



Authorised Distributors:-

**SELMARK PRIVATE LIMITED**

**SELMARK HOUSE, 1/195, SEMRA, CHINHAT,**

**FAIZABAD ROAD, LUCKNOW-227105**

**PH. 8189008201-09; email: [info@selmarklimited.com](mailto:info@selmarklimited.com)**

ISSN 0972-3536



**ida**  
Indian Dental Association  
*Committed to Dental Excellence*

## An official Publication of Indian Dental Association U.P. State Branch

[WWW.UPSDJOURNAL.COM](http://WWW.UPSDJOURNAL.COM)

**Issue 3  
September 2020**



## Office Bearers of the U.P. State Branch of the Indian Dental Association,

President

**Prof. T. P. Chaturvedi**

(Former Dean)

Faculty of Dental Sciences

BHU, Varanasi-221005

krtpchaturvedi@gmail.com

tpchaturvedi@rediffmail.com

Mob. : 945157084

Hon. State Secretary

**Dr. SACHIN PRAKASH**

Shree Dental Care

424A/285A, Madhwapur, Bairahana

Prayagraj - 211003

Mobile No. : 9454016701, 7565942535

E-mail : secretaryidaupstate@gmail.com

President Elect

**Dr. Umesh Sharma**

Immd. Past President

**Dr. S. K. Katharia**

Vice President

**Dr. Mirza Asad Beg**

**Dr. P. P. Upadhyay**

**Dr. R. S. Maurya**

Hon. Joint Secretary

**Dr. Ashish Tripathi**

Hon. Assistant Secretary

**Dr. Sandeep Shukla**

Hon. Treasurer

**Dr. Ashutosh Singh**

Hon. Editor Journal

**Prof. Anil Chandra**

Chairman CDH

**Dr. Nageshvar Tripathi**

Chairman CDE

**Dr. Deepak Kr. Shukla**

Representatives to Central Council

Members

**Dr. T. P. Chaturvedi**

**Dr. Umesh Sharma**

**Dr. Dhiraj Prakash**

**Dr. Sachin Prakash**

**Dr. P. N. Tandon**

**Dr. Ajay Singh**

**Dr. Raj Kamal Srivastava**

**Dr. Manoj Kr. Srivastava**

**Dr. Ashish Tripathi**

**Dr. Amit Shukla**

**Dr. Pradeep Agrawal**

**Dr. Murari Sharma**

**Dr. Kamendra Bharadwaj**

**Dr. S. K. Katharia**

**Dr. Sudhakar Singh**

**Dr. Vikash Tiwari**





## CONTENTS

S.No		Page No.
	<b>Review Article</b>	
1	Insight of Covid 19	54-72
2	Coronavirus Disease 19 (Covid-19): Patient Management at Oral Health Care Setup	73-85
3	Smile Makeover- Current Trends	86-96
4	The Covid Era And Aerosols In Restorative Dentistry	97-107
5	Importance of Ergonomics during and Post COVID-19 for Dental Practitioners	108-116
	<b>Original Research</b>	
6	Comparative Evaluation of Antimicrobial efficacy of Guava Leaf Extract, Asafetida Extract and 2.5% Sodium Hypochlorite used as Endodontic Irrigant: An In-vitro study	117-125
7	An in vitro Evaluation of Bond Strength of 7th Generation Bonding Agents ( AdperTM Easy Bond and Xeno V)	126-133
	<b>Case Report</b>	
8	Endodontic Management of Carious Lower Second Molar with Single Root and Single Canal	134-137
	<b>Book Review</b>	
9	Modern Concepts in Aesthetic Dentistry and Multidisciplined Reconstructive Grand Rounds: A Book Review	138
	<b>Letter to the Editor</b>	
10	Has Covid-19 Exposed our Business Sense/Financial Planning/Understanding of Economics?	139



**Editor-in-Chief**

Prof. Anil Chandra

**Consultant Editors**

Dr. Mahesh Verma

Dr. Shobha Tandon

**Associate Editors**

Dr. R. Reddy (South Africa)

Dr. Isabel C.C.M. Porto (Brazil)

Dr. Louis M . Lin (U.S.A)

Dr. Sangeeta Talwar

Dr. Ramesh Bharti

**Assistant Editor**

Dr. Akriti Goel

**Section Editors**

Dr. Aditya Mitra (Conservative)

Dr. Yazad Gandhi (O.M.F.S.)

Dr. Ajay Mahajan (Periodontology)

Dr. Atul Bhatnagar (Prosthodontics)

Dr. Farhan Durrani (Periodontology)

Dr. Ramesh Soni (Prosthodontics)

**Editorial Advisory Panel**

Dr. Syed Mehdi

Dr. Pawan Rai

Dr. Vipul Sharma

Dr. Preeti Tiwari

**Advisory Board**

Dr. R.K. Tiwari

Dr. P.N. Tandon

Dr. Nikhil Srivastava

Dr. Vinita Nikhil

Dr. H.C. Barnwal



## Review Article

Insight of Covid 19

**Authors:** Prerna Singh\*, Amita Sangwan\*, Ratnesh Kumar Srivastav, Saurabh Pratap Singh, Supriya Sharma, Shalini Gupta#, Shaleen Chandra

Department of Oral Pathology and Microbiology, King George's Medical University, 226016, Lucknow, U.P., India

\* Equal Contribution as first author

# Corresponding Author

**Corresponding Author Detail**

Prof. Dr. Shalini Gupta

Department of Oral Pathology & Microbiology

King George's Medical University, Lucknow, 226016, India

Email id: [sqmds2002@yahoo.co.in](mailto:sqmds2002@yahoo.co.in)

**ABSTRACT**

COVID-19 has emerged as a global pandemic. It is pneumonia like disease caused by SARS-CoV2 virus. This virus of *betacoronaviridae* family infects human cells using spike(S) protein. The human cells which express ACE2(Angiotensin Converting Enzyme 2) receptor on their surface are attacked by this virus. Due to specific modifications at Spike protein SARS-CoV2 has gained ability to strongly bind and transmits quickly which results into high infection rate and heavy mortality. SARS-CoV2 has multiple mechanisms to paralyze immune system of our body. There is no proper treatment available for COVID-19 but several drugs which have immune-suppressive or antiviral activity are undergoing clinical trials. In the present review we are summarizing the known facts of the COVID-19 and causative agent.

**Key words:** ACE2, COVID-19, Forensic, Hydroxy-chloroquine, RT-qPCR, Spike,



## Introduction:

Coronaviruses is a common term use for the viruses which belong to the Coronaviridae family of Nidovirales order. The novel coronavirus, named SARS-CoV-2 (colloquially known as 2019-nCoV, Human Coronavirus 2019 (HCoV-2019)), was discovered in December 2019 in Wuhan, Hubei province of China. SARS-CoV-2 is responsible for disease COVID-19<sup>1,2,3</sup>. The virus belongs to coronavirus family as they have spherical virions with core shell and surface projections resembling a solar corona. It was isolated and sequenced by January 2020<sup>4</sup>. SARS-CoV-2 is an enveloped, positive single strand RNA genome containing virus<sup>5, 6,7</sup>. SARS-CoV has been affirmed to accommodate the largest viral RNA genome known to date, encompassing 29,727 nucleotides predicted to contain 14 functional open reading frames (ORFs). The phylogenetic analyses of the major structural proteins illustrated that SARS-CoV does not closely resemble any of the previously known three groups of coronavirus<sup>6</sup>. It is more closely related to the virus which is found on bats as RaTG13.

SARS-CoV and MERS-CoV are two well-known members of beta corona virus family which have caused severe human life loss in recent pasts<sup>9</sup>. SARS-CoV was responsible for Severe Acute Respiratory Syndrome, a major outbreak in 2002-2003 whereas MERS-CoV causes Middle East Respiratory Syndrome, a disease which

was pandemic in 2012-2013<sup>5,6,9</sup>. MERS-CoV was suggested to originate from bats, but the reservoir host fueling spillover to humans is unequivocally dromedary camels. Both SARS-CoV and SARS-CoV-2 are closely related and originated in bats, who most likely serve as reservoir host for these two. Whereas palm civets and raccoon dogs have been recognized as intermediate hosts for zoonotic transmission of SARS-CoV between bats and human, the SARS-CoV-2 intermediate host remains unknown<sup>2</sup>. The recent statistics of the World Health Organization (WHO) seemingly attest that the effective reproductive number, which is the average number of secondary cases per infectious case, is higher for COVID-2019 (mortality rate ~2-4%) than for SARS (mortality rate ~34.4%) or MERS (mortality rate ~9.6%). The pathogenicity appears globally lower than other two coronavirus. These virus spread from human to human through air or droplets<sup>1</sup>. Nucleotide sequence homology of SARS-CoV-2 with SARS-CoV, and MERS-CoV is 77.5% and 50%, respectively (Fig.1)<sup>3</sup>. Here we will explain structure, mode of infection and spread of SARS-Cov2 virus, the clinical features and managements of Covid 19 disease as well as potential way to control the disease. The highly pathogenic zoonotic pathogens



SARS-CoV, MERS-CoV, and SARS-CoV-2, all belonging to the  $\beta$ -coronavirus genus. Except these three, some low-pathogenicity coronaviruses as HCoV-OC43, HCoV-HKU1, HCoV-NL63, and HCoV-229E also come in same genus<sup>10</sup>. The novel coronavirus uses the same receptor, angiotensin-converting enzyme 2 (ACE2) as that for SARS-CoV, and primarily spreads through the respiratory tract<sup>11</sup>. Evidence showed sustained human-to-human transmission, along with many exported cases across the globe. Based on over 80,000 laboratory confirmed cases of COVID-19, the most typical clinical signs and symptoms include fever, dry cough, fatigue, phlegm production and a small population of patients appeared gastrointestinal infection symptoms. According to World Health Organization (WHO) approximately 80% patients experience mild symptoms, ~15% patients suffer with severe infection (e.g., needing mechanical ventilation) and 2-5% of patients become critically ill (e.g., needing intensive care unit support). The risk of being infected by a patient with Coronavirus Disease 2019 (COVID-2019) can occur both the symptomatic and the non-symptomatic phases. SARS-CoV-2 target the alveolar epithelial type II cells, which would hence function as a reservoir for viral invasion in the lungs, histological

examination of lungs tissue frequently shows diffuse alveolar damage characterized by presence of cellular fibromyxoid exudates, desquamation of pneumocytes and hyaline membrane formation. This is consistent with acute respiratory distress syndrome (ARDS)

### Current outbreak

The first report of this virus came from Hubei province of China. India has reported more than 750,000 cases with 8500 deaths (till 11th July 2020). After claiming free from COVID-19, China and Singapore are facing second wave of the disease.

The Virus can survive on different surfaces for several hours to days. Table1 summarizes these surfaces and survival time.

**Table1.** Survival time of SARS-CoV2 at different surfaces

Surface	Examples of surface	SARS-CoV2 survival
Metal	Door knobs, Silverware	5 days
Wood	Furniture, Decking	4 days
Plastic	Milk containers and detergent bottles, Subway and bus seats, Backpacks, Elevator buttons	2-3 days
Stainless Steel	Refrigerators, Pots and pans, Sinks, some water bottles	2-3 days
Cardboard	Shipping boxes	24 hours
Copper	Pantries, Teakettles, cookware	4 hours
Aluminum	Drinking glasses, Measuring cups, Mirrors, Windows	Up to 3 days
Ceramics	Dishes, Pottery, Mugs	5 days
Paper	Mail, Newspaper	Varies a lot as some strains of coronavirus live for few minutes only whereas other live for up to 5 days
Food	Tabasco, Pickles	Doesn't seem to spread through food
Water	-	Doesn't seem to spread through water



As we can see, the virus has tremendous ability to survive on different surfaces. It binds to the ACE2 (Angiotensin Converting Enzyme 2) receptor on human cells which are present on almost all the tissues. Due to the mutation (which are described below) the virus has got strong ability to bind and transmit from one human to other quickly. These factors have enhanced the infection and mortality rate.

#### Structure of SARS-CoV-2

Coronavirus virions are spherical with diameters of approximately 125 nm as depicted in recent studies by cryo-electron tomography and cryo-electron microscopy<sup>12-13</sup>. The most prominent feature of coronaviruses is the club-shaped spike projections emanating from the surface of the virion. Within the envelope of the virion is the nucleocapsid. Coronaviruses have helically symmetrical nucleocapsids, which is uncommon among positive-sense RNA viruses, but far more common for negative-sense RNA viruses<sup>14</sup>.

Coronavirus is structured with four major structural proteins, which are spike (S), membrane (M), envelope (E), and nucleocapsid (N) proteins, all aforementioned are encoded within the 3' end of the viral genome. The S protein (~150 kDa), utilizes an N-terminal signal sequence to gain access to the ER, and is

heavily N-linked glycosylated. Homotrimers of the virus encoded S protein make up the distinctive spike structure on the surface of the virus.<sup>15,16</sup> The trimeric S glycoprotein is a class I fusion protein and mediates attachment to the host receptor<sup>17</sup>. S1 makes up the large receptor-binding domain (RBD) of the S protein, while S2 forms the stalk of the spike molecule<sup>18</sup>.

The M protein is the protein which is present in abundance in the virion. It is a small (~25–30 kDa) protein with three transmembrane domains and is thought to give the virion its framework. It has a small N-terminal glycosylated ectodomain and a much larger C-terminal endodomain<sup>19</sup>.

The E protein (~8–12 kDa) is found in small quantities within the virion. The E protein has an N-terminal ectodomain and a C-terminal endodomain and has ion channel activity. As opposed to other structural proteins, recombinant viruses lacking the E protein are not always lethal, although this is virus type dependent<sup>20</sup>. The E protein facilitates assembly and release of the virus along with the ion channel activity in SARS-CoV.

The N protein constitutes the only protein present in the nucleocapsid. It is composed of two separate domains, an N-terminal domain (NTD) and a C-terminal domain (CTD), both capable of binding



RNA in vitro, but each domain uses different mechanisms to bind RNA. It has been suggested that optimal RNA binding requires contributions from both domains<sup>20,21</sup>. N protein binds the viral genome in beads-on-a-string type conformation. Two specific RNA substrates have been identified for N protein; the TRSs and the genomic packaging signal. The genomic packaging signal has been found to bind specifically to the second, or C-terminal RNA binding domain. N protein also binds nsp3, a key component of the replicase complex, and the M protein. These protein interactions likely help tether the viral genome to the replicase–transcriptase complex (RTC), and subsequently package the encapsidated genome into viral particles.

A fifth structural protein, the hemagglutinin-esterase (HE), is present in a subset of  $\beta$ -coronaviruses. The protein acts as a hemagglutinin, binds sialic acids on surface glycoproteins, and contains acetyl-esterase activity. These activities are thought to enhance S protein-mediated cell entry and virus spread through the mucosa<sup>14</sup>. Table 2 summarizes ORFs and protein encoded by these genes<sup>22,23,24</sup>.

**Table.2** Different ORFs and expressed proteins

Gene	Encoded protein	Function	Similarity of SARS-CoV
ORF1ab	A polypeptide which gets processed into Nsp1-3, Nsp4, Nsp5, Nsp12-13	Replication, transcription, protease activity	67-88%
S	Spike	Host cell binding, form first on infection	77%
E	Envelope	Envelope surrounding the viral shell control assembly, release and infectivity of virus	89%
M	Nucleocapsid	binds and packages the RNA genome also hides virus from host immune system	94%
M	Membrane	Glycoprotein present beneath spikes which shapes mature viral particles and binds the inner layer of host cell membrane during infection	90%
ORF3	AP1	Viral replication and pathogenesis	74%
ORF4	AP4	IFN antagonist, NF- $\kappa$ B antagonist	NA
ORF5	AP5	IFN antagonist, NF- $\kappa$ B antagonist	NA
ORF6	PE	Accelerates viral infection, IFN and NF- $\kappa$ B antagonism	
ORF7a	7a	Induction of apoptosis in host cells, inhibition of host protein synthesis, Cell cycle arrest, enhances pro-inflammatory signals and MAPK pathway	90%
ORF7b	7b	unknown	NA
ORF8	8a,8b	unknown	88%
ORF9	9	unknown	NA

### Life cycle of SARS-CoV2:

#### Binding to receptors

Life cycle starts when COVID-19 virus binds to the ACE2 receptors (angiotensin converting enzyme<sup>2</sup>) of the host cells. For binding Spike protein is processed by Serine protease TMPRSS2 which cleave Spike protein into S1 and S2 subunit which remain non-covalently bound. This cleavage leads to conformational change in spike protein and exposes receptor binding domain (RBD) of S2 subunit which forms non-covalent bonds with ACE2 receptor. After binding virus can enter into



the host cells by two different ways<sup>1</sup> virus membrane fuses with cell membrane and RNA genome is internalize,<sup>2</sup> after binding with ACE2, whole structure gets internalize through endocytosis, the endosome now fuses with lysosome and N, S, E and M protein are degraded leaving RNA genome into endo-lysosome vacuole.

ACE2 is an important enzyme of Renin-Angiotensin System (RAS)<sup>25</sup> which regulate blood pressure, blood volume etc. ACE2 expresses on almost all the tissue but highest expression was found on endothelium cells<sup>26</sup>, heart, tongue, pneumocytes and enterocytes cells of respiratory system<sup>26,27,28</sup>. Inside mouth highest expression was found on tongue followed by buccal and gingival tissue.

Replication/ Transcription in cytoplasm:

Inside the cell, viral RNA genome remains surrounded by membrane all the time which protects viral genome from cellular defense machineries as mRNA or Pattern Recognition Receptors (PRR). With still unknown method, this membrane bound RNA internalizes ribosomes of host cell. Genomic RNA conjugates to host ribosomes and translation of two- third of its genome starts. It either form polyprotein pp1a (nsp1-11) or pp1ab (nsp1- 16) using frame shift(-1) on internalized ribosomes. These polyproteins are further processed and form Replication- Transcription complex (RTC).

Pp1a and pp1ab first get self-processed at nsp3 and nsp6 and form protease papain-like protease (PLpro) and chymotrypsin-like protease (Mpro; 3CLpro) respectively. PLpro cleaves polypeptide 1-3 and created 3 different proteins whereas Mpro target nsp7- 16 and creates other proteins. Some of the nsps and their functions are as follows

1. Nsp1: Inhibit host mRNA translation, induce degradation of host mRNA, inhibit induction of IFN signaling
2. Nsp2: Not very well known. Can act as adapter protein of Nsp3. Dispensable for replication process.
3. Nsp3: This code for PLpro protein.
4. Nsp4: Form a transmembrane protein which anchored RTC polyprotein to the membrane. Nsp6 also participate in this process.
5. Nsp5: Code for chymotrypsin-like protease (Mpro; 3CLpro) or main protease.
6. Nsp6: along with Nsp4 anchor RTC.
7. Nsp7- Nsp8: Form a complex which interact with double standard RNA and protect from degradation. Nsp8 also form primers for RNA dependent RNA polymerase.
8. Nsp9: It forms a RNA binding protein, known to protect nascent RNA during replication and transcription.



9. Nsp10: Product of Nsp10 is a nucleic acid binding protein, which involve in -ve RNA strand synthesis.
10. Nsp11: Frameshift occurs at this point. Function of this protein is still unclear.
11. Nsp12: This form RNA- dependent RNA polymerase.
12. Nsp13: Code for RNA helicase.
13. Nsp 14: It has 3'-5' exonuclease activity.
14. Nsp 15: This enzyme has endonuclease activity.
15. Nsp 16: It has methyl transferase activity.

Products of Nsp 13 to 16 form complex with Nsp12.<sup>29, 30</sup>

Rest one- third of the genome express structural and accessory proteins. Replication machinery also creates several subgenomic RNA. Now this whole complex which is surrounded by membrane fuses with endoplasmic reticulum (ER) and translation of structural and accessory protein begins. These proteins surround +ve strand full RNA genome and internalize into ER lumen. Inside ER lumen proteins properly fold and start forming virion structure. Proper virions form at ER-Golgi border. Through Golgi complex these virus particles are spitted out of the cells.

### Spread of virus

The virus can multiple times infect the host cells and can travel and infect other tissues as renal, cerebral neurons, immune cells and intestinal mucosa cells as ACE2 receptors express on these cells too. Normally patients die due to Acute Respiratory Distress Syndrome (ARDS). Patient with heart, lung or kidney related diseases are more susceptible to Covid19<sup>31, 32</sup>.

The fraction of undocumented but infectious cases is a critical epidemiological characteristic that modulates the pandemic potential of an emergent respiratory virus. These undocumented infections often go unrecognized owing to mild, limited, or lack of symptoms and thus, depending on their contagiousness and numbers, can expose a far greater portion of the population to the virus than would otherwise occur taking in account that it is stable for several hours to days in aerosols and on surfaces. According to a new study it has been found that severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was detectable in aerosols for up to three hours, up to four hours on copper, up to 24 hours on cardboard and up to two to three days on plastic and stainless steel.<sup>33</sup>

### Immune Evasion by SARS-CoV2

Our body has innate and adaptive immune system which fights against incoming pathogen. Innate immune response is first



line of defense whereas adaptive immune response depends upon innate immune cells to start its action. In lungs macrophages are main immune cells. Macrophages and dendritic cells act as bridge between innate and adaptive immune response<sup>34</sup>. Infarct dendritic cells need macrophages for the maturation. Macrophages are either circulate in blood or resides permanently inside the tissues. Langerhans cells, Kupffer cells are examples of tissue specific macrophages. Circulating macrophages are derived from monocytes<sup>35</sup>.

