup>

A ceramic inlay may be preferred over porcelain fused to metal crown due to various reasons, primarily due to the conservative tooth preparation required for fabricating the inlay. A second critical reason is esthetics. In porcelain fused to metal crowns, the grey colour of the metal substructure has to be masked by placing a layer of opaque ceramic material. Ceramic inlays are fabricated from translucent ceramic materials and therefore have better esthetic properties. A dark line along the

gingival margin, compromised periodontal health are more likely to be seen in porcelain fused to metal crowns as compared to the use of ceramic inlays.<sup>1,12,13</sup>

Chipping/delamination of the veneering ceramic seen in porcelain fused to metal restorations is frequently a clinical complication which is eliminated by the use of lithium disilicate restorations.<sup>14</sup>

Gupta et al have shown that ceramic inlays are viable alternatives to full coverage crowns.<sup>15</sup> Other in-vitro studies have shown that that all ceramic inlays placed in posterior teeth provide a highly successful esthetic restoration.<sup>16,17</sup>

A limited number of studies have been carried out using IPS Empress II system (IVOCLAR VIVADENT, SCHAAN, LIECHTENSTEIN) as the core material for the fabrication of ceramic inlays.<sup>18,19</sup> However, there is no literature on the use of modern lithium disilicate inlays to assess their clinical performance. The authors are presently carrying out a clinical trial on the same and the results are promising.

The literature also does not report on how much tooth structure must be destroyed to decide between an inlay and a full coverage crown as the post endodontic restoration. Clinical trials are needed to determine the extent of destruction that warrants a crown and not a partial coverage restoration.

## CONCLUSION

Ceramic inlays have many advantages as compared to porcelain fused to metal crowns for restoration of endodontically treated teeth and should be considered for the same in cases where tooth destruction may not warrant the use of an endodontic post or full coverage crown.

## DISCLAIMER

The authors state that there is no financial interest of any from in any product or company mentioned in the article.

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**How to cite this article:** Patankar A, Sandhu RK, Sandhu R, Kheur M. Bonded ceramic inlays or full coverage crowns? – a review and case report. *J Dent Specialities,* 2015;3(2):217-219.

**Source of Support:** NIL

**Conflict of Interest:** All authors report no conflict of interest related to this study.





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- 3 We encourage students at Sports & Cultural Activities Celebrities from Bollywood, Sports etc. regularly invited to share their success stories Ram Gopal Verma, Ayushmaan Khurrana, Kunaal Roy Kapoor, Piyush Chawla @ I.T.S and Dr. Palash Sen (Euphoria Band) & Shaan performing at Annual Cultural Fest "Occlusion"
- 4 Convocation & Alumni Meet
- 5 Top rank in University - Megha Nagpal got Gold Medal for securing 1st rank in CCS University in BDS Course(2008-2013)

7 Satellite Centres At

- \*Village Rawli \*Village Nagla Kumbha (Meerut) \*Village Arthala, Mohan Nagar, Ghaziabad \*Dasna Jail, Ghaziabad
- \*District Hospital, Sanjay Nagar \*MMG Hospital, Ghaziabad
- \*Nandgram, Ghaziabad



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### COURSES

#### Campus I

- ▶ **PGDM**
- ▶ **MBA** ▶ **MCA**
- ▶ **BBA** ▶ **BCA** ▶ **Ph.D**

### CAMPUS

#### I.T.S-Management & IT Institute I.T.S-UG Campus

Address : Mohan Nagar, Ghaziabad - 201007  
Ph. : 0120-2811000/111  
Mobile : 08588000190, 08447744044/43/42/41  
E-mail : itsmn@its.edu.in, admission.mn@its.edu.in  
: www.facebook.com/ITS.Education.Group  
: www.facebook.com/ITS.MohanNagar.Ghaziabad  
: www.facebook.com/ITSmohannagargzb



#### Campus II

- ▶ **BDS** ▶ **MDS**
- ▶ **BPT** ▶ **MPT**
- ▶ **B.Sc** (Biotech) ▶ **M.Sc** (Biotech)
- ▶ **B. Pharma** ▶ **M. Pharma**
- ▶ **Ph.D** (Pharmaceutical Science)

#### I.T.S-Dental College I.T.S-Paramedical (Pharmacy) College I.T.S-Paramedical College I.,T.S-Surya Hospital

Address : Delhi-Meerut Road, Muradnagar, Ghaziabad-201206  
Ph. : 01232-225380/81/82  
Mobile : 08447753520/21/22  
E-mail : dental@its.edu.in  
: www.facebook.com/ITSdentalcollege,Ghaziabad  
Mobile : 08447753523/24  
E-mail : biotech@its.edu.in, physio@its.edu.in  
: www.facebook.com/ITS.physio.Biotech  
Mobile : 08447753525/26  
E-mail : pharmacy@its.edu.in  
: www.facebook.com/ITS.PharmacyCollege



#### Campus III

- ▶ **B.Tech**  
•ME •CSE •CE •ECE •EEE
- ▶ **MBA**
- ▶ **M.Tech**  
•CSE •ECE
- ▶ **PGDM**

#### I.T.S-Engineering College

Address : 46, Knowledge Park-III, Greater Noida - 201308  
Ph. : 0120-2331000/1/2  
Mobile : 08510010840/41/42/43  
E-mail : admission.ec@its.edu.in  
: www.facebook.com/ITSEC.Greater.Noida



#### I.T.S-Institute of Management

Ph. : 0120-2331073  
Mobile : 08800211300/400/500, 07838599436/39, 07838555881/82  
E-mail : itsim@its.edu.in  
: www.facebook.com/ITS.InstituteofManagement.Greater.Noida



#### Campus IV

- ▶ **BDS**
- ▶ **MDS**

#### I.T.S-Dental College I.T.S-Surya Hospital

Address : 47, Knowledge Park-III, Greater Noida - 201308  
Ph. : 0120-2331089/1085  
Mobile : 07838555877/878/879  
E-mail : dentalgn@its.edu.in  
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