SARS-CoV2 infects pneumocyte cells of the lungs. In in-vitro experiment it has been found that the condition media obtained from the infected pneumocytes impaired the maturation of resident macrophages and dendritic cells as this media does not let these cells to express co-stimulatory molecules (CD40, CD86). Monocytes which circulate in lungs can also get infected with COVID-19 virus as these cells express ACE2 receptor on their surface. These monocytes secrete CCL10, CCL2 which attract more monocytes which again halt their maturation. Monocytes which have infiltrated the alveoli changes into macrophages. These macrophages now start secreting chemokines as CCL5/ CCL8 which attract more activated T cells, Nk cells. These activated cells secrete

more cytokines to bring similar type of cells to lungs. These excessive cytokines leads to lung damage. These cells secrete other factors too (which need to investigate) which blocks maturation of immune cells in bone marrow. On high infection SARS-CoV2 can travel to lymph nodes, spleen and infect resident macrophages as these macrophages express ACE2 receptors. Upon infection maturation of T and B cells (effectors of adaptive immunity) pauses. Thus SARS-CoV2 inactivate the adaptive and innate immune response of the person and results into high level of cytokine storm (Fig. 2). These cytokine storms are responsible for multiple organ failure and ARDS<sup>36, 37, 38, 39</sup>.

Inside the cells nucleocapsid protein and product of orf6 of virus prevent the expression of IFN $\gamma$  response signaling which has an antiviral effect<sup>40</sup>. Since viral genome is always surrounded by double layer membrane inside host cells, pattern associated responsible protein (PARPs) could not recognize viral RNA as foreign material. Thus virus stays any kind of immune response trigger.

### **Symptoms of COVID-19**

The most common clinical symptoms of the Covid 19 are fever, cough, dyspnoea and myalgia or fatigue. The other features are sputum production (28%), headache (8%). Few patients' complaint about diarrhoea or upper respiratory tract



problems<sup>41</sup>. There are also reports of rashes on the skin or oral lesions. Discoloration of the fingers and toes are also reports in few cases. There are reports that COVID-19 virus could also infect brain and leads to diseases like vessel stroke and ischemic stroke.

Mostly, patient with compromised immunity (old age, heart disease) are main victims. Clinical features developed in fourteen days but the virus can spread asymptotically too. It has been estimated that 75% of Covid 19 patients are male and the one with pre-existing conditions as diabetes (20%), hypertension (15%) and cardiovascular disease (15%)<sup>41</sup>.

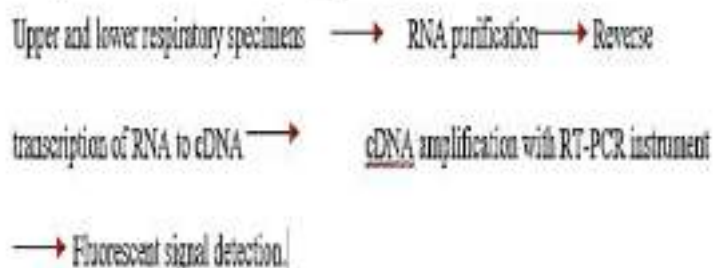
Laboratory features are leukopenia (25%), lymphopenia (25%) and raised aspartate aminotransferase (37%). Few had raised troponin (hypersensitive-troponin I (hs-cTnI)) possibly suggestive of virus-associated myocardial injury. Abnormalities on computed tomography (CT) of the chest are seen in all patients<sup>41</sup>.

### Diagnosis of COVID- 19

Testing of the presence of SARS-CoV2 into the blood, saliva, tracheal swabs or stool of patient is important to characterize the disease. The diagnosis either recognizes the morphology or the unique features of the genome and proteome of the virus. CT scan is an old method to recognize the virus particle in the chest x-

ray but this method is not reliable as there are several coronaviruses which have identical structure. Although this method is simple and easily doable in any hospital settings.

The other two methods which identify the unique properties of the genome of the virus are known as RT-qPCR (Reverse Transcriptase Quantitative Polymerase Chain Reaction) and isothermal PCR amplification technique. RT-qPCR based method recognizes the unique nucleotides sequences of the RNA of the gene Envelope (E), RNA dependent RNA polymerase (RdRP) and Nucleocapsid (N) of SARS-CoV2 (42). RT-PCR involves the reverse transcription of SARS-CoV-2 RNA into complementary DNA (cDNA) strands, followed by amplification of specific regions of the cDNA. Thus a typical RT-PCR procedure for detecting SARS-CoV-2 infection typically encompasses in sequence the following step:



There are few loopholes in RT-qPCR based method. First, this method is unable to detect the virus in the sample of newly infected person as the virus load is too low. Second, sometime this method gives false



positive results due to the crude nature of the samples. Third, the technique is hard to operate in hospital settings as it requires highly sophisticated machines and highly skilled person to set up the reaction.

Isothermal PCR amplification is coming up as an alternative of RT-qPCR based method. This method converts RNA of the viruses into cDNA and amplifies specific sequences of this cDNA. Although this sounds similar to RT-qPCR based technique but the difference is that the whole procedure completes at a unique temperature and do not require specific PCR machine. The detection can be done using biotin- streptavidin reaction or fluorescent dye. Researchers are trying to perform this whole reaction on a paper strip. This would help to detect COVID-19 at very low price and enable common men to perform the test at home. This paper based detection will be very similar to pregnancy test or blood group test.

Viral protein antigens and antibodies that are created in response to a SARS-CoV-2 infection can be used for diagnosing COVID-19. Changes in viral load over the course of the infection may make viral proteins difficult to detect. One potential challenge with developing accurate serological tests includes potential cross-reactivity of SARS-CoV-2 antibodies with antibodies generated against other coronaviruses. Currently, serological tests

(i.e., blood tests for specific antibodies) are in development. Zhang et al. detected immunoglobulin G and M (IgG and IgM) from human serum of COVID-19 patients using an enzyme-linked immunosorbent assay (ELISA). They used the SARS-CoV-2 Rp3 nucleocapsid protein, which has 90% amino acid sequence homology to other SARS-related viruses<sup>42, 43</sup>

To curb the outspread of pandemic smart phone surveillance is used up by several countries to track the suspected COVID-19 patients. Controlling epidemics requires extensive surveillance, sharing of epidemiological data, and patient monitoring. Arogya-setu is a similar app tracking the patients and the probable suspects, including the geo-location of patients, travel history and related data.

### **Therapeutic options of COVID-19**

So far there is no medicine or treatment available for COVID-19, several drugs are being tested in clinical trials. Some of them are as follows

1. Remdesivir: It is an antiviral drugs which is given intravenously. It degrades viral genome. This drug is under clinical trial<sup>44</sup>
2. Dexamethasone: This is a steroid drug which can be given orally or intravenously. According to clinical trial conducted in UK this drug reduce death rate by 40% in patient



who have mild COVID-19 symptoms<sup>45</sup>

3. Hydroxychloroquine and chloroquine:

These are antimalarial drugs which have properties to block interaction of spike protein with ACE2 receptors. In few small studies it has been shown to reduce viral load in body but there are few reports which oppose the prior one. There are reports of cardiac arrest in few older patients<sup>46, 47</sup>

4. Azithromycin: This is an antibacterial drug which is given in case of influenza attack. There are few studies which have shown faster recovery of the patients who took Azithromycin in combination of Hydroxychloroquine. There are serious side effects too<sup>47</sup>

5. Actemra (tocilizumab): It is an IL-6 blockers. IL-6 is responsible for cytokine storm in case of COVID-19. The drug is under clinical trial<sup>48</sup>

6. Kaletra (lopinavir/ritonavir): This is an anti HIV drug and has shown activity against SARS-CoV2 in small cohort study<sup>49</sup>

7. Tamiflu (oseltamivir): This is an antiviral drug which is being given to the patient who have influenza attack.

8. Colcrys (colchicine): This is an anti-inflammatory drug. This is given to the patient who suffer from gout

disease. The drug is under clinical trial.

9. Ivermectin: This is an antiparasite drug which has shown potential against COVID-19 virus in cell culture study.

### Forensic Outlook

Forensic practitioners are important professionals whose work have legal, social, and economic consequences for communities, deceased individuals, and families of the deceased. During a pandemic such as COVID-19, the forensic community plays a key role in the management of the crisis, both nationally and internationally. The challenge for forensic practitioners has been twofold: first, to minimize the spread of the virus and, second, to advise authorities, hospitals, and funerary workers on proper protocols when deaths risk exceeding the capacities of local medico-legal services. Forensic autopsy is currently the main way to identify and accumulate systematic pathological information for death cases. Examination agencies should fully record



and maintain the basic information for COVID-19 patients (name, age, sex, place of origin, place of residence, and place of onset and travel history), information from the anatomical examination and epidemiological and clinical data.

It is important that in addition to knowledge regarding public health measures to mitigate the coronavirus spread, we also take into consideration the reality of many of novel coronavirus reaches these vulnerable populations or others such as displaced communities, migration camps, or prison environments in different parts of the world the result will be a humanitarian crisis. The containment of the spread will be impossible, and the death toll caused by the disease will be unprecedented for modern times.

Figure 1

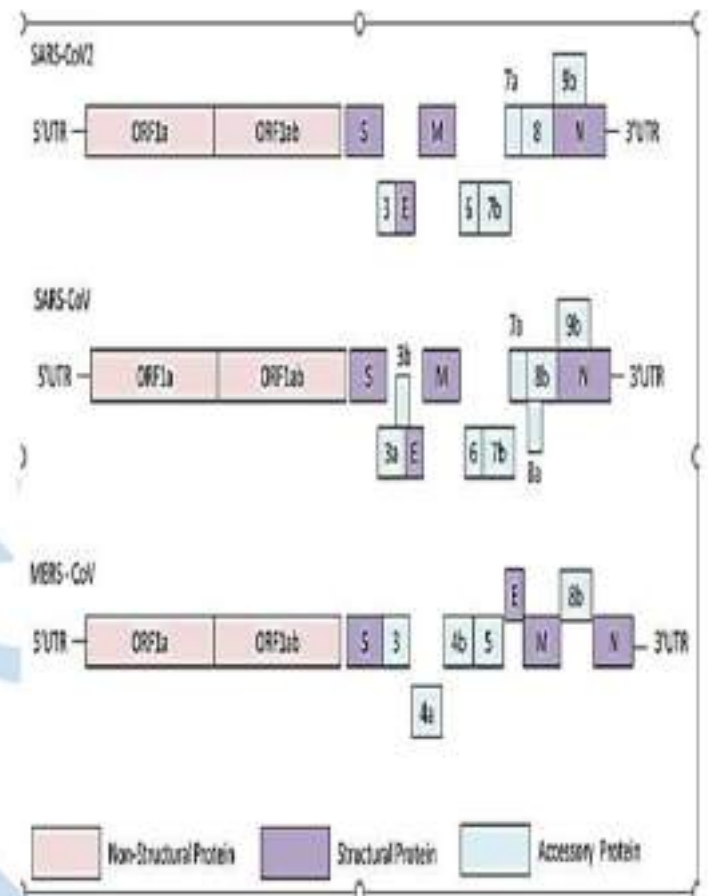


Figure1. Genome organization of SARS-CoV2 , SARS-CoV and MERS-CoV. Color codes define Structural, Non-structural and Accessory proteins. Boxes sizes are not according to gene size. E: Envelop protein, M: Membrane protein, N: Nucleocapsid protein, ORF: Open reading frame, S: Spike protein,



Figure 2

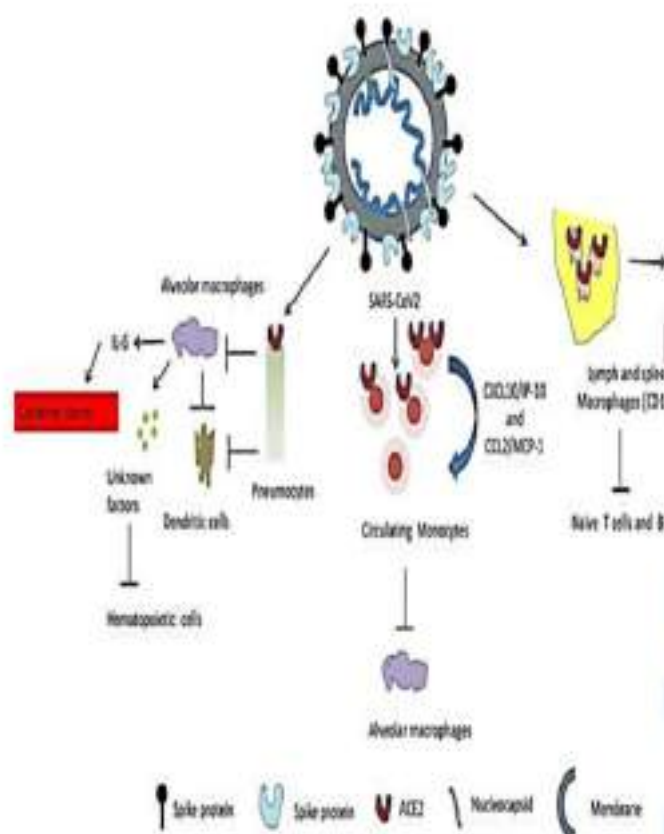


Figure2. SARS-CoV2 infects ACE2 receptors bearing cells as pneumocytes cells, monocytes and macrophages of lungs, blood, lymph nodes and spleen. Infected Pneumocytes cells do not let alveolar macrophages and dendritic cells to mature. Due to virus infection circulating monocytes do not change into macrophages. These monocytes release chemokine as CXCL10 and CCL2 which attract more monocytes and macrophages. Immature macrophages release pro-inflammatory cytokines as IL6 which can channelize more similar kind of cytokines to initiate cytokine storm.

### Conclusion:

SARS-CoV2 virus is well adapted to infect human. Specific 'RRAR' furin cleavage site at the S1-S2 boundary of the SARS-CoV-2 spike protein induces stronger binding and rapid transmissibility. Due to membrane bound, Pattern recognition receptors (PRR) machinery fails to recognize RNA genome. Whole transcription and replication takes place inside the membrane only. Once outside the cells, viruses evade immune response by a) downplaying IFN signaling using its Nucleocapsid protein and b) directly infecting immune cells as macrophages and monocytes. Depleting macrophages produce lot of pro-inflammatory cytokines as IL-6 (Interleukin -6) responsible for triggering cytokine storm in patients. These cytokine storms become fatal for the patients who have weak immunity. That is the reason IL-6 blockers as tocilizumab is undergoing clinical trial.

Since there is no treatment available and virus has remarkable capacity to survive at different surfaces for hours it is very important to maintain proper hygiene, sanitize ourselves time to time and maintain social distancing to protect ourselves from COVID-19.



## References:

1. Wang C, Horby PW, Hayden FG and Gao GF (2020). A novel coronavirus outbreak of global health concern. *Lancet* 395, 470–473.
2. Organization WH. Laboratory testing of human suspected cases of novel coronavirus (nCoV) infection: interim guidance, 10 January 2020. World Health Organization.
3. Peng Zhou, Xing-Lou Yang, Xian-Guang Wang, Ben Hu, Lei Zhang, Wei Zhang, Hao-Rui Si, Yan Zhu, Bei Li, Chao-Lin Huang, Hui-Dong Chen, Jing Chen, Yun Luo, HuaGuo, Ren-Di Jiang, Mei-Qin Liu, Ying Chen, Xu-RuiShen, Xi Wang, Xiao-ShuangZheng, Kai Zhao, Quan-Jiao Chen, Fei Deng, Lin-Lin Liu, Bing Yan, Fa-Xian Zhan, Yan-Yi Wang, Geng-Fu Xiao and Zheng-Li Shi (2020). A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature* 579, 270–273.
4. Fan Wu, Su Zhao, Bin Yu, Yan-Mei Chen, Wen Wang, Zhi-Gang Song, Yi Hu, Zhao-Wu Tao, Jun-HuaTian, Yuan-Yuan Pei, Ming-Li Yuan, Yu-Ling Zhang, Fa-Hui Dai, Yi Liu, Qi-Min Wang, Jiao-Jiao Zheng, Lin Xu, Edward C Holmes, Yong-Zhen Zhang (2020). A New Coronavirus Associated With Human Respiratory Disease in China. *Nature*.579 (7798), 265-269.
5. Alexander E. Gorbalenya, Susan C. Baker, Ralph S. Baric, Raoul J. de Groot, Christian Drosten, Anastasia A. Gulyaeva, Bart L. Haagmans, Chris Lauber, Andrey M Leontovich, Benjamin W. Neuman, Dmitry Penzar, Stanley Perlman, Leo L.M. Poon, Dmitry Samborskiy, Igor A. Sidorov, Isabel Sola and John Ziebuhr (2020). Severe acute respiratory syndrome-related coronavirus: The species and its viruses—a statement of the Coronavirus Study Group. *bioRxiv*.
6. Thirumalaisamy P. Velavan and Christian G. Meyer (2020). The COVID-19 epidemic. *Tropical Medicine and International Health*. 25 (3), 278–280.
7. Sin-Yee Fung , Kit-San Yuen , Zi-Wei Ye , Chi-Ping Chan and Dong-Yan Jin (2020). A tug-of-war between severe acute respiratory syndrome coronavirus 2 and host antiviral defence: lessons from other pathogenic viruses. *Emerging Microbes &Infection* 9, 558- 570.
8. Shuai Chen, HaibinLuo , Lili Chen, Jing Chen, JianhuaShen, Weiliang Zhu, Kaixian Chen , XuShen and



- Hualiang Jiang (2006). *Curr Pharm Des* 12(35), 4539-53.
9. Emmie de Wit, Neeltje van Doremalen, Darryl Falzarano, Vincent J Munster (2016). *Nat Rev Microbiol* 14(8), 523-34.
10. Alexandra C Walls, Young-Jun Park, M Alejandra Tortorici, Abigail Wall, Andrew T McGuire, David Veasler (2020). Structure, Function, and Antigenicity of the SARS-CoV-2 Spike Glycoprotein. *Cell* 181 (2), 281-292.e6.
11. Yan-Rong Guo, Qing-Dong Cao, Zhong-Si Hong, Yuan-Yang Tan, Shou-Deng Chen, Hong-Jun Jin, Kai-Sen Tan, De-Yun Wang, Yan Yan (2020). The Origin, Transmission and Clinical Therapies on Coronavirus Disease 2019 (COVID-19) Outbreak - An Update on the Status. *Mil Med Res.* 13 321-326.
12. Montserrat Bárcena, Gert T Oostergetel, Willem Bartelink, Frank G A Faas, Arie Verkleij, Peter J M Rottier, Abraham J Koster, Berend Jan Bosch (2009). Cryo-electron Tomography of Mouse Hepatitis Virus: Insights Into the Structure of the Coronavirus.
- Proc Natl Acad Sci U S A* 106(2), 582-7.
13. Benjamin W Neuman, Brian D Adair, Craig Yoshioka, Joel D Quispe, Gretchen Orca, Peter Kuhn, Ronald A Milligan, Mark Yeager, Michael J Buchmeier (2006). Supramolecular Architecture of Severe Acute Respiratory Syndrome Coronavirus Revealed by Electron Cryomicroscopy. *J Virol* 80(16), 7918-28.
14. Anthony R Fehr, Stanley Perlman (2015). Coronaviruses: An Overview of Their Replication and Pathogenesis. *Methods Mol Biol* 1282, 1-23.
15. Daniel R Beniac, Anton Andonov, Elsie Grudeski, Tim F Booth (2006). Architecture of the SARS Coronavirus Prefusion Spike. *Nat Struct Mol Biol.* 13, 751-759.
16. B Delmas, H Laude (1990). Assembly of Coronavirus Spike Protein Into Trimers and Its Role in Epitope Expression. *J Virol* 64(11), 5367-75.
17. A R Collins, R L Knobler, H Powell, M J Buchmeier (1982). Monoclonal Antibodies to Murine Hepatitis virus-4 (Strain JHM) Define the Viral Glycoprotein Responsible for Attachment and Cell-Cell Fusion. *Virology* 119(2), 358-71.



18. R J de Groot, W Luytjes, M C Horzinek, B A van der Zeijst, W J Spaan, J A Lenstra (1987). Evidence for a Coiled-Coil Structure in the Spike Proteins of Coronaviruses. *J Mol Biol.* (4), 963-6.
19. J Armstrong, H Niemann, S Smeekens, P Rottier, G Warren (1984). Sequence and Topology of a Model Intracellular Membrane Protein, E1 Glycoprotein, From a Coronavirus. *Nature* 308(5961), 751-2.
20. Chung-ke Chang, Shih-Che Sue, Tsan-hung Yu, Chiu-Min Hsieh, Cheng-Kun Tsai, Yen-Chieh Chiang, Shin-jye Lee, Hsin-hao Hsiao, Wen-Jin Wu, Wei-Lun Chang, Chun-Hung Lin, Tai-huang Huang (2006). Modular Organization of SARS Coronavirus Nucleocapsid Protein. *J Biomed Sci.* 3(1), 59-72.
21. Kelley R Hurst, Cheri A Koetzner, Paul S Masters (2009). Identification of in Vivo-Interacting Domains of the Murine Coronavirus Nucleocapsid Protein. *J Virol* 83(14), 7221-34.
22. SuhasSrinivasan , Hongzhu Cui , ZiyangGao , Ming Liu , Senbao Lu , Winnie Mkandawire , OleksandrNarykov , Mo Sun and Dmitry Korkin (2020). Structural Genomics of SARS-CoV-2 Indicates Evolutionary Conserved Functional Regions of Viral Proteins. *Viruses* 12 (360), 1-17.
23. Rachel L. Graham, Jennifer S. Sparks, Lance D. Eckerle, Amy C. Sims and Mark R. Denison (2008). SARS coronavirus replicase proteins in pathogenesis. *Virus Res* 133(1), 88–100.
24. Krishna Narayanan, Cheng Huang, and Shinji Makino (2008). SARS coronavirus Accessory Proteins. *Virus Res* 133(1), 113–121. DOI: 10.1016/j.virusres.2007.10.009
25. James F Riordan (2003). Angiotensin-I-converting enzyme and its relatives. *Genome Biology* .225, 4.
26. Hong PengJia, Dwight C. Look, Lei Shi, Melissa Hickey, LeciaPewe, Jason Netland, Michael Farzan, Christine Wohlford-Lenane, Stanley Perlman, and Paul B. McCray, Jr (2005). ACE2 Receptor Expression and Severe Acute Respiratory Syndrome Coronavirus Infection Depend on Differentiation of Human Airway Epithelia. *J Virol.* 79(23), 14614–14621.
27. Inge Hamming WimTimens Marian BulthuisTitia Lely GerjanNavis and Harry van Goor (2004). Tissue distribution of ACE2 protein, the



- functional receptor for SARS Coronavirus. *Journal of Pathology* 203(2), 631-637.
28. HaoXu, Liang Zhong, Jiaxin Deng, JiakuanPeng, Hongxia Dan, XinZeng, Taiwen Li and Qianming Chen (2020). High expression of ACE2 receptor of 2019-nCoV on the epithelial cells of oral mucosa. *International Journal of Oral Science*. 12 (8).
  29. E J Snijder, E Decroly, J Ziebuhr (2016). The Nonstructural Proteins Directing Coronavirus RNA Synthesis and Processing. *Adv Virus Res* 96, 59-126.
  30. Sawicki SG, Sawicki DL, Younker D, Meyer Y, Thiel V, Stokes H, Siddell SG (2005). Functional and Genetic Analysis of Coronavirus Replicase-Transcriptase Proteins. *PLoS Pathog* 1(4):e39.
  31. LanyingDu, Yuxian He, Yusen Zhou, Shuwen Liu, Bo-JianZhengll, and Shibo Jiang (2009). The spike protein of SARS-CoV — a target for vaccine and therapeutic development. *Nat Rev Microbiol* 7(3), 226–236.
  32. Ding Y, He L, Zhang Q, Huang Z, Che X, Hou J, Wang H, Shen H, Qiu L, Li Z, Geng J, Cai J, Han H, Li X, Kang W, Weng D, Liang P and Jiang S (2004). Organ distribution of severe acute respiratory syndrome (SARS) associated coronavirus (SARS-CoV) in SARS patients: implications for pathogenesis and virus transmission pathways. *J Pathol* 203(2), 622-30.
  33. Mary E. Wilson, Van Doremalen N (2020). Survival of SARS-CoV-1 and SARS-CoV-2 in Aerosols and on Surfaces. *N Engl J Med*, 2004973.
  34. Clare M. Lloyd, and Benjamin J. Marsland (2017). Lung Homeostasis: Influence of Age, Microbes and the Immune System. *Immunity* 46.
  35. D. Ferenbach, J. Hughes (2008). Macrophages and dendritic cells: what is the difference? *Kidney International* 74, 5-7.
  36. Ahmet Kursat Azkur, Mübeccel Akdis, Dilek Azkur, Milena Sokolowska, Willem van de Veen, Marie-Charlotte Brüggemann, Liam O'Mahony, Yadong Gao, Kari Nadeau, Cezmi A. Akdis (2020). Immune response to SARS-CoV-2 and mechanisms of immunopathological changes in COVID-19. *Allergy*.
  37. Matthew Zirui Tay, Chek Meng Poh, Laurent Rénia, Paul A. MacAry & Lisa F. P. Ng (2020). The trinity of COVID-19: immunity, inflammation



- and intervention. *Nat Rev Immunol*. 20, 363–374.
38. Ling NiFangYeMeng-Li ChengCheng-FengQinFangChenChen Dong (2020). Detection of SARS-CoV-2-Specific Humoral and Cellular Immunity in COVID-19 Convalescent Individuals. *Immunity* 52, 971–977.
  39. JixinZhong\*, Jungen Tang\*, Cong Ye, Lingli Dong (2020). The immunology of COVID-19: is immune modulation an option for treatment? *Lancet Rheumatol* 2, e428–36.
  40. Yong Hu, Wei Li, Ting Gao, Yan Cui, Yanwen Jin, Ping Li, Qingjun Ma, Xuan Liu, Cheng Cao (2017). The Severe Acute Respiratory Syndrome Coronavirus Nucleocapsid Inhibits Type I Interferon Production by Interfering with TRIM25-Mediated RIG-I Ubiquitination. *Journal of Virology* 91 (8) e02143-16.
  41. Lake MA (2020) , What we know so far: COVID-19 current clinical knowledge and research. *Clin Med (Lond)* 20, 124-127.
  42. Wang W, Xu Y, Gao R I (2020). Detection of SARS-CoV-2 in Different Types of Clinical Specimens. *JAMA*. 323(18), 1843–1844.
  43. RekhaJalandraad,AmitK.Yadavb,D aminiVermac,NishuDalalae,Minaks hiSharmad,RajeevSinghe, AnilKumaraPratima, R.Solan (2020). Strategies and perspectives to develop SARS-CoV-2 detection methods and diagnostics.*Biomedicine & Pharmacotherapy* 129, 110446.
  44. John H. Beigel, M.D., Kay M. Tomashek, M.D., M.P.H., Lori E. Dodd, Ph.D., Aneesh K. Mehta, M.D., Barry S. Zingman, M.D., Andre C. Kalil, M.D., M.P.H., Elizabeth Hohmann, M.D., Helen Y. Chu, M.D., M.P.H., Annie Luetkemeyer, M.D., Susan Kline, M.D., M.P.H., Diego Lopez de Castilla, M.D., M.P.H., Robert W. Finberg, M.D (2020). Remdesivir for the Treatment of Covid-19 — Preliminary Report. *New Eng. J. of Medicine*.
  45. Efficacy and Safety of Corticosteroids in COVID-19. *ClinicalTrials.gov* Identifier: NCT04273321. Accessed on 11 May 2020.
  46. S A Meo , D C Klonoff, J Akram (2020). Efficacy of Chloroquine and Hydroxychloroquine in the Treatment of COVID-19.*Eur Rev*



Med Pharmacol Sci. 24(8), 4539-4547.

47. Samia Arshad, MPH, Paul Kilgore, MD, Zohra S. Chaudhry, MD, , Gordon Jacobsen, MS, Dee Dee Wang, MD, Kylie Huitsing, BS, Indira Brar, MD, George J. Alangaden, MD, Mayur S. Ramesh, MD, John E. McKinnon, MD, William O'Neill MD, Marcus Zervos, MD (2020) Treatment with Hydroxychloroquine, Azithromycin, and Combination in Patients Hospitalized with COVID-19. International Journal of Infectious Diseases.

48. Rand Alattar Tawheeda B. H. Ibrahim Shahd H. Shaar Shiema Abdalla Kinda Shukri Joanne N. Daghfal Mohamed Y. Khatib Mohamed Aboukamar Mohamed Abukhattab Hussam A. Alsoub Muna A. Almaslamani Ali S. Omrani (2020). Tocilizumab for the treatment of severe coronavirus disease 2019. Journal of Medical Virology.

49. Bin Cao, M.D., Yeming Wang, M.D., Danning Wen, M.D., Wen Liu, M.S., Jingli Wang, M.D., Guohui Fan, M.S., Lianguo Ruan, M.D., Bin Song, M.D., Yanping Cai, M.D., Ming Wei, M.D., Xingwang Li, M.D., Jiaan Xia, M.D (2020). A Trial of

Lopinavir–Ritonavir in Adults Hospitalized with Severe Covid-19. N Engl J Me 382, 1787-1799.



**Coronavirus Disease 19 (Covid-19): Patient Management at Oral Health Care Setup**

Jitendra Sharan<sup>1\*</sup>, N. Ibemcha Chanu<sup>2</sup>, Pallawi Sinha<sup>3</sup>, Ashok Kumar Jena<sup>1</sup>

<sup>1</sup> Unit of Orthodontics and Dentofacial Orthopedics, Department of Dentistry, All India Institute of Medical Sciences, Bhubaneswar, Odisha, India.

<sup>2</sup> Consultant (Orthodontics), Imphal, Manipur, India

<sup>3</sup> Department of Prosthodontics, Hi-Tech Dental College and Hospital, Bhubaneswar, Odisha, India

**<sup>1\*</sup>Corresponding Author**

Jitendra Sharan  
Assistant Professor  
Unit of Orthodontics and Dentofacial Orthopedics,  
Department of Dentistry  
All India Institute of Medical Sciences  
Bhubaneswar 751019  
Odisha, India.

Email: [jsbmids@gmail.com](mailto:jsbmids@gmail.com)  
[dent\\_jitendra@aiimsbhubaneswar.edu.in](mailto:dent_jitendra@aiimsbhubaneswar.edu.in)

**ABSTRACT**

The global outbreak of novel coronavirus 2019 (SARS-CoV-2) is a great threat to the public health system. Coronavirus disease 2019 (COVID-19) infection was first reported to be caused by a newly identified  $\beta$ -coronavirus, at Wuhan, the capital of China's Hubei province. As of July 11, 2020, according to the Johns Hopkins University, the COVID-19 has infected more than 1.25 crore people, resulting in the death toll above 6 lakhs around the world. The rapid spread of coronavirus pandemic has challenged the overall health care systems, including dental health care, to a great extent of fear and reactions. The dental professionals have suspended routine dental care and elective procedure to limit the spread through droplets and aerosols during the lockdown days and are very concerned post lockdown. With the importance of limiting the transmission of COVID-19 from any of the procedures, or from patients to staff and vice versa, to restrict fomite transmission, the need for alteration of



workflow and the patient management was felt by clinicians. Tele-screening and virtual assistance-based approaches were given preference for a dental consultation for most of the patients and dental set visits were reserved only for the patient with an emergency, which requires immediate intervention. Dental health care providers should have a responsibility and a sense of moral duty and dental practices, including trauma emergencies. This mini-review addresses novel coronavirus pandemic, transmission, risk assessment and patient management at oral health care set up during the pandemic and post-pandemic phase.

**Keywords:** COVID-19, dental practices, dentistry, oral health care, patient management.

### Introduction :

In the month of December 2019, the world saw an outbreak of coronavirus disease 2019 (COVID-19) in the area of Wuhan, Public Republic of China.<sup>1</sup> In a very short span of time, it has spread to other parts of China and world and rapidly evolved into a public health crisis.<sup>2-4</sup> The World Health Organization (WHO), on January 30, 2020, announced the COVID-19 outbreak as a public health emergency of international concern.<sup>5</sup> Due to its rapid spread to different geographical areas, on March 11, 2020, WHO declared this condition as a pandemic.<sup>6</sup> As of July 11, 2020, more than 1.25 crore world's population got infected in 188 countries or regions with COVID-19 leading to the death of close to 6 lakhs; in India, more than 8 lakhs people got infected with close to twenty-two thousand death (Fig 1.).<sup>7</sup> This pandemic has resulted in a major health, financial and

humanitarian crises, for which the world was not ready, leading to chaos. The pattern of spread for this disease is through fomite and aerosol, and studies have proven that SARS-CoV-2 virus can remain viable and infectious in aerosols for hours and on surfaces up to 3 days.<sup>8,9</sup>

During COVID-19 pandemic, medical and dental facilities in many countries are providing only emergency services. Most of the dental setups have suspended elective dental procedures on order from the respective federal government or health regulatory authorities. Many of the dental professional bodies have requested their members to limit the practice and come up with specialty wise guidelines for the safe and effective dental practice.<sup>10-13</sup> The present article put the emphasis on the effective and efficient management of patients with oral health care needs during



the COVID-19 pandemic and post-pandemic phases.

## Etiology and Pathogenesis

### Etiology

The COVID-19 infection was first identified and reported in a cluster of cases, caused by a newly identified  $\beta$ -coronavirus also, named SARS-CoV-2 which is a non-segmented positive-sense RNA virus encapsulated by a lipid bilayer envelope ranging from 60 nm to 140 nm in diameter with spike-like glycoprotein projections on its surface giving it a crown-like appearance under the electron microscope; hence the name coronavirus.<sup>14</sup>

Coronaviruses are naturally hosted and evolutionarily shaped by bats. Thus, it has been postulated that most of the coronaviruses in humans are derived from the bat reservoir. The whole-genome sequence identity of the novel virus has 96.2% similarity to a bat SARS-related coronavirus (SARS-CoV; RaTG13) collected in Yunnan province, China, but is not very similar to the genomes of SARS-CoV (about 79%) or MERS-CoV (about 50%).<sup>15,16</sup>



A snapshot of the COVID-19 map of the global cases by Centre for System Science and Engineering at Johns Hopkins University showing real-time status. URL

<https://coronavirus.jhu.edu/map.html>.

Accessed on July 11, 2020.

### Routes of transmission

On the basis of epidemiologic and genetic studies, researchers have pointed out the zoonotic origin of the COVID-19, outbreak of which has started through animal to human transmission, followed by the human to human transmission.<sup>17,18</sup> The human to human transmission of the SARS-CoV-2 virus has been observed in the health care, family, and the community set up. Aerosol transmission of COVID-19 is considered to be the main mode of transmission and is suspected of playing a key role in the high transmissibility of COVID-19.<sup>19,20</sup> Studies have shown that



aerosol and fomite transmission of SARS-CoV-2 is plausible since the virus can remain viable and infectious in aerosols for hours and on surfaces up to 4 days.<sup>8,9</sup> The predominant mode of transmission is from the respiratory tract via droplets or indirectly through the fomites and, to a lesser extent, via aerosols. Seeding of the virus to mucous membranes of the nose, oral cavity, and eyes are possible through the contaminated finger or objects when they are touched with the same. In a recent study under experimental conditions, the human coronavirus remains infectious on inanimate surfaces at room temperature for up to nine days, the duration of persistence decreases with temperature. The SARS-CoV-2 can specifically survive for a longer duration of 72 hours on surfaces of stainless steel and plastic in comparison to 4 hours on copper, and up to 24 hours on cardboard.<sup>8,9</sup> The SARS-CoV-2 was detected up to three hours in aerosolized form or in the dust, which is one of the main concerns in clinical dentistry.<sup>8,9</sup>

The incubation period of SARS-CoV-2 reportedly ranges from 1 to 14 days, with an average of 3–7 days.<sup>21,22</sup> The time from the exposure to infectiousness (latent period) is shorter than the incubation period, as COVID-19 can transfer through asymptomatic or mildly symptomatic carriers. Generally, patients are

considered to be in convalescence when they present with the: (1) a normal temperature for more than 3 days, (2) resolved respiratory symptoms, and (3) two negative oropharyngeal swab reverse transcription-polymerase chain reaction (RT-PCR) viral ribonucleic acid (RNA) tests that are taken at least 24 hours apart. However, SARS-CoV-2 detection can also occur after this, as seen from RT-PCR test results 5–13 days later, and positive fecal viral RNA tests in a small percentage of patients during convalescence.<sup>23</sup>

### Symptoms & Clinical manifestation

Patients with COVID-19 usually present with clinical symptoms of fever, dry cough, and myalgia. In addition, less obvious symptoms such as nausea, diarrhea, reduced sense of smell (hyposmia), and abnormal taste sensation (dysgeusia) have also been reported. The clinical manifestations of COVID-19 are very broad and can be classified as mild, moderate to severe forms.<sup>24</sup> The COVID-19 infection in the milder form usually is asymptomatic or present with very mild symptoms and no sign of any respiratory distress clinically or radiological changes in the chest X-ray film. The moderate form is associated with increased body temperature ( $>37.4^{\circ}\text{C}$ ), dry cough, shortness of breath, non-specific gastrointestinal symptoms such as



diarrhea, respiratory symptoms and sign of pneumonia on chest x-ray. In severe to a very severe form, which usually occurs seven to ten days after the infection, difficulty in breathing and hypoxia are usually observed in patients with rapid progression to acute respiratory distress syndrome, septic shock, and multiple organ failure. Studies have suggested that 80% of the patients usually get a mild presentation of the symptoms followed by 15% of moderate symptoms, and the remaining 5% presents with severe to very severe clinical manifestations.<sup>24</sup> Laboratory evaluation suggests that most patients have normal to decrease white blood cell counts and lymphocytopenia.<sup>25</sup> In patients with severe complications, there is derangement of the neutrophil count, blood urea and creatinine levels along with a continuous decrease in the lymphocytes count.

All age groups have shown the various degree of sensitivity to the COVID-19 infection. However, it has been observed that the elderly population with associated medical risk factors are more prone to developing a severe risk illness once infected. Studies have been shown that younger individuals possess a better prognosis than individuals with age groups above 60 with or without associated risk factors.<sup>26-28</sup> A recent study in China has shown that young children, particularly

infants, are more sensitive to the COVID-19 infection. The clinical manifestations of COVID-19 infected children were usually mild than those of the adult patients, young children, particularly infants, were vulnerable to infection.<sup>27</sup>

### Patient screening

#### *Tele screening and triaging*

Initial telephone triage or telescreens procedure prior to the dental appointments for assessment of risk, the vulnerability of patients, and the potential threat they may pose to members of the professional team, other patients and the accompanying attendant is performed by trained staff. The three most pertinent questions for initial screening should include the presence of any symptoms of febrile respiratory illness such as fever or cough, any recent travel history to an area with a high incidence of COVID-19, or any exposure to a person with known or suspected COVID-19 presentation (Fig 2a and b).

The COVID-19 Patient Triage Plan can be considered for all the patients, and they are asked to provide the information as mentioned in the patient triage form. A positive response to either of the three questions should raise initial concern, and elective dental care should be deferred for at least 2 weeks. These patients should be encouraged to engage in self-quarantine



and contact their primary care physician by telephone or email.

Patient's Name:		DOB:	
Residential Address:			
Contact Number:			
Do you have any respiratory symptoms?		Yes <input type="checkbox"/> No <input type="checkbox"/>	
List symptoms:			
Have you traveled outside the country or state in the last 4 weeks?		Yes <input type="checkbox"/> No <input type="checkbox"/>	
If yes, which country or state you traveled to?			
Have you been in close contact with a COVID-19 patient?		Yes <input type="checkbox"/> No <input type="checkbox"/>	
If yes, close contact: within six feet to the symptomatic COVID-19 patient information reviewed by:			
For positive responses to travel or close contact AND symptoms, contact your local or state health department. Have patients contact their healthcare provider.			

a

Patient's Name:		DOB:	
Residential Address:			
Contact Number:			
Do you have any respiratory symptoms?		Yes <input type="checkbox"/> No <input type="checkbox"/>	
If yes, ensure the patient is wearing a mask.		List symptoms:	
Have you traveled outside the country or state in the last 4 weeks?		Yes <input type="checkbox"/> No <input type="checkbox"/>	
If yes, which country or state you traveled to?			
Have you been in close contact with a COVID-19 patient?		Yes <input type="checkbox"/> No <input type="checkbox"/>	
If yes, close contact: within six feet to the symptomatic COVID-19 patient information reviewed by:			
For positive responses to travel or close contact AND symptoms, contact your local or state health department, contact your healthcare provider. The contact number of the local health department:			
The contact number of the state health department:			

b

COVID-19 Patient Triage Forms (a) Patient screening form before a dental visit, (b) Patient screening before elective or emergency procedure).

### Risk assessment

Importantly, to identify high-risk areas, live global tracking of reported cases can be done using the dashboard made accessible by the Center for Systems Science and Engineering at Johns Hopkins University (Fig. 1). Similarly, National Informatics Centre, Government of India, has come up with a COVID-19 tracking mobile app, Aarogya Setu. The main goal behind developing this app was to spread awareness of COVID-19 and to connect essential COVID-19 related health services to the people of India. Aarogya

Setu uses location information and determines whether the selected geographic location belongs to one of the infected areas based on the data available.

### Patient registration protocol

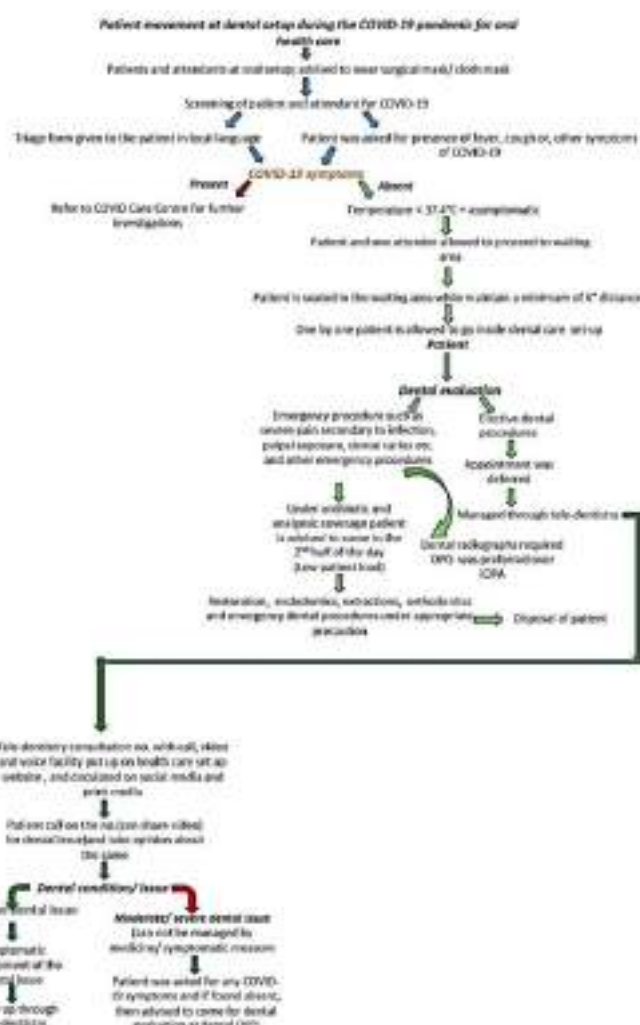
At the entrance of the registration area, trained dental staff should measure the patient's body temperature using a non-contact forehead infrared thermal sensor. Patients and their attendants should be asked to rub their hands with an alcohol-based sanitizer. Patients then are asked to fill a specially designed form containing various demographic data like name, age, sex, address, mobile number etc. A detailed, in-depth COVID-19 screening questionnaire, including medical history, social history gatherings, meetings, and travel history to assess true emergency is taken as soon as a patient report at the dental clinic. At least a 6 feet distance should be maintained between the patients during the registration. As per the Centers for Disease Control and Prevention (CDC) guidelines, individuals exposed to a person with COVID-19 or patient presenting with fever ( $100.4^{\circ}\text{F}/38^{\circ}\text{C}$  or higher), and any high-risk patient suspected as per the questionnaire, symptoms should wear a mask or use tissues to cover cough and offer separate space to wait. Following registration, patients are advised to remain



seated in the waiting area while maintaining the social distance (Fig 3.).

### Waiting area protocol

Once the registration formalities are completed, the patient and attendant should be advised to proceed towards the waiting area. Seating arrangements be made in such a way that an appropriate prescribed distance (i.e., 6 feet) is always maintained between two persons at any given point. For example, in three-seater chairs, the middle seat should be blocked by putting a cross (X) mark on that seat. Patient management in the waiting and registration area can be supervised by clinic staff. All reading materials like newspapers, magazines, and TV remote should be removed and made the least cluttered.



An outline of the patient movement at dental set up for oral health care needs.

### Patient management considerations

The dentist must be careful only to do what is necessary to resolve the emergency and to take the patient to a position of safety during the COVID-19 outbreak and remain vigilant in the post-outbreak phase before resuming any elective dental procedures (Fig 4.).

The patient may be asked to do the oral rinse for 30 seconds with 1% solution of H<sub>2</sub>O<sub>2</sub> (1 part of 10 vol 30% H<sub>2</sub>O<sub>2</sub> and 2 parts of water) or with 0.2% povidone-



iodine for at least 15 seconds before the clinical procedure to reduce the viral load in the patient's saliva as viruses are sensitive to oxidation and structural lysis by these agents.<sup>25</sup> However SARS-CoV-2 virus is not sensitive to routinely used oral chlorhexidine rinse.<sup>30</sup>

Dental practitioners should refrain from performing any procedures that lead to the generation of aerosols, such as the use of air-water syringes, high-speed handpieces, and ultrasonic scalers. This is because long-distance transmission is possible when viral particles become suspended in the air and viral particles may remain in aerosols for up to 3 hours.<sup>31</sup> The CDC has recommended that N95 masks, eye protection, a gown, and gloves should be used for any aerosol producing procedure that must be completed, as asymptomatic individuals can transmit COVID-19.<sup>32</sup> Intraoral imaging (IOPA) should be restricted and extraoral radiograph (OPG) should be utilized to reduce the excessive salivation and cough secondary to gag reflex associated with intraoral radiographs.<sup>33,34</sup> If a local anesthesia application is required, the gel form of local anesthetics should be preferred over spray type as it might generate the aerosol, this might cause the potential spread of the virus in the air.<sup>35</sup> Disposable and single-use instruments and devices should be used whenever

possible to reduce the cross-infection risks.

Adequate ventilation of the waiting area, as well as the dental operator, should be considered.<sup>11</sup> The central air conditioning unit should not be used inside the dental operator as it has a tendency to recirculate the air. The windows should be kept open and fans should be positioned in such a way it should take the air out from the dental operator area to the outside. Along with this, high volume suction should be used to minimize the formation of aerosol along with four-handed dentistry. The patient should be told from the beginning to follow cough etiquette.

### Discussion

The dental practice during and post-pandemic COVID-19 should be done following the guidelines of various health regulatory authorities, with precaution and proper case evaluation based on the practitioner's judgment to reduce cross-contamination and prevent new outbreaks. The clinician should try to work under the guidelines provided by the concerned health regulatory authorities. They might require some level of modification and redesign of dental setup to maintain efficient air circulation and ventilation with appropriate standard PPE.

The present pandemic scenario can be difficult and challenging for many



practitioners. Nevertheless, dental practitioners should maintain the balance between the level of care and the cost involved. Patients should be well informed about the changed norms of infection control measures and the cost factors.

Clinic disinfection protocols during pre-treatment, during treatment, and post-treatment should be strictly adhered to. The dental health care provider, office staff, and patient well being should be given maximum priority. The proposed workflow and guidelines collected from various health regulatory authorities in the review will provide appropriate and effective management of dental care during the ongoing and post COVID-19.



An outline of the patient screening for COVID-19 and oral health care management.

### Conclusions:

Dental health care professionals must maintain high standards of care with the emerging SARS-CoV-2 threat and educate the public to prevent panic. Its high time to redesign the clinical practice into a new normal of need-based dentistry with the

sole purpose of containing the risk of cross-contamination of the SARS-CoV-2 virus to dental staff and patients. With time and patience, the face of current uncertainty and panic among the peers will gradually diminish. Till then, patient management must adapt to change to maintain the balance between service and social needs.

### Disclaimer:

Guidelines for COVID-19 are frequently changing, which is secondary to the outcome of various studies going on in this aspect. Readers are advised to be thorough with the guidelines related to various aspects of patient management, dental setup infection control, waste disposal etc. from dental professional bodies and Federal Government.

### References:

1. [Sohrabi C](#), [Alsafi Z](#), [O'Neill N](#), [Khan M](#), [Kerwan A](#), [Al-Jabir A](#), et al., (2020) Outbreak of pneumonia of unknown etiology in Wuhan, China: The mystery and the miracle. J Med Virol 92, 410-402.
2. Hartley DM, Perencevich EN (2020) Public Health Interventions for COVID-19: Emerging Evidence and Implications for an Evolving Public



- Health Crisis. JAMA 323:1908–1909.
3. [Heymann](#) DL, [Shindo](#) N (2020) WHO Scientific and Technical Advisory Group for Infectious Hazards. COVID-19: what is next for public health? Lancet 395:542–545.
  4. Nacoti M, Ciocca A, Giupponi A, Brambilla P, Lussana F, Pisano M, et al., (2020) At the epicenter of the Covid-19 pandemic and humanitarian crises in Italy: changing perspectives on preparation and mitigation. NEJM Catalyst Inno. Care Del. doi:10.1056/CAT.20.0080.
  5. Mahase E (2020) China coronavirus: WHO declares international emergency as death toll exceeds 200. BMJ. doi:10.1136/bmj.m408.
  6. WHO, 2020. COVID-19 as a pandemic. URL <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen>. Accessed on July 11, 2020.
  7. Corona Resource Centre- Johns Hopkins University and Medicine, 2020. URL <https://coronavirus.jhu.edu/map.html>. Accessed on July 11, 2020.
  8. [Asadi](#) S, [Bouvier](#) N, [Wexler](#) AN, [Ristenpart](#) WD (2020) The coronavirus pandemic and aerosols: Does COVID-19 transmit via expiratory particles? [Aerosol Sci Technol](#). 54:635–638.
  9. van Doremalen N, Bushmaker T, Morris D, Holbrook M, Gamble A, Williamson B, et al., (2020) Aerosol and surface stability of hCoV-19 (sars-cov-2) compared to sars-cov-1. N Engl J Med. doi:10.1056/NEJMc2004973.
  10. American Dental Association (ADA) (2020) Interim guidance on minimizing COVID-19 transmission risk when treating dental emergencies. URL <https://www.ada.org/en/publication/s/ada-news/2020-archive/april/ada-releases-interim-guidance-on-minimizing-covid-19-transmission-risk-when-treating-emergencies>. Accessed on May 2, 2020.
  11. Ministry of Health and Family Welfare- Government of India (2020) Guidelines for Dental Professionals in Covid-19 pandemic situation. URL <https://www.mohfw.gov.in/pdf/DentalAdvisoryF.pdf#:~:text=In%20the%20current%20COVID%2019,be%20treated%20with%20due%20precautions>. Accessed on May 19, 2020.



12. Krithikadttta J, Nawal RR, Amalavathy K, McLean W, Gopikrishan V (2020) Endodontic and dental practice during COVID-19 pandemic: Position statement from the Indian Endodontic Society, Indian Dental Association, and International Federation of Endodontic Associations. *Endodontol.* 32,55-66.
13. American Association of Orthodontists (AAO) (2020) COVID-19 resources for orthodontists. URL <https://www1.aaoinfo.org/covid-19/>. Accessed on May 15 & June 25, 2020.
14. Boopathi S, Poma AB, Kolandaivel P (2020) Novel 2019 coronavirus structure, mechanism of action, antiviral drug promises, and rule out against its treatment. *J Biomol Struct Dyn.* doi: [10.1080/07391102.2020.1758788](https://doi.org/10.1080/07391102.2020.1758788).
15. Suri S, Vandersluis YR, Kochhar AS, Bhasin R, Abdallah MN (2020) Clinical orthodontic management during the COVID-19 pandemic. *Angle Orthod.* doi: [10.2319/033120-236.1](https://doi.org/10.2319/033120-236.1).
16. Zhu N, Zhang D, Wang W, et al., (2020) A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med.* 382:727–733.
17. Paraskevis D, Kostaki EG, Magiorkinis G, Panayiotakopoulos G, Sourvinos G, Tsiodras S. (2020) Full-genome evolutionary analysis of the novel coronavirus (2019-nCoV) rejects the hypothesis of emergence as a result of a recent recombination event. *Infect Genet Evol.* 79:104212. doi: [10.1016/j.meegid.2020.104212](https://doi.org/10.1016/j.meegid.2020.104212).
18. Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, et al., (2020) Genomic characterization and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *Lancet.* doi: [10.1016/S0140-6736\(20\)30251-8](https://doi.org/10.1016/S0140-6736(20)30251-8).
19. Wrapp D, Wang N, Corbett KS, Goldsmith JA, Hsieh C-L, Abiona O, et al., (2020) Cryo-EM structure of the 2019-nCoV spike in the prefusion conformation. *bioRxiv.* doi: [10.1101/2020.02.11.944462](https://doi.org/10.1101/2020.02.11.944462)
20. Peng X, Xu X, Li Y, Cheng I, Zhou X, Ren B (2020) Transmission routes of 2019-nCoV and controls in dental practice. *Int J Oral Sci.* 12,1-6.
21. Wu JT, Leung K, Leung GM (2020) Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a



- modelling study. *Lancet* 395, 689–697.
22. Ryu S, Chun BC, Korean Society of Epidemiology 2019-nCoV Task Force Team (2020) An interim review of the epidemiological characteristics of 2019 novel coronavirus. *Epidemiol Health*. doi:10.4178/epih.e2020006e2020006.
23. Lan L, Xu D, Ye G, et al., (2020) Positive RT-PCR test results in patients recovered from COVID-19. *JAMA*. doi: 10.1001/jama.2020.2783.
24. Wu Z, McGoogan JM (2020) Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese Center for Disease Control and Prevention. *JAMA* 323, 1239–1242.
25. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al., (2020) Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med*. doi:10.1056/NEJMoa2002032.
26. Verity R, Okell LC, Dorigatti I, Winskill P, Whittaker C, Imai N, et al., (2020) Estimates of the severity of COVID-19 disease. medRxiv. doi:10.1101/2020.03.09.20033357.
27. Dong Y, Mo X, Hu Y, Qi X, Jiang F, Jiang, Tong (2020) Epidemiology of COVID-19 among children in China. *Pediatrics*. doi:10.1542/peds.2020-0702.
28. Onder G, Rezza G, Brusaferro S (2020) Case-fatality rate and characteristics of patients dying in relation to COVID-19 in Italy. *JAMA* doi: 10.1001/jama.2020.4683.
29. Giudice RL (2020) The severe acute respiratory syndrome Coronavirus-2 (SARS CoV-2) in dentistry. Management of biological risk in dental practice. *Int. J. Environ. Res. Public Health*. doi: [10.3390/ijerph17093067](https://doi.org/10.3390/ijerph17093067).
30. Meng L, Hua F, Bian Z (2020) Coronavirus disease 2019 (COVID-19): emerging and future challenges for dental and oral medicine. *J Dent Res*. doi: [10.1177/0022034520914246](https://doi.org/10.1177/0022034520914246).
31. World Health Organization (2014) Infection Prevention and Control of Epidemic- and Pandemic-Prone Acute Respiratory Infections in Health Care. Annex G, Use of disinfectants: alcohol and bleach. URL <https://www.ncbi.nlm.nih.gov/books>



/NBK214356/. Accessed on June 10, 2020.

32. American Dental Association. Coronavirus Frequently Asked Questions. 2020. Available at: <https://success.ada.org/en/practice-management/patientcoronavirusfrequently-asked-questions>. Accessed on May 15, 2020.
33. Dong Y, Mo X, Hu Y, et al., (2020) Epidemiological characteristics of 2143 pediatric patients with 2019 coronavirus disease in China. Pediatrics. doi: 10.1542/peds.2020-0702.
34. Liu Y, Ning Z, Chen Y, Guo M, Liu Y, Gali NK, et al., (2020) Aerodynamic Characteristics and RNA Concentration of SARS-CoV-2 Aerosol in Wuhan Hospitals during COVID-19 Outbreak. bioRxiv. doi: 10.1101/2020.03.08.982637.
35. Tao KX, Zhang BX, Zhang P, Zhu P, Wang GB, Chen XP (2020) General surgery branch of Hubei Medical Association, general surgery branch of Wuhan Medical Association recommendations for general surgery clinical practice in 2019 coronavirus disease situation. Zhonghua Wai Ke Za Zhi 58, 170–177.



### Smile Makeover- Current Trends

<sup>1</sup>**Dr. Ajay Singh, MDS**, Professor and Director, Department of Prosthodontics  
Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow.

<sup>2</sup>**Dr. Abhishek Singh**, PG Student, Department of Prosthodontics, Sardar Patel Post Graduate  
Institute of Dental and Medical Sciences, Lucknow.

<sup>3</sup>**Dr. Ansuman Jyoti Das**, PG student, Department of Prosthodontics  
Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow.

Corresponding Author- **Dr Ajay Singh**  
Add- Krishna Nagar, Lucknow , Uttar Pradesh  
Email id- [ajaysingh07@gmail.com](mailto:ajaysingh07@gmail.com)  
Mob- 9839539288

### ABSTRACT

A systematic approach is required to evaluate, diagnose and solve esthetic problems predictably. Diagnosis and treatment planning should be done thoroughly before proceeding for the treatment. It is of prime importance that the final result is not dependent only on the looks alone. As a clinician our goal is to achieve pleasing composition in the smile by creating an arrangement of various esthetic elements. This article reviews the various principles and methods that govern the art of smile designing. This article will provide a basic knowledge to the reader to bring out a functional stable smile and the basic components of smile and their effect on smile.

Keywords: Elements of smile designing; esthetic smile; smile designing; esthetic proportions.

### **Introduction:**

Smile is the ability of person to express a range of emotions with the structure and movement of the teeth and lips. It can often determine how well a person can function in society<sup>1</sup>.

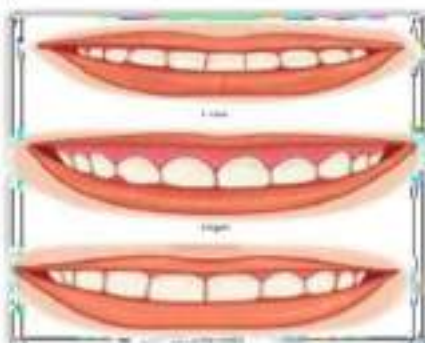
Esthetic dentistry is characterized primarily by the smile. The goal in the creation of esthetic dental restorations is to stimulate, or improve upon, the appearance of the natural dentition. The successful esthetic restorations must integrate harmoniously with the whole of the face, not just with the surrounding teeth.



Smile designing is not only related to restorative dentistry, in fact it is an interdisciplinary approach involving restorative, orthodontic, prosthodontic and periodontal approaches.

Smile designing- Is a process whereby the complete oral hard and soft tissues are studied and evaluated and certain changes are brought about which will have a positive influence on the overall esthetics of the face. These changes are governed by the principles of esthetic dentistry.

### Classification of Smile: (Solomon)2-



Types of Smile

Depending on the nature of labial mucous membrane  
papilla smile  
Gingival smile  
Mucosa smile

### Dependant on the lip component

Straight smile  
Convex smile  
Concave smile

### Esthetic Diagnosis & Treatment Planning:

A meticulous esthetic diagnosis followed by a well-defined treatment plan is the foundation of successful esthetic dental treatment.

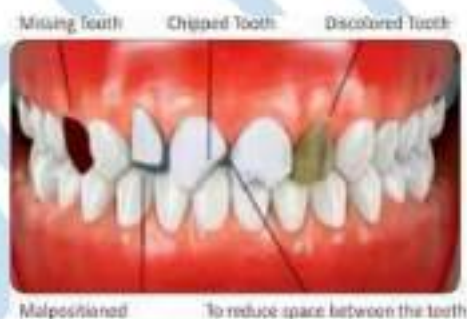
1. Patient history
2. Clinical examination-

A clinical examination involves a thorough evaluation of-

Facial components  
Occlusion relationships  
Periodontal attachment  
Teeth  
TMJ

### Total Smile Analysis:

Total smile analysis is a cumulative analysis, drawn by interpreting and integrating various analysis like a visual, space profile and computer analysis after performing the preliminary analysis.



Smile analysis on different aspects

### Space Analysis:

It helps to gauge the amount of space available during the treatment planning stage (measure the widths of all teeth and to compare it with the space present in the arch). Disproportionate space may be due to discrepancies in jaw and tooth size, malformed teeth, missing teeth, mal-aligned teeth.



Congenitally present space due to peg laterals



### Components of An Esthetic Smile-

Facial component  
Hard tissues  
Soft tissues  
Dental components  
Teeth  
Gingiva

### Facial Composition-

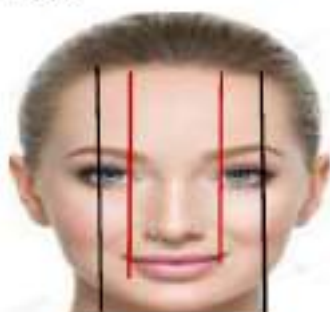
Facial beauty involve proper-  
**alignment**  
**symmetry**  
**proportion of the face**

There are two facial features which do play a major role in the smile design- The interpupillary line and the lips<sup>4</sup>. Lips are important since they create the boundaries of smile design. The interpupillary line should be parallel to the occlusal plane and perpendicular to the midline of the face.



Facial midline, interpupillary line and the lip line

### Horizontal Dimensions For An Ideal Face



Horizontal dimensions

The width of the face should be the width of five "eyes".

The width of the nose should be equal to the intercanthal distance

The width of the mouth should equal to the distance between two pupils

### Vertical Dimensions For An Ideal Face



The full face is divided into three equal parts

Upper part from hair line to the glabella (or eyebrow)

Middle part from glabella to the base of the nose

The lower part from the base of the nose to the chin which is subdivided into two parts, the upper lip forms one-third of it and the lower lip and the chin two-thirds of it.

### Vital Elements Of Smile Design- Dental Components<sup>1</sup>-

**Tooth components-** Dental midline, Incisal lengths, Tooth dimensions, Zenith point, Axial inclinations, Interdental contact, Embrasures, SPA, Symmetry and balance.

**Soft tissue components-** Gingival health, Gingival levels and harmony, Interdental embrasure, Smile line.

### Midline-

Dental midline should be collinear with facial midline Vertical contact interface between the 2 central incisors. Midline



should be perpendicular to the interpupillary line and parallel to facial midline. As long as the midline is parallel with the long axis of the face midline discrepancies up to 4mm is not considered unaesthetic but canted midlines aren't considered esthetic<sup>5,6</sup>.



Image of smile where the facial and dental midline do not line up.

#### Incisal Lengths (Incisal Edge Positions)-

It is the most important determinant in smile creation because it serves as a reference point to decide the proper tooth proportion and gingival levels.

Degree of tooth display:

2 mm of incisor edge show at rest



about 2 mm of gingival show When smiling



#### Phonetic References:

Phonetics play a part in determining maxillary central incisor design and position<sup>7,8</sup>.

'F' and 'V' sounds are used to determine the tilt of the incisal third of the maxillary central incisors and their length



'F' and 'V' sounds

'E'- incisal edge should be halfway between upper and lower lip.

The 'M' sound is used to achieve relaxed rest position and repeated at slow intervals can help evaluate the incisal display at rest position



'E'> incisal edge should be halfway between upper and lower lip.

'S' or 'Z' sounds determine the vertical dimension of speech. Its pronunciation makes the maxillary and the mandibular ant. teeth come in near contact and determine the ant. speaking space



'M' sound



### Tooth Dimensions-

Correct dental proportion is related to facial morphology and is essential in creating an esthetically pleasing smile.

**CENTRAL DOMINANCE-** dictates that the centrals must be the dominant teeth in the arch and they must display pleasing proportions. The proportions of width and length of the central incisor must be esthetically and mathematically correct (4:5)



S' or 'Z' sounds

The shape and appearance of the centrals influences the placement of laterals and canines.

### Guidelines For Correct Proportions-

Golden proportion

Recurring esthetic dental proportion (ward)

M proportions (methot)

Chu's esthetic gauges

### Golden Proportion-

It is expressed in numerical form and applied by classical mathematicians such as Euclid and Pythagoras in pursuit of universal divine harmony and balance. It has been applied to a lot of ancient Greek and Egyptian architecture and may be expressed as the ratio 1.618:



width to length ratio —4:5

1 If the ratio is applied to the smile made up of the central, lateral incisor and the mesial half of the canine, it shows that the central incisor is 62% wider than the lateral incisor which in turn is 62% wider than the visible portion of the canine which is the mesial half, when viewed from the front.

### Chu's Esthetic Gauges-

Dr. Chu's research supports Levin's RED concept and refutes the golden proportion. A series of gauges are available to make intraoral

analysis easier. The gauges allow for-fast, simple analysis and diagnosis of tooth width problems, tooth length problems and gingival length discrepancies.

colour coding predefines desired tooth proportions, quicker and easier to read than any other instrument.

### Individual Tooth Dimensions-

Centrals wider than laterals by 2-3mm  
canines by 1-1.5MM

Canine wider than lateral by 1- 1.5mm

Canine and central are longer than lateral by 1-1.5mm

### Buccal Corridor-

In an esthetic smile there is a negative space, which is a small space between the maxillary posterior teeth and the inside of the cheek<sup>12</sup>. In esthetic smile the percentage visibility decreases as we go more posteriorly.



Measurement of width ratio



Buccal corridor



If there is any malocclusion or discrepancy in arch form leads to loss of esthetics.



Gives depth & mystery to the smile

### Interdental Contact Areas & Points-

The contact points of the maxillary teeth are relevant for ensuring optimal 'pink aesthetics' for patients with a high smile line (or visible cervical margins).



- Occlusal disturbance or inadequate restorative dentistry

The '5 mm rule', states that when the distance from the contact point to the interproximal osseous crest is 5 mm or less, there is complete fill of the gingival embrasures with an interdental papilla. For every 1 mm above 5 mm, the chance of complete fill is progressively reduced by 50%.

### Gingival Zenith Or Height Of Contour-

The apex of the gingival height of contour on the anterior teeth is called zenith point<sup>13</sup>.



Interdental Contacts

Central: distal third  
Lateral: central  
Cuspid: distal third  
Bicusps: central

### Incisal Embrasures-

In an esthetic smile, the edges of the maxillary anterior teeth follow a convex or gull-wing course matching the curvature of the lower lip<sup>14,15</sup>.



zenith point

Reduced incisal embrasures and leveling of the gull-wing effect as in a straight smile line is associated with aging.

### Sex, Age And Personality<sup>16</sup>-

#### Sex-

Maxillary incisors

In females – round, smooth and delicate

In males – cuboidal and vigorous

#### Age-

Youthful teeth- unworn incisal edge, defined embrasures, high value

Aged teeth- shorter minimal embrasure and low value

#### Personality

Maxillary canine

If long fang like- Aggressive, hostile

If blunt, rounded short cusp- passive and soft

### Soft Tissue Component Of Smile-

The lips frame the teeth and gingiva. The gingiva frames the teeth. The ratio of tooth structure to the amount of gingival and labial tissue should be harmonized to prevent an over-dominance of any one element.



**Gingival Line-**

GAL- gingival aesthetic line – the ideal gingival line from the cuspid to the central incisors intersects the dental midline at an angle  $>45^\circ$  but  $<90^\circ$ .



Edges of maxillary anteriors following curvature of lip line

The key esthetic issue is that the gingival line for the anterior teeth should be relatively horizontal to the horizon and relatively symmetric on both sides of the midline. In an esthetic smile, the volume of the gingiva from the apical aspect of the free gingival margin to the tip of the papilla is about 40% to 50% of the length of the maxillary anterior tooth and fully fills the gingival embrasure.



Gingival line



Ideal gingival scallop, with the papilla length relative to tooth length.

**Periodontal Biotype And Bioform**

The human tissue biotype is classified as thin, normal or thick. The thin periodontal biotypes are friable, escalating the risk of recession following crown preparation and periodontal or implant surgery. This is particularly significant for full coverage crowns

**Esthetic Treatment Planning And Sequencing<sup>17</sup>-**

Integral part of treatment planning

Treatment procedure which will be programmed or charted

**Final Case Presentation-**  
three basic methods

Mock up - with soft tooth coloured wax or composite resin- Direct composite resin placement along with the use of intraoral markers (provide a visual three dimensional means for the patient to see the final result prior to committing to treatment).

Diagnostic wax-up or study casts- This wax up can be evaluated by the patient directly on the diagnostic casts of the articulator and also intraorally with the use of acrylic overlays and acetate matrices.



Gingival line on the same patient on lateral and central apical position



Diagnostic cast



Computer imaging- Digital imaging takes advantage of contemporary technology. In a particular case, esthetic enhancement with a change of arrangement, form, shape and color can be demonstrated quickly.

### Smile Line-

It refers to an imaginary line along the incisal edges of the maxillary anterior teeth which should mimic the curvature of the superior border of the lower lip while smiling.



Diagnostic wax up

Another frame of reference for the smile line suggests that the centrals should appear slightly longer or, at least, not any shorter than the canines along the incisal plane<sup>18</sup>. The gum line follows the upper most point of the upper anterior teeth. Usually in a perfect smile design the gum line follows the upper lip or is just above it and ensures that just enough gums (2-3mm) are shown to be attractive.



lower lip line during smile

### Perceptual Aspects - The Art Of Illusion-

Illusion is a figment of imagination where a perception of an object is created.

### Fundamentals And Principles-

The art of creating illusion consists of changing perception, to cause an object to appear different from what it actually is. Teeth can be made to appear smaller, larger, wider, narrower, shorter longer, younger, older, masculine or feminine. Illusion works on two basic principles, which are the illusion of principles of illumination and the principle of line.



- upper lip line during smile

The most important of these is the perception that light approaches and dark recedes. This is termed as "Principle of illumination".

The second artistic prediction of great importance in dentistry is the use of horizontal and vertical lines and ridges.

Horizontal lines make the objects appear wider and vertical lines make the object appear longer. This is termed as the principle of line.

### Law Of Tooth Face-

The face of a tooth is that area on the facial form on both anterior and posterior teeth, that is bound by the transitional line angles as viewed from the facial i.e. labial or buccal aspect. These transitional line angles mark the transition from the facial surface to the mesial, distal, cervical and incisal surfaces. The tooth surface slopes lingually in the mesial and distal region while it slopes cervically from the line angles towards the root surface. Whenever there is no transitional line angle demarcating the incisal portion of the facial surface, the face is bound by the incisal edge as the occlusal tip.



The law of the face implies making dissimilar teeth appear similar by making the apparent faces equal. The apparent face should be manipulated, not the actual face. This is more importantly in the canine and the posterior as the "apparent face". The transitional line angles are relocated so that the apparent face looks equal. Similar faces produced attract light and appear highlighted while the dissimilar areas that are in a shadow appear to recede.

## Techniques Of Esthetic Recontouring-

### Achievement Of Illusions-

The purpose of planning is to determine how to achieve an illusion of straightness. This process must include different views and perceptive. An optical illusion must work most effectively in the position from which most people would be viewing the patient.

Developmental grooves play important role in creating illusion. If the grooves are placed more apart illusion of more wide teeth can be created & vice versa. If there is dark pigmentation in the periphery and light in central portion of the facial aspect of tooth an illusion of narrow teeth can be created.

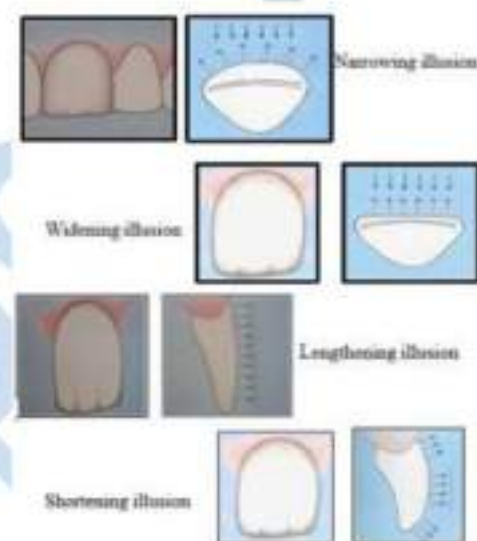
### Angle Of Correction-

A lower incisor that actually or apparently, extends above the lower incisal plane is quite noticeable. The angle of view is important specially in shaping lower teeth. Because of the angle of view, an anterior tooth which is in linguoversion appears to be much more prominent than the one in labioversion. To contour the tooth in linguoversion, its incisal edge should be beveled lingually.

### Reduction-

Reshaping of the natural dentition must always be in relationship to

the lip position in both speaking and smiling. With the use of water, it is often possible to see a slight color shift before the enamel is completely penetrated. The last few layers of enamel are more translucent so that the yellow dentin becomes more visible. Enamel removal should be stopped as soon as color shift is observed and hopefully before it. Anterior teeth in the lower arch should be shortened only to the level where they still occlude in protrusive movements.



Illusions for esthetics

### Alteration Of Tooth Form-

A canine that has drifted or been repositioned into the space of an extracted or a congenitally missing lateral incisors can sometimes congenitally be reshaped to resemble the missing tooth. Another example is to remove the part of the lingual cusp and reshaping of the labial surface of a first bicuspid so that it resembles a cuspid.



Selective reduction of Lower anteriors



### Esthetics With Ceramics-

In many dental practices, the ceramic crowns and bridges are one of the most widely used fixed restorations. This has resulted part from technologic improvements in the fabrication of restoration by dental laboratories and in part from growing amount of cosmetic demands that challenge dentists today.

Initial



Post-Treatment



Shape and position of canines changed to lateral incisors

Goals for achieving maximum esthetics with ceramics-

**Tooth preparation-** Adequate tooth preparation is required to avoid unaesthetic contours. It allows sufficient bulk of the material

**Gingival retraction-** Harmony with the adjacent periodontium, Emergence profile, high esthetic are achieved by gingival retraction.

**Impression-** Correct reproducing the finish lines and accuracy is required for better results.



Esthetic with all ceramic crown

### Veneers-

It is a layer of tooth coloured material that is applied to a tooth to restore. It is used for localized or generalized defects and intrinsic discoloration.



Tooth preparation and impression

### Types ...

Directly fabricated veneers

Indirectly fabricated veneers- This category can be subdivided to the material used-

Composite

Porcelain

Two types of esthetic veneers exist-

Partial veneer

Full veneers



Veneer

### Conclusion:

Smile correction is the requirement of modern era due high esthetic demand. With increasing awareness, number of patients for smile designing is increasing. Diagnosis and treatment planning is very much required before proceeding for the treatment. Treatment planning should depend on patient's requirement and condition of dentition and surrounding structures.

### References:

- Bhuvaneshwaran M. Principles of smile design. J Conserv Dent. 2010;13(4):225-232. doi:10.4103/0972-0707.73387.  
Khan R, Samant PS, Razdan A, Chauhan R Journal of Current Research, 2010, (05), 68989-68991



- Goldstein RE. Change your smile. Chicago, US : Quintessence Publication; 1997.
- Davis NC. Smile Design. Dent Clin N Am 2007;51:299-318.
- Fradeani M. Evaluation of dentolabial parameters as part of a comprehensive esthetic analysis. Eur J Esthet Dent 2006;1:62-9.
- Kokich VG, Spear FM, Kokich VO. Maximizing anterior esthetics: An interdisciplinary approach. In: McNamara JA, editor. Carionafacial Growth Series, Centre for Growth and Development. Ann Arbor: University of Michigan; 2001.
- Pound E. Personalized denture procedures. Dentist Manual. Denar Corp. 1973.
- Bloom DR, Padayachy JN. Increasing occusal vertical dimension – Why, When, How. Br Dent J 2006;200:251-6.
- Levin EI. Dental esthetics and Golden proportion. J Prosthet Dent 1978;40:244-52.
- Ricketts RM. The biological significance of the divine proportion and Fibonacci Series. Am J Ortho 1982;81:35.
- Moore T, Southard KA, Casko JS, Qian F, Southard TE. Buccal corridor and Smile esthetics. Am J Orthod Dentofacial Orthop 2005;127:208-13.
- Rufenacht C. Fundamentals of Esthetics. Chicago, US : Quintessence publications Co.; 1990.
- Al-Hababbeh R, Al-Shammout R, Al-Jabrah O, Al-Omari F. The effect of tooth and gender on tooth display in the anterior region during rest and smiling: Eur J Esthet Dent 2009;4:382-95.
- Tarnow DP, Wagner AW, Fletcher P. The effect of the distance from the contact point to the crest of the bone on the presence or absence of the interproximal papilla. J Periodontol 1992;63:995-6.
- Kois JC, Vakay RT. Relationships of the periodontium to impression procedures. Compend Contin Educ Dent 2000;21:684-6, 688, 690.
- Rufenacht CR. Principles of Esthetic Integration. Chicago, US: Quintessence Publishing Co.; 2000.
- Garcia PP, da Costa RG, Calgaro M, Ritter AV, Correr GM, da Cunha LF, Gonzaga CC. Digital smile design and mock-up technique for esthetic treatment planning with porcelain laminate veneers. J Conserv Dent 2018;21:455-8.
- Chiche GJ, Pinault A. Esthetics of Anterior Fixed Prosthodontics. Chicago, US : Quintessence Publications Co.; 1994.



## Review Article

**The Covid Era And Aerosols In Restorative Dentistry**

Mamatha Kumaraswamy,<sup>1</sup> Sheela N.V.,<sup>2</sup> H Murali Rao <sup>3</sup>, B.S. Keshava Prasad<sup>4</sup>

<sup>1</sup>Postgraduate Student, Department of Conservative Dentistry and Endodontics, D.A.P.M.R.V. Dental College and Hospital, Bengaluru, Karnataka, India.

<sup>2</sup>Reader, Department of Conservative Dentistry and Endodontics, D.A.P.M.R.V. Dental College and Hospital, Bengaluru, Karnataka, India.

<sup>3</sup>Professor, Department of Conservative Dentistry and Endodontics, D.A.P.M.R.V. Dental College and Hospital, Bengaluru, Karnataka, India.

<sup>4</sup>Professor and Head, Department of Conservative Dentistry and Endodontics, D.A.P.M.R.V. Dental College and Hospital, Bengaluru, Karnataka, India.

Corresponding Author- : Dr. H Murali Rao,  
Professor, Department of Conservative Dentistry and Endodontics, D.A.P.M.R.V. Dental College and Hospital, CA-37, 24th Main, JP Nagar, ITI Layout, 1st Phase, Bengaluru, Karnataka- 560078, India.  
E-mail: drmuralihrao@yahoo.com,

**ABSTRACT**

Occupational hazards for dentists are the respiratory diseases caused by aerosol-generating dental procedures. This review describes the probable role of aerosols in restorative dentistry in transmitting the novel coronavirus disease and suggests a workflow based on triage categories. Four categories are suggested based on the severity of symptoms or on whether the treatment provided would be emergency or elective. Based on the categories, a workflow is designed to minimise the exposure to these droplets. Studies have shown that triaging helps to significantly reduce the risk of cross-infection, hence, standard operating procedures for disinfection and sterilization must be revised in the future.

**Introduction:**

Coronaviruses are zoonotic RNA viruses that cause diseases in both animals and

humans (1). Severe acute respiratory disease (SARS) is a severe pneumonia disease caused in humans by the SARS-Coronavirus (SARS-CoV). It was first



reported in November 2002 in China and had spread to 27 countries by 2003. Middle East Respiratory Syndrome (MERS) is another disease caused by Coronaviruses and the outbreak had occurred in 2012, in Saudi Arabia.

The ongoing pandemic is the Coronavirus disease (COVID-19) and is caused by SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2). The transmission of the disease is not yet certain but it is well-known that there are intermediate animal hosts and that human-to-human transmission occurs by droplets or aerosols (2). Also, SARS-CoV-2 disease is more infectious than the disease caused by SARS-CoV. This review aims to describe the role of aerosols in tooth preparations in restorative dentistry and techniques and alternate procedures to reduce the production of aerosols in a dental care setting.

### **Implications in restorative dentistry and endodontics**

Dental professionals have always been at a risk of cross-contamination due to the type of work involved (3). The combination of saliva and high-speed equipment with water-coolant generates a large amount of spray comprising of droplets of various sizes (4). SARS-CoV-2 is found mainly in nasopharyngeal secretions and saliva (5) and thus, the disease has a massive

potential to be transmitted to dental care providers through the spray production by instrumentation. Larger droplets settle quickly on various objects and can aerosolize due to movement of people and these new, smaller aerosols in turn remain suspended in the environment. Moreover, the virus's viability differs from surface to surface, the maximum persistence on a surface being 9 days. On plastic surfaces, the viability is 3 days, and on stainless steel surfaces, the viability is 2 days (3). Thus, considering the current scenario, the dental care provider should be the main decision-maker in performing risk-assessment (6) for treatments mandating immediate attention.

### **Methodology**

MEDLINE (PubMed) and Google Scholar were scoured for clinical trials, randomized controlled trials, narrative reviews and systematic reviews, short communications, commentaries, and correspondences that are relevant to the objectives of this study.

### **Results and Discussion**

#### **1. Aerosol-producing procedures**

Aerosols have been defined by Micik et al as, "particles that are suspended in the air for long periods of time and are invisible to the naked eye." These minute particles are less than 50  $\mu\text{m}$  in size and can travel with air currents (7,8). The smaller particles, in



particular, of an average size of 5  $\mu\text{m}$ , have a hazardous potential to enter through the upper respiratory tract and settle in the alveoli in the lungs (7). Thus, they can be a route for transmission of infectious airborne diseases (9). Particles of these sizes are said to settle very slowly. Particles of even smaller sizes (less than or equal to 0.1  $\mu\text{m}$ ) behave as colloids and remain suspended indefinitely due to random, Brownian movement (7). Aerosols in a dental setup would comprise mainly of microorganisms, enamel and/or dentin debris, plaque, restorative material, and fluids. When combined with bodily fluids and microorganisms they are called 'bio-aerosols (9,10).'

Literature clearly suggests splatter to also be a source of infectious disease transmission (7,8,11). Particles are more than 50  $\mu\text{m}$  in size and they settle quickly on objects as they are heavier than aerosols. Splatter can be clearly visible on nearby objects such as operatory lights, protective eyewear and other clear, plastic objects.

Aerosol-generating dental procedures are abbreviated 'AGDPs.' In descending order of the quantity of aerosols produced, these are (8):

- 1) Ultrasonic instrumentation
- 2) Air polishing
- 3) Air-water syringes or three-way syringes

- 4) Use of high-speed turbines
- 5) Lasers (4)
- 6) Use of air abrasion.

Most common diseases spread by aerosol or droplets are caused by Mycobacterium, H1N1 virus (influenza A), and Hepatitis B virus (8,12). Less common diseases are those caused by emerging coronaviruses (13) and Legionnaire's disease.

## 2. Viral load

Studies to quantify the SARS-CoV-2 viral load in aerosols and spatter in a dental setup were not available. Zou et al, in their study determining viral load in the upper respiratory tract of infected patients, have found that viral RNA is highest at the onset of symptoms (14). Viral load decreases from days 5 to 18 from the onset of the first symptom (15). It is also higher in the lungs than in the upper respiratory tract (16) possibly due to the high affinity of the novel coronavirus to ACE2 receptors present in the tracheobronchial epithelia and lungs (17).

Table 2 provides details of the viral load of SARS-CoV-2.



**Table 2. Viral load of SARS-CoV-2**

Authors	Situation/location	Viral load
Vuorinen et al (18)	At onset of symptoms	$10^8$ copies/mL
Wölfel et al (19)	Oral fluids/sputum	$7 \times 10^5$ copies/mL
Liu et al (20)	Doffing area	0.02-0.04 copies/L of air
Liu et al (20)	Toilets	0.02 copies/L of air
Chia et al (21)	Isolation rooms with air changes/circulation	1.8-3.4 copies/m <sup>3</sup>

Stadnytskyi et al have estimated that an average viral load of  $7 \times 10^6$ /mL generates 1000 virus-filled droplet nuclei during loud speaking for 1 minute, provided the particles remain airborne for more than 8 minutes (22).

### 3. Emergency procedures

Elective treatment should be stopped and preference should be given to emergency procedures (23). A protocol must be followed for a smooth work-flow. Firstly, tele-screening or tele-triaging (24) should be done to screen out patients who do not require urgent treatment and whose symptoms can be managed through pharmacological therapy. Thorough travel and medical history should be taken in the tele-triage. Patients who require a face-to-face consultation and immediate treatment for relief from symptoms should be done so on an appointment basis with timed

intervals to accommodate sterilization and disinfection of the working area. In case the patients have been a primary contact or reside in a Covid-containment zone, treatment should be deferred for 14 days (24).

**Table 3. Summary of procedures that qualify for dental care (23,25–28) (29)**

Triage Category	Symptoms/Diagnosis	Procedure/Treatment
Emergency: A	Life-threatening head and neck infections, cellulitis, obstructing airway, abscesses Trauma to facial bones Uncontrolled bleeding	Pharmacological therapy Refer to OMS*
Urgent: B	Symptomatic irreversible pulpitis/symptomatic apical periodontitis	Pharmacological therapy Endodontic therapy
	Crown fracture with pulp exposure	Vital pulp therapy or pulpectomy
	Intrusion/extrusion/lateral luxation	Repositioning and splinting of teeth
	Acute apical abscess	Incision and drainage Endodontic treatment Pharmacological therapy
Dolorescent: C	Reversible pulpitis	Forest the cause Pharmacological therapy, if required
	Deep caries lesions	Vital pulp therapy or pulpectomy
Elective: D	Aesthetic procedures	
	Routine recall visits	
	Restoration of asymptomatic teeth	
	Preventive/fluoride treatments	

### 1. Techniques to reduce the quantity of aerosols produced

It is almost impossible to completely eliminate the aerosols formed in restorative dentistry. Coronaviruses maintain virulence from 2 h to up to 9 days at room temperature and the virulence is



higher at 50% humidity than at 30% humidity (30). No assumptions should be made that a patient is covid-free as research has proven the transmissibility of asymptomatic cases (3,31). These techniques should be employed to reduce the aerosols produced during treatment:

- a. Four-handed dentistry: Ease of handling instruments, and suctioning around the operative tooth during treatment to reduce spatter and aerosol production is necessary, hence, four- or six-handed dentistry is advisable (23).
- b. Pre-procedural mouth-rinse: Usage of 0.02% chlorhexidine mouthwash only weakly inactivates the coronavirus, but the combination of chlorhexidine with ethanol was suggested by Kelly et al to help reduce viral load (33). A more efficient method to reduce salivary viral load is to use 0.23% povidone-iodine (PVPI) mouthwash or 2% hydrogen peroxide for at least 15 s prior to the procedure. It is proven to inactivate coronaviruses like SARS-CoV-1 and MERS-CoV (34). Hydrogen peroxide is a strong oxidant and may cause damage to the SARS-CoV-2 virus (35).
- c. Rubber dam: Barabari and Moharamzadeh, in their review stated that there is evidence that aerosols are reduced by 70% within 3-foot diameter of the operating field. The quantity of aerosols can be further reduced when

the tooth of interest is disinfected using 0.23% PVPI, hydrogen peroxide (35) or sodium hypochlorite (36). An in-vitro study by Cochran et al confirmed that the number of colony-forming units (CFUs) when rubber dam and high-volume suction are used concurrently is reduced up to 99% (37). Contrarily, a study by Al-Amad et al revealed that a short, 30 minute procedure can be completed without the settling of aerosols on the head even when a rubber dam is not used (38).

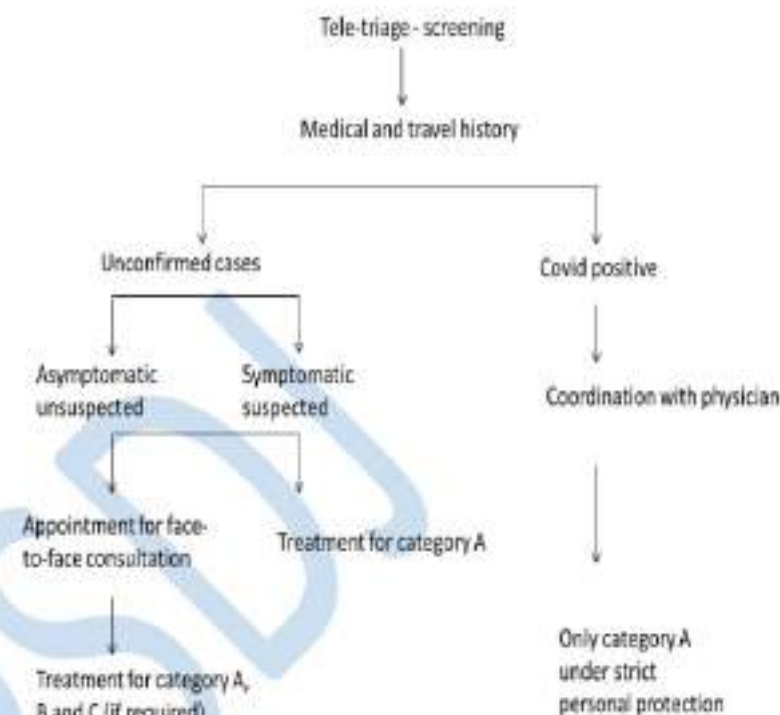
- d. Anti-retractive hand-piece (39): Ordinary hand-pieces cause backflow of saliva and other fluids into the dental unit water lines (DUWLs). They can later be ejected from the hand-piece and be a source of cross-contamination. To prevent this, anti-retractive hand-pieces with valve mechanism were specially designed (36,39). If this is not possible, high-speed arotors with reduced water or without water cooling can be used with tungsten-carbide burs (36).
- e. Single-visit endodontics: Whenever possible, endodontic treatment should be completed in a single visit. This will reduce the number of appointments and also production of aerosols limited to one appointment (36). Intraoral radiography must be avoided as this



can cause gagging or coughing in some persons (23,32).

- f. High volume evacuators: High volume evacuators or suctions used with rubber dam isolation results in 99% reduction of the bio-aerosols produced (25).
- g. Chemo-mechanical caries removal: Manual excavation or atraumatic restorative techniques (ART) should be used whenever possible (39).
- h. Adhesive restorative materials: Glass ionomer cements and bulk-fill composites must be used to reduce the clinical time required for treatment. Repair dentistry is advocated rather than replacing fractured restorations or crowns (39,40).
- i. Surface disinfection: Surfaces that are frequently touched must be disinfected with a minimum concentration of 60% ethanol or 0.1% sodium hypochlorite (39).
- j. Waste management: All contaminated disposables should be treated as infectious medical waste (39). Re-usable instruments and hand-pieces must be pre-treated, cleaned and sterilized (35).

### Flowchart 1. Suggested workflow for patient-triaging



### 1. Personal protection and air-purification (41)

Wearing a Personal Protective Equipment prior to interacting with patients is a must (42) to prevent cross-infection and droplets from settling on personnel's clothes and skin (43). The PPE donned should preferably be a disposable one (44). Oral respirators (valved or non-valved) having a high filtering capacity like the N 95, N 99, or N100 must be used. Their filter capacities are 95%, 99%, and 99.97%, respectively (3). The clinic should have the minimum number of people necessary and also be equipped with exhaust vents and adequate ventilation either by natural or mechanical means. This must be done to



avoid air re-circulation (45). Twenty-three minutes of 12 air changes per hour are required to filter the air with an efficiency of 99% (46). Air disinfection devices such as Ultraviolet Germicidal Irradiation (UVGI) have been shown to be effective against coronaviruses. Viral aerosols containing SARS-CoV-1 and MERS-CoV were inactivated with UV-C decontamination devices (45). Two most common methods to filter contaminated air are:

**High-Volume Evacuator (HVE):** They are suction devices held at approximately 6-15 cm from the operatory site and remove around 90% contamination contributed by aerosols (10). Some studies state that around 97% of these aerosols are removed by HVEs (25).

**High Efficiency Particulate Arrestor (HEPA):** This device essentially removes 99.7% of particulate matter of sizes 0.3  $\mu\text{m}$  and above (47), thus protecting the dental worker from bio-aerosols. There are two main disadvantages of HEPA filters, i.e., they are expensive, and the filters themselves can be a site for growth of retained microbes which can re-enter the filtered air (10).

### Conclusion and Future Perspectives

The pandemic has had a huge impact on dentistry and dental education. The current sterilization, hygiene, and personal protection protocols have been

questioned. A small lapse in these procedures may trigger an unpredictable chain reaction. Although we have more knowledge about the SARS-CoV-2 disease presently, it is still insufficient to prepare us for the future (48). In the past, coronaviruses have been susceptible to public-health interventions but the recent outbreak of the novel coronavirus has proven otherwise. Therefore, more resources should be mobilized to improve public health care, diagnostics, and immunology related to these viruses. This review addressed the effect of the disease on providing routine and urgent endodontic and restorative treatment. Taking these challenges into consideration, dentists should rely on their knowledge and experience in taking adequate measures to prevent cross-infection and providing high-quality treatment.

### References:

1. Leao JC, Gusmao TP de L, Zarzar AM, Leao Filho JC, Barkokebas Santos de Faria A, Morais Silva IH, et al. Coronaviridae—Old friends, new enemy! Oral Dis. 2020 Jun 26;odi.13447.
2. Jayaweera M, Perera H, Gunawardana B, Manatunge J. Transmission of COVID-19 virus by droplets and aerosols: A critical



- review T on the unresolved dichotomy. *Environ Res.* 2020;19.
3. Checchi V, Bellini P, Bencivenni D, Consolo U. COVID-19 dentistry-related aspects: a literature overview. *Int Dent J.* 2020 Jul 5;idj.12601.
  4. Kumar PS, Subramanian K. Demystifying the mist: Sources of microbial bioload in dental aerosols. *J Periodontol.* 2020 Jul 27;JPER.20-0395.
  5. Ali K, Raja M. Coronavirus disease 2019 (COVID-19): challenges and management of aerosol-generating procedures in dentistry. 2020;2.
  6. Peditto M, Scapellato S, Marciano A, Costa P, Oteri G. Dentistry during the COVID-19 Epidemic: An Italian Workflow for the Management of Dental Practice. *Int J Environ Res Public Health.* 2020 May 11;17(9):3325.
  7. Micik RE, Miller RL, Mazzarella MA, Ryge G. Studies on Dental Aerobiology: I. Bacterial Aerosols Generated during Dental Procedures. *J Dent Res.* 1969 Jan;48(1):49–56.
  8. Harrel SK, Molinari J. Aerosols and splatter in dentistry. *J Am Dent Assoc.* 2004 Apr;135(4):429–37.
  9. Zemouri C, de Soet H, Crielaard W, Laheij A. A scoping review on bio-aerosols in healthcare and the dental environment. Zhou D, editor. *PLOS ONE.* 2017 May 22;12(5):e0178007.
  10. Ge Z, Yang L, Xia J, Fu X, Zhang Y. Possible aerosol transmission of COVID-19 and special precautions in dentistry. *J Zhejiang Univ-Sci B.* 2020 May;21(5):361–8.
  11. Miller RL, Micik RE, Abel C, Ryge G. Studies on Dental Aerobiology: II. Microbial Splatter Discharged from the Oral Cavity of Dental Patients. *J Dent Res.* 1971 May;50(3):621–5.
  12. Pai B, Prashant G, Shenoy R, Chandu G. Knowledge, attitude, and practice of oral health care personnel regarding airborne spread of infection in Davangere, India. *J Indian Assoc Public Health Dent.* 2014;12(1):38.
  13. Tellier R, Li Y, Cowling BJ, Tang JW. Recognition of aerosol transmission of infectious agents: a commentary. *BMC Infect Dis.* 2019 Dec;19(1):101.
  14. Zou L, Ruan F, Huang M, Liang L, Huang H, Hong Z, et al. SARS-CoV-2 Viral Load in Upper Respiratory Specimens of Infected Patients. *N Engl J Med.* 2020 Mar 19;382(12):1177–9.
  15. Walsh KA, Jordan K, Clyne B, Rohde D, Drummond L, Byrne P, et



- al. SARS-CoV-2 detection, viral load and infectivity over the course of an infection. *J Infect.* 2020 Sep;81(3):357–71.
16. Tang S, Mao Y, Jones RM, Tan Q, Ji JS, Li N, et al. Aerosol transmission of SARS-CoV-2? Evidence, prevention and control. *Environ Int.* 2020 Nov;144:106039.
  17. Jia HP, Look DC, Shi L, Hickey M, Pewe L, Netland J, et al. ACE2 Receptor Expression and Severe Acute Respiratory Syndrome Coronavirus Infection Depend on Differentiation of Human Airway Epithelia. *J Virol.* 2005 Dec 15;79(23):14614–21.
  18. Vuorinen V, Aarnio M, Alava M, Alopaeus V, Atanasova N, Auvinen M, et al. Modelling aerosol transport and virus exposure with numerical simulations in relation to SARS-CoV-2 transmission by inhalation indoors. *Saf Sci.* 2020 Oct;130:104866.
  19. Wölfel R, Corman VM, Guggemos W, Seilmaier M, Zange S, Müller MA, et al. Virological assessment of hospitalized patients with COVID-2019. *Nature.* 2020 May;581(7809):465–9.
  20. Liu Y, Ning Z, Chen Y, Guo M, Liu Y, Gali NK, et al. Aerodynamic analysis of SARS-CoV-2 in two Wuhan hospitals. *Nature.* 2020 Jun;582(7813):557–60.
  21. For the Singapore 2019 Novel Coronavirus Outbreak Research Team, Chia PY, Coleman KK, Tan YK, Ong SWX, Gum M, et al. Detection of air and surface contamination by SARS-CoV-2 in hospital rooms of infected patients. *Nat Commun.* 2020 Dec;11(1):2800.
  22. Stadnytskyi V, Bax CE, Bax A, Anfinrud P. The airborne lifetime of small speech droplets and their potential importance in SARS-CoV-2 transmission. *Proc Natl Acad Sci.* 2020 Jun 2;117(22):11875–7.
  23. Diegritz C, Manhart J, Bücher K, Grabein B, Schuierer G, Kühnisch J, et al. A detailed report on the measures taken in the Department of Conservative Dentistry and Periodontology in Munich at the beginning of the COVID-19 outbreak. *Clin Oral Investig.* 2020 Aug;24(8):2931–41.
  24. Izzetti R, Nisi M, Gabriele M, Graziani F. COVID-19 Transmission in Dental Practice: Brief Review of Preventive Measures in Italy. *J Dent Res.* 2020 Aug;99(9):1030–8.
  25. Long RH, Ward TD, Pruett ME, Coleman JF, Plaisance MC.



- Modifications of emergency dental clinic protocols to combat COVID-19 transmission. *Spec Care Dentist*. 2020 May;40(3):219–26.
26. Pajpani M, Patel K, Bendkowski A, Stenhouse P. Rapid response: activity from a hospital based Urgent Dental Care Centre during the COVID-19 pandemic. 2020;7.
27. Umer F, Motiwala M. Dental services during the COVID-19 pandemic: A tertiary care hospital experience. *Spec Care Dentist*. 2020 Sep;40(5):431–6.
28. Khanagar SB, Al-Ehaideb A, Vishwanathaiah S, Maganur PC, Naik S, Siddeeqh S. Exposure Risks and Preventive Strategies Considered in Dental Care Settings to Combat Coronavirus Disease (COVID-19). *HERD Health Environ Res Des J*. 2020 Aug 30;193758672095074.
29. Alharbi A. Guidelines for dental care provision during the COVID-19 pandemic. :6.
30. Fallahi HR, Keyhan SO, Zandian D, Kim S-G, Cheshmi B. Being a front-line dentist during the Covid-19 pandemic: a literature review. *Maxillofac Plast Reconstr Surg*. 2020 Dec;42(1):12.
31. Gandhi M, Yokoe DS, Havlir DV. Asymptomatic Transmission, the Achilles' Heel of Current Strategies to Control Covid-19. *N Engl J Med*. 2020 May 28;382(22):2158–60.
32. Pereira LJ, Pereira CV, Murata RM, Pardi V, Pereira-Dourado SM. Biological and social aspects of Coronavirus Disease 2019 (COVID-19) related to oral health. *Braz Oral Res*. 2020;34:e041.
33. Kelly N, Íomhair AN, McKenna G. Can oral rinses play a role in preventing transmission of Covid 19 infection? 2020;2.
34. Vergara-Buenaventura A, Castro-Ruiz C. Use of mouthwashes against COVID-19 in dentistry. 2020;5.
35. Barabari P, Moharamzadeh K. Novel Coronavirus (COVID-19) and Dentistry—A Comprehensive Review of Literature. *Dent J*. 2020;18.
36. Ayub K, Alani A. Acute endodontic and dental trauma provision during the COVID-19 crisis. *Br Dent J*. 2020 Aug;229(3):169–75.
37. Cochran MA, Miller CH, Sheldrake MA. The efficacy of the rubber dam as a barrier to the spread of microorganisms during dental treatment. *J Am Dent Assoc*. 1989 Jul;119(1):141–4.
38. Al-Amad SH. The effect of rubber dam on atmospheric bacterial



- aerosols during restorative dentistry. :6.
39. Gomes R de L, Pedrosa M da S, Silva CHV da. Restorative dental treatment in times of COVID-19. *RGO - Rev Gaúcha Odontol*. 2020;68:e20200019.
40. Burke FT, Mackenzie L, Sands P. Suggestions for Non-Aerosol or Reduced-Aerosol Restorative Dentistry (for as Long as is Necessary). *Dent Update*. 2020 Jun 2;47(6):485–93.
41. Umer F. Ancillary considerations for endodontic emergency treatment of Covid-19 positive patients. *Spec Care Dentist*. 2020 Jul;40(4):395–6.
42. Jevon P, Shamsi S. COVID-19 and medical emergencies in the dental practice. *Br Dent J*. 2020;229(1):6.
43. Mattos FF, Pordeus IA. COVID-19: a new turning point for dental practice. *Braz Oral Res*. 2020;34:e085.
44. Ilhan B, Bayrakdar IS, Orhan K. Dental radiographic procedures during COVID-19 outbreak and normalization period: recommendations on infection control. *Oral Radiol [Internet]*. 2020 Jun 29 [cited 2020 Sep 6]; Available from: <http://link.springer.com/10.1007/s11282-020-00460-z>
45. Morawska L. How can airborne transmission of COVID-19 indoors be minimised? *Environ Int*. 2020;7.
46. Chigurupati R, Henry AM, D'innocenzo R, Mehra P, Krishnan DG, Roser SM. Considerations for Oral and Maxillofacial Surgeons in COVID-19 Era: Can We Sustain the Solutions to Keep Our Patients and Healthcare Personnel Safe? :17.
47. Yadav N, Agrawal B, Maheshwari C. Role of high-efficiency particulate arrestor filters in control of air borne infections in dental clinics. *SRM J Res Dent Sci*. 2015;6(4):240.
48. Meng L, Hua F, Bian Z. Coronavirus Disease 2019 (COVID-19): Emerging and Future Challenges for Dental and Oral Medicine. *J Dent Res*. 2019;7.



### Importance of Ergonomics during and Post COVID-19 for Dental Practitioners

RA Pragati<sup>1\*</sup>, Rameshwari Singhal<sup>2</sup>, Pavitra Rastogi<sup>3</sup>

<sup>1</sup> Research Assistant, Department of Periodontology, Faculty of Dental Sciences, King George's Medical University, Lucknow, U P, INDIA.

<sup>2</sup> Additional Professor, Department of Periodontology, Faculty of Dental Sciences, King George's Medical University, Lucknow, U P, INDIA Mobile: + 91- 9837400562  
Email: [rameshwarisinghal@kgmcindia.edu](mailto:rameshwarisinghal@kgmcindia.edu)

<sup>3</sup> Professor, Department of Periodontology, Faculty of Dental Sciences, King George's Medical University, Lucknow, U P, INDIA.

#### ABSTRACT

Dental professionals have always been vulnerable to musculoskeletal disorders due to nature of their work. The key to prevent work related musculoskeletal disorders is following the rules of ergonomics.

Present world is dealing with one of the most catastrophe pandemic, which is one of the most fiercely contagious infections reported till date. The World health organization suggested a high risk group that includes dental professionals either being infected with SARS-CoV-2 or passing it as nosocomial infection to patients. Alternatives to promote good oral health care during the pandemic have been deployed.

This article highlights on importance of good posture, armamentarium, appropriate working pattern that enhances productivity and ensures safety of both patient and the dentist. This article provides insights about increased significance of ergonomics during COVID-19.

#### **Introduction:**

COVID -19 was declared pandemic by World Health Organization on March 11, 2020. The declaration of pandemic has changed the working for dental professionals drastically. A statement

released on August 3, 2020, by the World Health Organization had issued directions for the treatment of only essential oral health services in the present times of COVID-19. Guidelines, need to followed, till the time COVID-19 is in phase of



community transmission and not reduced to cluster cases. The recommendations from World Health organization have stated that the local officials either on the national or community level will specify set of instructions for COVID-19 risk of transmission because dental treatment involves aerosol-generating procedures, and the potent infection risks are posed especially by dental health care providers. This article suggests ways to be considered by the dental practitioner in light of the practitioners' own working circumstances and experiences.

### **Etiology and Pathogenesis**

Ergonomics was often ignored due to lack of awareness, but now the appropriate working conditions need to be in focus more than before. Till date, no specific protocol has been declared for working of dental professionals in COVID-19 times, but the least that could be done to promote safety and efficiency is to follow the rules of Ergonomics in dentistry. Ergonomics is an applied science used for designing and arranging things such that they interact in an efficient and safe manner for people's use and increase efficiency.<sup>1</sup>

With the current COVID-19 pandemic situation, importance of ergonomics has increased beyond just safety related to musculoskeletal disorders. It is important for practitioners to realize the importance

of appropriate posture while maintaining dentist-patient safe distance rules. With the new normal, the working shift needs to be more precisely correct especially for a dental practitioner.

Modern ergonomics is an interdisciplinary applied science that studies the optimization possibilities of the man-machine system design by knowing the human's physical and mental possibilities and limits, his/her capacity to learn, the factors generating errors, the work, the physiology, the human behavior as an individual and within a team, the managerial possibilities, the organizational culture (interdisciplinary study of anatomy, physiology, psychology, management), and the technical and designing possibilities (engineering, design).<sup>2</sup> Dentistry always had unique ergonomic challenges. Dental professionals' work requires repeated adjustments in their positions like sitting, standing, and sometimes staying in one position for long period of time resulting in muscle strain. While treating the patients, the dental surgeons are concerned about patients' comfort and pay little attention to their own posture until pain is perceived. If proper principles of ergonomics are followed then dental surgeons can improve comfort during work.<sup>3</sup>

The term work-related musculoskeletal disorders (MSDs) is related to



musculoskeletal disorders to which the work environment contributes significantly or to musculoskeletal disorders that get worse or longer lasting by work conditions or workplace risk factors. Some of the common workplace risk factors that have been frequently mentioned includes jobs requiring repetitive, forceful or prolonged exertions of the hands (example hands of players in table tennis sport, dentist's hand in manual prophylaxis); frequent or heavy lifting (example weight lifters), pushing or pulling, or carrying of heavy objects (example daily wage construction building workers) and prolonged awkward postures (example most common in dental profession). There is increased level of risk, as the intensity, frequency and duration of the exposure to these conditions soar. Dentists are prone to MSDs because of their bad postures, as proximity is required and is of utmost concern owing to the visibility constraints. Occupational hazard related to early retirement by dentists are: <sup>4</sup>

- Musculoskeletal disorders (29.5%)
- Cardiovascular disease (21.2%)
- Neurotic symptoms (16.5%)
- Tumors (7.6%)
- Nervous system diseases (6.1%)

### **1. Importance of ergonomics in dentistry**

Ergonomics is essential so that working capacity and efficiency does not deteriorate over time. Its many advantages are: good interaction and communication between the dental team, appropriate lighting, noise reduction, less perception of malodors. The dental clinic environment with the patient chair, dental unit, operating light, hand instrumentation, cabinetry and peripheral equipment must be ergonomically correct. Dentists need to adapt good working postures, sufficient lighting and dental assistants need to provide easy access to required instrumentation and materials for different clinical procedures and patient types. COVID-19 has now made it mandatory to follow the technically correct distance and attain good postures.

#### **1.1 To avoid the different types of MSDs**

Musculoskeletal disorders come in a variety of forms. Some general information about the primary types of MSDs that dentists regularly report:

**Lower Back Pain:** According to reports 70 -90% of dentists have recurrent episodes of back pain, and one-third of dentists continue to have persistent, recurrent or intermittent pain after their first episode. This condition is further exacerbated by inflexibilities around the hips and pelvis as well as relative weakness of the stabilizer muscles of the lumbar spine, including the



abdominal and gluteal muscles. Furthermore, evidence of back pain can exist due to abnormal postures, relative weakness and decreased endurance, and then exacerbated by a specific repetitive injury.

**Upper Back Pain:** Upper back pain is not as common as lower back pain. Some dental professionals report extensive pain in the mid and upper back. The abnormal posture, poor core body strength and endurance, and overall lack of individual conditioning are mostly responsible for this type of chronic pain.

**Hand and Wrist Pain:** The most common cause of hand pain is constant flexion and extension movements of the wrist and fingers which is required in dentistry. Tactile sensation is important while performing dental clinical work. The common hand in 'pinch' position (modified pen grasp) is the most detrimental position as it causes mechanical stresses to digital nerves. Prolonged grasp of sharp instruments, forceful work and extended use of vibratory instruments with no proper finger rest further aggravate the condition. Common hand and wrist problems faced by dentists are:

- Tendinitis/tenosynovitis
- De - Quervain's disease
- Trigger finger
- Carpal Tunnel syndrome

- Guyon's syndrome

### **Some common signs of MSDs observed by practitioner**

- Decreased range of motion
- Loss of normal sensation
- Decreased grip strength
- Loss of normal movement
- Loss of coordination.

### **1.2 Ergonomic considerations while design of work space**

Operator's body structure should be kept in mind with simultaneous consideration of ergonomic specifications. The construction of the work space and work equipment should notice even the minor details of body constraints. The work space could be made easily adaptable to the operator-

- a) The working height needs to be readapted to the individual height of operator and the kind of work performed. The operator's stool and desk (tray) are designed as a unit to achieve the ergonomically correct body posture, with trunk erect, body weight appropriately balanced, elbows at the side of the body, and forearms approximately horizontal.
- b) Physical body dimensions are kept in mind while all designing.
- c) Dental operatory area should provide sufficient space for body movements (without interception of armamentarium), in



particular of the head, arms, hands, legs and feet.

**Designing should always consider maintaining good body posture, muscular strength and body movement.**

The work station should be such, so as to avoid unnecessary or excessive strain in muscles, joints, ligaments, and in the respiratory and circulatory systems. The Strength requirements should be within physiological limits. Body movements should be in line with natural body rhythms. The body posture, strength exertion and body movement should be in harmony with each other.

### **1.3 To avoid bad body posture**

In present times of COVID-19 maintaining safe distance from patient have become way more necessary than ever before, attention is paid primarily to the following:

- The dentist should alternate between sitting and standing. If one of these postures must be chosen, then sitting is preferable to standing; however, standing may be necessitated by the work process.
- Body postures must be maintained to avoid muscle strain and work fatigue from prolonged static muscular tension.

- Feasibility of alternations in body posture must be made possible.

### **1.4 Body movement and patient**

**Dentist minimum distance rules are indispensable and must be religiously followed during and post COVID-19 period as they might prove to be an effective safety precaution.**

The body movements with great accuracy requirements should not entail exertion of considerable muscular strength, as in long run they might be the cause of chronic recurrent or chronic continuous pain. It is absolute need of the hour to preserve the balanced body posture and its symmetry throughout the clinical work situation.

As per available protocols the distance between the clinical working area and the dentist's eyes is of 35-40 cm or slightly higher for very tall dentists.<sup>5</sup> The surface of the teeth to be treated should be parallel from the front view of the dentist and his view should oriented perpendicular to the working field. If dentist fail to attain this advised distance and orientation is not established or it is lost during the clinical act, the dentist's eyes will strain and try look for alternates and in this dentist will displace instinctively from the balanced posture. In order to establish a perfect orientation it is important to pay attention to the dentist's position around the patient



and the patient's head position on the headrest.

For positioning the patient's head it is important to use all his possibilities of motion: extension and flexion, rotation right or left and side flexion right or left in varying degrees and combinations<sup>13</sup>. The active balanced posture mean spine has its original "S" curvature and passive balanced posture involves lumbar support with help of back support from the seating stool.<sup>5</sup>

#### 1.4 To prevent aerosol particles transmission in dental operatory

Particles can be classified based on their size:

- coarse particles (2.5–10 microns)
- fine particles (< 2.5 microns)
- ultrafine particles (< 0.1 micron)

Human olfactory organ is the first line of defense against foreign materials, as it can filter up to 10 microns. Any particle of dimension less than 10 microns may enter the respiratory tract, and < 2.5 microns can enter the alveoli. An ultrafine particle like the COVID-19 virus, can enter the human body through various external connections like respiratory system. Dentists are recommended to take strict precaution measures and avoid surgical or non-surgical procedures that can produce droplets or aerosols. Use of four handed

dentistry and saliva ejectors can effectively decrease risk of transmission.<sup>6,7</sup>

Suspended aerosols are a potential cause of viral transmission. Typically the larger droplets fall on the grounds while suspended aerosols of varied sizes (5 micron -12 micron) stay in atmosphere. Dental treatment generates lots of aerosol, splatter, and droplets in the surroundings,

Sno.	Different surface	Virus viability and transmission risk time in hours
1	Plastic and <u>stainless steel</u> surface	72 hours
2	Cardboard surface	24 hours
3	Suspended aerosols	<u>3 hours</u>
4	Copper surface	9 hours

since dentistry involves use of ultrasonic scalers and air-rotors.

#### Body postures by dental practitioners and their implications

- Continuous bending of head over patient creates weight of head to be pulled in downwards direction which generates continuous pressure and leads to chronic pain.
- Typical position used by many dental surgeons with flexed and twisted neck and torso. It is so because of lack of awareness about



ergonomics; underutilization of four handed dentistry; insufficient training about how to get direct and indirect vision without violating the personal space of patient.

- Extremely, bent-over positions are frequently observed due to inability to see.

### **Theoretical ideal position**

The torso leaning back slightly between 100° and 110° (90° is vertical), the buttocks, thighs, and legs are supported and the back of the knee is free. The operative field (the patient's mouth) to be placed at the same height as the practitioner's elbows and held close to the body. This allows the arms to be at 0° from the horizontal axis or 90° to the shoulder.

This posture is rarely observed in dental clinics because for many dental surgeons the eye-task distance is too great. Dental work requires bending of the neck and back in order to be able to see and to perform extremely precise work in the patient's oral cavity. Increasing awareness about ergonomics and use of magnification techniques can help the practitioner and also save them from possible infection because of very close contact with the patient.

Ergonomically designed dentist's stool encourages a good posture. The stool's height adjustment is necessary feature to

maintain the thighs to the floor and a minimum angle of 105-110°. Too high or too low positions of the dental stool both are deleterious to the dentist.

Standard requirements as stated in Standard ISO 11226 "Ergonomics evaluation of static working postures" are:

- The upper body could bend forward from the hip joints maximally 10-20° but bending sideward/laterally and rotations must be avoided. The head can be bended forward maximally 25°.
- Extreme positions and movements of hands and arms including raising the shoulders should be avoided.

### **2. Optimization of principles of ergonomics to lessen chances of COVID-19 infection**

1. Bending forward with the upper body more than 10° is irresponsible for dentists, as a result of the unfavorable static load that this posture brings.

2. To achieve a dynamic way of working, the dentist should move as much as possible during patient treatment in order to alternate the load and relax the muscles and vertebral column.

3. Ensure a firm muscle corset by sport or other physical activity: this is particularly important for recovery of the burdened muscles and enlarging the muscle



strength, to be better able to maintain a correct posture.

#### **4. Possible way to always attain the ergonomically correct posture**

##### **Using the magnification systems**

If provided with proper magnification techniques the fine balanced posture and patient – dentist minimum rules could be easily followed. Use of dental loupes and telescopes, the operating microscope could prove to be a boon if properly chosen, adjusted, and trained for use. And if no proper training is provided for their use then their misuse could lead to the risk of musculoskeletal injuries or aggravating them.

Dental loupes provide magnification, eases the visibility constraints and helps in increased chair side work time. It balances the ergonomics, maintains minimum distance from patient and gives clear view.

##### **Mandating all recommended personal protection gears**

###### **Protective eyewear**

There are various eye protection devices (such as eyewear goggles or face shield) the need according to individual's personal vision guides their selection. Eye protection must be comfortable and allowing efficient working.

###### **Mask**

The evidence does not identify any special advantage of the N95 on comparison with

surgical masks in terms of protection from the influenza virus.<sup>8, 9</sup> Studies suggest that there is an equal effectiveness between the two types of masks for protection from the influenza virus. It is also important to mention that if comparison is made to nonspecific respiratory tract infections, then N95 masks give slightly better results.<sup>10</sup>

##### **Conclusion:**

Ergonomics is neglected part of our dental curriculum, in spite of being of so much significance, as MSDs are much frequently prevalent among dental surgeon. Unfortunately, this lack of awareness among undergraduates is quite high and this result in making these undergraduate the worst sufferers of pain associated to wrong postures. As soon as musculoskeletal disorders arise, immediate correcting actions and compensatory measures should be employed to ward off negative effects of the unbalanced posture. Good posture is not a luxury this is needed to be understood, as no major investments are required but to alter the thinking and bring in changes. Post-COVID-19. World of dentistry is expected to change dramatically, since dentistry will continue to revolve around and have aerosols, mist, spatter, saliva, visibility constraints. Any changes or a proper protocol which will be mandated in upcoming times will have to



be followed by every dentist to ensure their own and patient's safety. Prior to mandating changes that will require adequate research, the ergonomics needs to be followed and guidelines specified by WHO, patient dentist minimum distance rule, use of magnification loupes could be employed till we find better way to practice dentistry more safely and efficiently.

#### References:

1. Gupta A, Bhat M, Mohammed T, Bansal N, Gupta G. Ergonomics in dentistry. *Int J Clin Pediatr Dent*. 2014;7(1):30-34. doi:10.5005/jp-journals-10005-1229
2. Longchar I, Ahuja R, Abraham D. Don't get bent out of shape - Ergonomics: good form. Good function. Good health. *J Appl Dent Med Sc* 2016; 2(2): 204-209
3. Graham C. Ergonomics in dentistry, Part 2. *Dent Today* 2002;21:106-9.
4. Murphy DC. Ergonomics and dentistry. *NY State Dent J*. 1997;63(7):30-34.
5. Todd AI, Bennett AI. Physical implications of prolonged sitting in a confined posture – A literature review. *Ergonomics SA*. 2007; 19:7-21.
6. Li, R, Leung, K, Sun, F, Samaranayake, L. 2004. Severe acute respiratory syndrome (SARS) and the GDP. Part II: implications for GDPs. *Br Dent J*. 197(3):130-134.
7. Kohn, WG, Collins, AS, Cleveland, JL, Harte, JA, Eklund, KJ, Malvitz, DM; Centers for Disease Control and Prevention . 2003. Guidelines for infection control in dental health-care settings—2003. <https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5217a1.htm>.
8. Long Y, Hu T, Liu L, et al. Effectiveness of N95 respirators versus surgical masks against influenza: A systematic review and meta-analysis. *J Evid Based Med*. 2020;13(2):93-101. doi:10.1111/jebm.12381
9. Radonovich LJ Jr, Simberkoff MS, Bessesen MT, et al. N95 Respirators vs Medical Masks for Preventing Influenza Among Health Care Personnel: A Randomized Clinical Trial. *JAMA*. 2019;322(9):824-833. doi:10.1001/jama.2019.11645
10. Offeddu V, Yung CF, Low MSF, Tam CC. Effectiveness of Masks and Respirators Against Respiratory Infections in Healthcare Workers: A Systematic Review and Meta-Analysis. *Clin Infect Dis*. 2017;65(11):1934-1942. doi:10.1093/cid/cix681



**Comparative Evaluation of Antimicrobial efficacy of Guava Leaf Extract,  
Asafetida Extract and 2.5% Sodium Hypochlorite used as Endodontic Irrigant:  
An In-vitro study**

Dr. Gaurav Jain<sup>1</sup>, Dr. Akriti Goel<sup>2</sup>, Dr. Balakrishnan Rajkumar<sup>3</sup>, Dr. Jiji George<sup>4</sup>, Dr. Ravinder Singh Bedi<sup>5</sup>

<sup>1</sup>Associate Professor, Department of Conservative Dentistry and Endodontics, Saraswati Dental College, Lucknow – 227105 Uttar Pradesh, India E-mail:- [gauravjs23@yahoo.com](mailto:gauravjs23@yahoo.com)

<sup>2</sup>Senior Resident, King George's Medical University, Lucknow – 226003 Uttar Pradesh, India

<sup>3</sup>Principal, Professor and Head of Department, Department of Conservative Dentistry and Endodontics, BBD College of Dental Sciences, Lucknow – 227105 Uttar Pradesh, India

<sup>4</sup>Professor, Department of Oral Pathology, BBD College of Dental Sciences, Lucknow – 227105 Uttar Pradesh, India

<sup>5</sup>Principal, Professor and Head of Department, Department of Oral and Maxillofacial Surgery, Saraswati Dental College, Lucknow- 227105 Uttar Pradesh, India

**ABSTRACT**

**Background:** Chemo-mechanical preparation for debridement and disinfection of infected root canal system plays a vital role in long term success of an endodontic therapy. It is a scientifically proven fact that most of the irrigants used for eradication of micro-organism from the root canal system can remove these microbes surviving in the biofilms but none them are able to do so successfully alone. Studies have found that natural medicinal herbs can be used as root canal irrigant and are found to be equally effective as compared to their counterparts. These herbal extracts being more bio-friendly having negligible side effects and can be considered an alternative to commonly used root canal irrigant. Hence; the present study was conducted for assessing antimicrobial efficacy of two different herbal extracts namely Guava Leaf extract and Asafetida extract along with 2.5% Sodium Hypochlorite when used as an endodontic irrigant against *Enterococcus faecalis*.



**Materials and methods:** The antimicrobial activity of irrigants used was determined using agar diffusion test. The group allocation was done based on the irrigants used into three groups: Group I- Guava Leaf extract, Group II- Asafetida extract and Group III- 2.5% Sodium Hypochlorite. The zones of inhibition of growth were recorded. The results obtained were tabulated and statistically analyzed by one way ANOVA with post-hoc Tukey's HSD and level of significance set at a p value<0.05.

**Results:** The mean zones of growth inhibition in 2.5% Sodium Hypochlorite (Group III) was significantly higher than that for Asafetida extract (Group II) ( $p<0.001$ ). This difference was also statistically significant for Guava Leaf extract (Group I) and Asafetida extract (Group II) ( $p<0.001$ ).

**Conclusion:** In the present study Guava leaf extract showed significant inhibitory effect against *Enterococcus faecalis*. However, Sodium Hypochlorite demonstrated the best antimicrobial efficacy and Asafetida extract showed the least. Moreover, considering side effects Sodium Hypochlorite, Herbal extracts like Guava leaf extract having significant antimicrobial activity can be considered as

potential antimicrobial alternative to existing endodontic irrigants.

**Key words:** Antimicrobial efficacy, Antibacterial agents, Herbal, Root canal irrigants, Sodium Hypochlorite

### **Introduction:**

Endodontic therapy provides opportunities to maintain teeth compromised by infection or trauma, in function and improve the health of dentition and a successful endodontic therapy requires proper chemo-mechanical preparation followed by, three dimensional obturation to attain adequate sealing of the disinfected root canal space.<sup>(1)</sup> Literatures show that infected root-canal is a great source of micro-organisms both aerobic and anaerobic, which play a vital role in initiating and sustaining the root canal infection and inflammation of peri-radicular tissues.<sup>(2)</sup> An anatomical and morphologic complexity of the infected root canal often makes its adequate disinfection a tough task.<sup>(3)</sup> Thus, eradication of micro-organisms from the infected root canal system is primary goal for long term success of any endodontic therapy and chemo-mechanical preparation involving use of various root canal irrigants serves this purpose. Bystrom A and Sundqvist G<sup>(4)</sup> found in their study that mechanical cleaning of the canal with normal Saline,



alone does not completely remove the bacteria from the canal and use of antimicrobial solution seems necessary to remove microorganisms from the root canal system.

Over the last many years, several materials, such as Sodium hypochlorite (NaOCl) and bisbiguanide antimicrobial agent Chlorhexidine, have been used for canal irrigation; but, none of them solely were able to completely remove the microorganisms from the root canal space.<sup>(5)</sup> However, Sodium hypochlorite (NaOCl) in concentrations of 0.5-5% has been a gold standard in root canal irrigation. Although, it has well known antibacterial and tissue dissolving properties, rather it is also known for undesirable tissue toxicity.<sup>(6)</sup> Since most chemical and synthetic drugs used as antimicrobial agents for root canal disinfection have toxic effect on human cells, use of herbal medicinal extracts, due to their biocompatibility and naturalness, have gained popularity in recent times.<sup>(7)</sup> The use of herbal plants for treatment, due to their antimicrobial, analgesic, anti-inflammatory and antioxidant properties have been there for thousands of years. These herbal products are natural and environmental-friendly and also been traditionally used by the society for treatment of gingival inflammation as home remedy. In recent years, many herbal

extracts have used for root canal disinfection, debridement and smear layer removal.<sup>(8-10)</sup>

The microorganisms are a proven cause of persistent peri-radicular diseases, and subsequent failure of root canal treatment.<sup>(2)</sup> As a result, many studies are always carried out to detect antimicrobial efficacy of root canal irrigants. Considering the antimicrobial and antioxidant effect of various herbal extracts,<sup>(11-12)</sup> like Guava leaf extract, Asafetida extract and their possible use in root canal treatment due to their proven antimicrobial action, the present study was carried out to make a comparison of antimicrobial effects of Guava leaf extract, Asafetida extract and 2.5% Sodium Hypochlorite against oral pathogen *Enterococcus faecalis*.

### Materials And Methods

The present study was conducted in the Department of Conservative Dentistry & Endodontics for assessing the antimicrobial efficacy of two different herbal extracts and compares it with traditionally used 2.5% Sodium Hypochlorite endodontic irrigant against oral pathogen *Enterococcus faecalis*. The antimicrobial activity of irrigants used was determined using agar diffusion test. The group allocation was done based on the irrigants used into three groups: Group I- Guava Leaf extract, Group II- Asafetida



extract and Group III- 2.5% Sodium Hypochlorite (positive control group). Standard strains of *Enterococcus faecalis* ATCC 29212 were used in the study to check antimicrobial activity of irrigants studied.

#### Preparation of Guava Leaves Extract (Group I):

Fresh leaves of Guava were taken and air dried in open while protecting them from direct sunlight. Dried leaves were then powdered and 50gm of this powder was taken and mixed with 500ml of sterile distilled water. This was heated for complete evaporation of water content and resulting liquid was filtered using filter paper to obtain desired Guava Leaf extract.

#### Preparation of Asafetida Extract (Group II):

Asafetida (Hing) is a dried latex (gum oleoresin) derived from the root of ferula. 50gm powder of this was taken and dissolved in 500ml of sterile distilled water to obtain a smooth solution. Later water evaporation and adding of 90% v/v pure alcohol was done simultaneously to obtain desired 30% concentration Asafetida extract.

#### Agar-diffusion test:

Hundred microliters of test organism *Enterococcus faecalis* (*E. faecalis*) suspension were obtained and inoculated in culture plates having previously set layers of Mueller Hinton Agar. Sterile spreader was used for inoculation of these micro-organisms across media. Three uniform cavities with a size of 6mm diameter and 3mm depth were made on each plate. These cavities were later filled respectively with 200µl of experimental solution and incubated at 37°C for 24 hours. Plates were then checked for zones of inhibition of bacterial growth and diameters of zones achieved by *E. faecalis* in each group, which was recorded in centimeter (cm). Agar diffusion test was done 10 times to achieve statistically significant result.

Table 1 : Mean  $\pm$  SD diameter of zones of inhibition of bacterial (*E. faecalis*) growth in centimeter (cm) comparing antimicrobial activity of experimental solutions

Irrigants	N	Mean $\pm$ SD	F value
Guava leaves extract (Group 1)	10	1.897 $\pm$ 0.026	1253.919
Asafetida Extract (Group 2)	10	1.054 $\pm$ 0.038	
2.5% NaOCl (Group 3)	10	2.163 $\pm$ 0.076	

N: Sample size, SD: Standard deviation



Table 2 : Significance (p values) of mean difference of zones of inhibition of bacterial (*E. faecalis*) growth between groups (i.e., when comparing different irrigating solutions) by Tukey's HSD test

Irrigants	Tukey HSD Q statistic	p-value	Tukey HSD inference
Guava leaves extract (Group I) vs Asafetida Extract (Group II)	51.546	0.0010053	$p < 0.05$ (highly significant)
Guava leaves extract (Group I) vs 2.9% NaOCl (Group III)	16.285	0.0010053	$p < 0.05$ (highly significant)
Asafetida Extract (Group II) vs 2.9% NaOCl (Group III)	67.632	0.0010053	$p < 0.05$ (highly significant)

p-value: Level of significance, HSD: Honestly significant difference, Q: Q-statistic

## Results

The data obtained was tabulated and statistically analysed using analysis of variance (ANOVA) and Tukey's HSD post-hoc test using SPSS 19 (Statistical Package for Social Sciences) (IBM Corporation, Chicago). The selected level of significance was set at a p value  $< 0.05$ . The mean diameter and standard deviation values of zones of inhibition for bacterial (*E. faecalis*) growth in centimeter (cm) comparing antimicrobial activity of experimental solutions and descriptive statistics are presented in Table 1 and Table 2 respectively. Results obtained showed existence of significant difference in diameters of zones of inhibition of *E. faecalis* microbial growth obtained for Guava Leaf extract (Group I), Asafetida

extract (Group II) and 2.5% Sodium Hypochlorite (Group III).

In Tukey's HSD post-hoc test for inter group comparison of antimicrobial efficacy, Group III- 2.5% Sodium Hypochlorite showed statistically significant and superior antimicrobial efficacy with greater zones of inhibition against *E. faecalis* than Group I- Guava Leaf extract and Group II- Asafetida extract. However, Guava Leaf extract (Group I) also demonstrated statistically significant and greater antimicrobial activity when compared to Asafetida extract (Group II).

## Discussion

The main objective of a root canal treatment is complete disinfection of root canal space from the micro-organism and their by-products which solely is the main cause of pulpal and peri-radicular infection, thus preventing recontamination of root canal system.<sup>(5)</sup> However, anatomical root canal complexities like presence of lateral, accessory or furcal canals, apical deltas and isthmus often provide an undisturbed area for biofilm presence even after biomechanical preparation.<sup>(13)</sup> So, for the purpose of complete disinfection, biomechanical instrumentation of root canal space along with use of effective irrigating solution is always advisable for producing a debris free surface.<sup>(14)</sup> Hence; the present *in-vitro* study was conducted



for assessing antimicrobial efficacy of two different herbal extracts used as an endodontic irrigant.

Infected root canal space is host for micro-organisms both aerobic and anaerobic bacteria with *E. faecalis* most commonly being found and thought to be the main cause for endodontic failures.<sup>(15)</sup> In the present study 2.5% Sodium Hypochlorite [NaOCl] (Group III) and Guava Leaf extract (Group I) were shown to inhibit the *E. faecalis* effectively. However, Asafetida extract (Group II) showed very minimal activity against *E. faecalis* in the present study.

Since ages, chemicals like NaOCl has been an irrigant of choice commonly used in endodontic therapy due to its proven high anti-microbial efficacy and tissue dissolving capacity. The high anti-microbial activity of NaOCl is mainly attributed to its high pH that causes alteration in cytoplasmic membrane integrity and biosynthetic alteration in cellular metabolism.<sup>(16)</sup> However, due to its high caustic potential, toxicity, non-biocompatibility and sensitivity even to normal peri-radicular tissues,<sup>(17-18)</sup> over time, use of herbal extracts as root canal irrigants has gained attention. These herbal extracts are natural, biocompatible and non-caustic with relative very less side effects as compared to their counterparts.<sup>(9)</sup>

In the present *in-vitro* study, although Group III- 2.5% NaOCl showed superior antimicrobial efficacy with greater zones of inhibition against *E. faecalis* as compared to herbal extracts [Guava leaf extract (Group I) and Asafetida extract (Group II)]. However, both the herbal extracts used in the present *in-vitro* study showed an acceptable antibacterial activity and marked zones of inhibition against *E. faecalis*. Previous study by Mistry KS *et al.*<sup>(19)</sup> also evaluated antimicrobial activity of methanolic extracts of herbal plants and compared it with that of 5.25% NaOCl. They found that 5.25% NaOCl was the most effective antimicrobial agent having statistically significant difference against herbal extracts.

Moreover, in the present *in-vitro* study, Guava Leaf extract (Group I) demonstrated statistically significant and greater antimicrobial activity when compared to Asafetida extract (Group II). This can be attributed to the presence of flavonoids such as mosin glycosides, quercetin and quercetin glycosides in Guava leaf extracts. The higher bacterial resistance shown by Guava leaf extract may also be due to occurrence of polygalacturonase inhibitory proteins in the plant cell wall. So, the aqueous extracts of Guava leaf cause a marked reduction in early biofilm formation.<sup>(11,20)</sup> Hence, these may contribute to the enhanced



antimicrobial efficacy of Guava Leaf extract (Group I) in the present *in-vitro* study.

In the present *in-vitro* study, Group II-Asafetida extract showed least antimicrobial efficacy against *E. faecalis* when compared to Guava Leaf extract (Group I) and 2.5% NaOCl (Group III). However, although being a herbal plant extract, it did showed antimicrobial activity which can be due to its essence. Previous studies,<sup>(21-23)</sup> have shown that herbal essence can disrupt the lipid structures in the bacterial cell wall, resulting in cell wall lysis, causing cytoplasmic leakage, impairment in DNA transcription, disruption of protein synthesis and ultimately cell death.

Although the zones of inhibition of bacterial growth obtained by herbal extracts were found to be less than 2% NaOCl in the present *in-vitro* study. However, Group I- Guava leaf extract did showed almost similar antibacterial activity to 2% NaOCl. So, the results obtained in our study emphasized that herbal extracts, being more biocompatible and non-toxic, would also provide acceptable antimicrobial activity against *E. faecalis* in routine endodontic procedure.

#### Conclusion:

Based on the findings of the present *in-vitro* study, it can be concluded that herbal

extracts like Guava leaf extract, Asafetida extract can be effectively used as root canal irrigant against *E. faecalis* during routine endodontic procedure. Among herbal extracts studied, guava leaf extract showed statistically significant antimicrobial activity against *Enterococcus faecalis* as compared to asafetida extract but was less than 2.5% NaOCl. Additionally, further studies are needed to evaluate antimicrobial efficacy of guava leaf extract to be used as root canal irrigant.

#### References:

1. Haapasalo M, Shen Y, Qian W, Gao Y. Irrigation in endodontics. Dent Clin N Am. 2010;54:291-312
2. Kakehashi S, Stanley HR, Fitzgerald RJ. The effects of surgical exposures of dental pulps in germ free and conventional laboratory rats. J South Calif Dent Assoc. 1966;34:449-451.
3. Peters OA. Current challenges and concepts in the preparation of root canal systems: a review. J Endod. 2004;30:559-567
4. Bystrom A, Sundqvist G. The antibacterial action of sodium hypochlorite and EDTA in 60 cases of endodontic therapy. Int Endod J. 1985;18(1):35-40
5. Jose J, Krishnamma S, Peedikayil F, Aman S, Tomy N, Mariodan JP.



- Comparative evaluation of antimicrobial activity of Qmix, 2.5% sodium hypochlorite, 2% chlorhexidine, guava leaf extract and aloe vera extract against *Enterococcus faecalis* and *Candida albicans* – An in-vitro study. J Clin Diagn Res. 2016;10(5):ZC20-ZC23
6. Jaju S, Jaju P.P. Newer root canal irrigants in horizon: a review. Int J Dent. 2011;8(2):1-9
7. Aniketh TN, Idris M, Geeta IB, Nandakishore KJ, Sahu GK. Root canal irrigants and irrigation techniques: A review. J Evol Med Dent Sci. 2015;4:4694-4700
8. Iranshahy M, Iranshahi M. Traditional uses, phytochemistry and pharmacology of asafoetida (*Ferula assa-foetida* oleo-gum-resin)- a review. J Ethnopharmacol. 2011;134(1):1-10
9. Sinha DJ, Sinha AA. Natural medicaments in dentistry. Ayu. 2014;35(2):113-118
10. Sadr Lahijani MS, Raoof Kateb HR, Heady R, Yazdani D. The effect of German chamomile (*Matricaria recutita* L.) extract and tea tree (*Melaleuca alternifolia* L.) oil used as irrigants on removal of smear layer: a scanning electron microscopy study. Int Endod J. 2006;39(3):190-195
11. Biswas B, Rogers K, McLaughlin F, Daniels D, Yadav A. Antimicrobial activities of leaf extracts of guava (*Psidium guajava* L.) on two gram-negative and gram-positive bacteria. Int J Microbiol. 2013;1-7
12. Athiban PP, Borthakur BJ, Ganesan S, Swathika B. Evaluation of antimicrobial efficacy of Aloe vera and its effectiveness in decontaminating gutta percha cones. J Conserv Dent. 2012;15:246-248
13. Gomes BPFA, Vianna ME, Sena NT. In vitro evaluation of antimicrobial activity of calcium hydroxide combined with chlorhexidine gel used as intracanal medicament. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006;102:544-550
14. Kamat S, Rajeev K, Saraf P. Role of herbs in endodontics: An update. Endodontology. 2011;23:96-100
15. L. E. Chavez De Paz, G. Dahlen, A. Molander, A. M'oller, G. Bergenholtz. Bacteria recovered from teeth with apical periodontitis after antimicrobial endodontic treatment. Int. Endod. J. 2003;36(7):500-508
16. Baumgartner JC, Cuenin PR. Efficacy of several concentrations of sodium hypochlorite for root canal



- irrigation. J Endod. 1992;18(12):605-612
17. Ghivari SB, Bhattacharya H, Bhat KG, Pujar MA. Antimicrobial activity of root canal irrigants against biofilm forming pathogens- An in vitro study. J Conserv Dent. 2017;20(3):147-151
18. Goswami M, Chhabra N, Kumar G, Verma M, Chhabra A. Sodium hypochlorite dental accidents. Paediatr Int Child Health. 2014;34(1):66-69
19. Mistry KS, Sanghvi Z, Parmar G, Shah S. Comparative evaluation of antimicrobial activity of herbal extracts with 5.25% sodium hypochlorite against multispecies dentinal biofilm. Saudi Endod J. 2016;6:71-76
20. Ravi K, Divyashree P. Psidiumguajava: A review on its potential as an adjunct in treating periodontal disease. Pharmacognosy Reviews. 2014;8(16):96-100
21. Araghizadeh A, Kohanteb J, Fani MM. Inhibitory activity of green tea (*Camellia sinensis*) extract on some clinically isolated cariogenic and periodontopathic bacteria. Med Princ Pract. 2013;22(4):368-372
22. Rawdkuen S, Suthiluk P, Kamhangwong D, Benjakul S. Mechanical, physico-chemical, and antimicrobial properties of gelatin-based film incorporated with catechin-lysozyme. Chem Cent J. 2012;6(1):131
23. Nazari ZE, Iranshahi M. Biologically active sesquiterpene coumarins from *Ferula* species. Phytother Res. 2011;25(3):315-323



### An in vitro Evaluation of Bond Strength of 7th Generation Bonding Agents (AdperTM Easy Bond and Xeno V)

Sofia Ganai<sup>1</sup>, S.Vijay Singh<sup>2</sup>, Saurabh Gupta<sup>3</sup>, Poonam Bogra<sup>4</sup>

<sup>1</sup>M.D.S Consultant Endodontist , Jammu.

<sup>2</sup>Professor and Head, Department of dentistry, NEIGRIHMS, Shillong, Meghalaya.

<sup>3</sup>Deptt. Of Conservative Dentistry and Endodontics D.A.V @ Dental College and Hospital Yamunanagar, Haryana.

<sup>4</sup>Deptt. Of Conservative Dentistry and Endodontics D.A.V @ Dental College and Hospital Yamunanagar, Haryana.

#### **ABSTRACT**

**Introduction:** Today, the popularity of amalgam as restorative material has decreased due to poor esthetic characteristics and mercury contamination, With the advancement composite resin materials were introduced in dentistry and has become a choice among the patient as it not only helps in maintaining the ideal tooth form and function but also esthetics. However, there are certain drawbacks of composite such as post operative sensitivity, discoloration of the restoration etc. The development in technology has improved the physical properties of resin based composite and has also expanded their use in clinics.

**Aim-** The objective of this in-vitro study was to evaluate the bond strength of 7th generation bonding agents (AdperTM Easy Bond and XenoV).

**Material and Methods** - Sixty caries free human molars with no cracks or previous restorations were used for investigation. Standard box-type Class-I Cavities of 3.5mm x 3.5mm and depth of 4mm were prepared on the occlusal surface of the molars. Teeth were randomly divided into two groups namely Group A and Group B of teeth each, according to the dentin adhesives applied i.e AdperTM Easy bond and Xeno V. Two bonding agents were selected for the study, one was AdperTM Easy Bond and the other was Xeno V. Push-out test was performed by placing specimens within a centralizing ring to ensure a centered application of the load, resting on another ring, with a central hole slightly larger than the restoration diameter. The test was performed with a Universal Testing Machine to express



bond strength in mega Pascals (MPa), and load value in Newton (N). After testing the push-out bond strength, the samples were analyzed under a stereomicroscope.

**Results-** The overall clinical outcome of our study is that Adper<sup>TM</sup> Easy bond is better as compared to Xeno V Self etch. The most common mode of failure observed with Adper<sup>TM</sup> was mixed fracture and cohesive dentin fracture and with Xeno V was adhesive failure between resin and dentin and Cohesive resin fracture. The mean maximum force was significantly more among Adper<sup>TM</sup> compared to Xeno V.

**Conclusion-** The overall results showed that the bond strength was better with Adper<sup>TM</sup> as compared to Xeno V. The most common mode of failure observed with Adper<sup>TM</sup> was mixed fracture and cohesive dentin fracture and with Xeno V was adhesive failure between resin and dentin and Cohesive resin fracture. The mean maximum force was significantly more among Adper<sup>TM</sup> compared to Xeno V.

**Keywords-** Bonding agents (Adper<sup>TM</sup> Easy Bond and Xeno V), push-out bond strength.

#### Introduction:

Amalgam was introduced to the United States in the 1830s. Today, the popularity of amalgam as restorative material has decreased due to poor esthetic characteristics and mercury contamination, this material was mainly used as it still cost-effective when used as direct restorative material<sup>1</sup>. This material has gained popularity due to its good mechanical properties such as, easy handling, low technique sensitivity, wear resistance and low cost. The most common reason for replacing amalgam are marginal degradation and secondary caries<sup>2</sup>. With the advancement composite

resin materials were introduced in dentistry more than 50 years ago, since then these materials have been continuously evolving. It has become a choice among the patient as it not only helps in maintaining the ideal tooth form and function but also esthetics<sup>3</sup>

Among all the direct filling restorative materials, composite is the most known material esthetically. Initially these materials were used as anterior restorative materials, but later due to improvement in technologies the possibility of restoring posterior teeth with composite was introduced. However there are certain drawbacks of composite such as post



operative sensitivity, discoloration of the restoration, marginal fracture, recurrent caries, gross fracture of the restoration, lack of maintaining contact, accumulation of plaque around the restoration<sup>4</sup>. With development in technology has improved the physical properties of resin based composite and has also expanded their use in clinics. Therefore newer composites have been introduced with better properties and different restoration techniques like bulk fill, flowable and incremental<sup>2</sup>. The most widely accepted method of placement of composite is incremental method. According to this technique composite should be placed in layers to reduce the polymerization shrinkage and to achieve depth of cure<sup>5,6</sup>. Adhesion refers to the forces or energies between atoms or molecules at an interface that hold two phases together. Adhesive restorations better transmit and distribute functional stresses across the bonding interface to the tooth and have the potential to reinforce weakened tooth structure<sup>7</sup>. A strong bond between dental material and tooth structure is very important so as to achieve esthetic and biologic properties. The bonding between enamel and resin is due to micromechanical bond, However bonding of resin to dentin is difficult due to complex dentin structure. Bonding with dentin is achieved by acid etching which removes

the inorganic matrix of dentin leaving organic substance but when the tooth is dried the collagen in the organic substance shrinks and collapse in order to prevent the collapse the moist and wet bonding technique should be used to preserve the integrity of collagen matrix.(bonding)<sup>8</sup>. In order to achieve a balance various desensitizing solution have been used as rewetting agents which is said to enhance the bond strength and also reduces the postoperative sensitivity<sup>9,10</sup>.

### **Material and Methods**

Sixty caries free human molars with no cracks or previous restorations were fabricated. These molars were cleaned and stored in distilled water. During sample preparations, standard box-type Class-I Cavities of 3.5mm x 3.5mm and depth of 4mm were prepared with the help of air-rotor and bur on the occlusal surface of the molars.

### **Cavity Restoration**

In order to compare the bond strength, the teeth were randomly divided into two groups namely Group A and Group B of 30 teeth each, according to the dentin adhesives applied i.e Adper<sup>TM</sup> Easy bond and Xeno V.

### **GROUPS:**

Group A and Group B

**Group A (n=30)** restored with Adper <sup>TM</sup> Easy bond



**Group B (n=30)** restored with Xeno V Self etch adhesives

The bonding agents were used according to manufacturer's instructions (Table 1)

#### Push-out test

To access the bond strength of restoration to the lateral walls of the occlusal cavity, the specimens were placed within a centralizing ring to ensure a centered application of the load, resting on another ring, with a central hole slightly larger than the restoration diameter. The load was applied on the apical coronal direction using a punch tip, which passed through a guide cylinder to ensure a central load application. The test was performed with a universal Testing Machine and bond strength was recorded for statistical analysis.

Fractured slices were carefully removed and observed under a stereo microscopic at 20x to categorize the type of failure as follows;

Type I: Adhesive failure between resin composite and dentin.

Type II: Cohesive resin fracture

Type III: Mixed fracture: pressure of fragments of dentinal tissues or resin composite adhered to interface.

Type IV: Cohesive dentin fracture

The results were statistically analyzed using following methods.

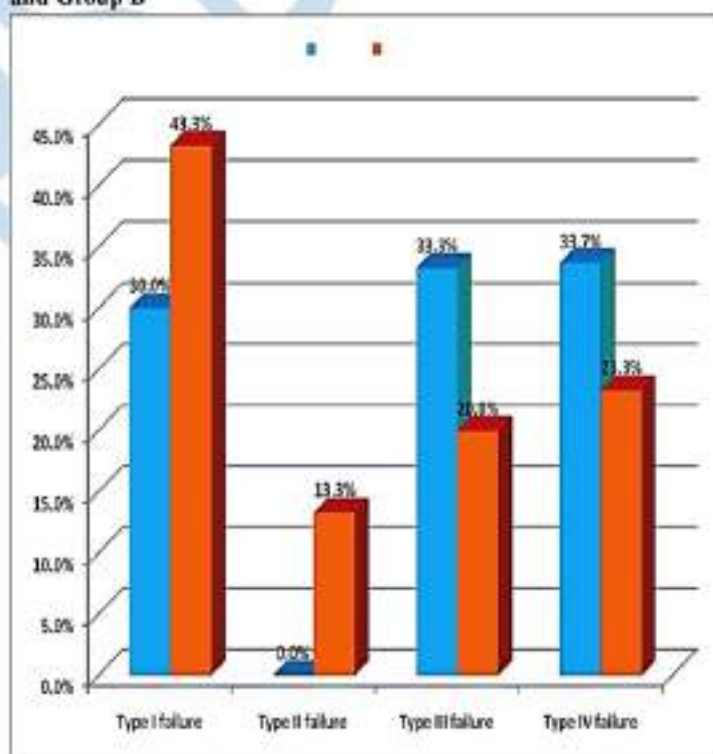
**CHI-SQUARE TEST and Unpaired or Independent 'Student's't-test**

## RESULTS.

When Group A i.e (Adper™ Easy bond) was compared with Group B i.e.(Xeno V) the maximum failure in Group A were Type IV with 36.7% and minimum were Type III and Similarly the maximum failure in Group B was Type I 43.3% followed by Type II 13.3%. As seen in **graph 1**.

The mean maximum force (in Newton) was significantly more among Adper™ (with p-value 0.019) as compared to Xeno V.

**Graph 1 Comparison of type of failure between Group A and Group B**

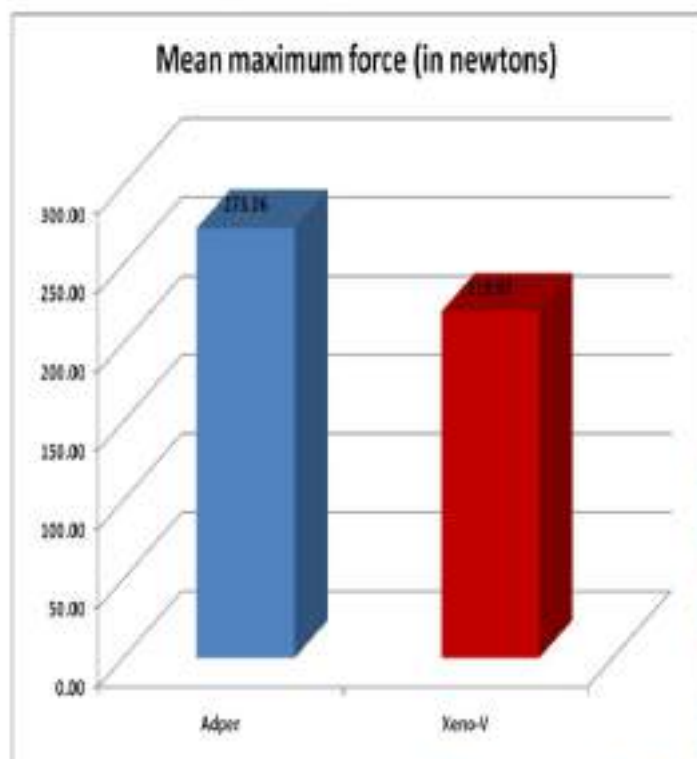


Bar diagram depicting percentage % distribution of types of failure between Group A and Group B. Type III and IV failure was significantly more among Adper (33.3% and 36.7% respectively) whereas the type I failure was significantly more among Xeno-V (43.3%).



Comparison of mean maximum force between Adper™ Easy bond and Xeno V

Graph 2 Comparison of mean maximum force between Adper™ Easy bond and Xeno V



Bar diagram depicting the mean force exerted by Adper and Xeno V. The mean maximum force (in newtons) was significantly more among Adper ( $273.06 \pm 134.18$ ) compared to Xeno-V ( $219.97 \pm 115.52$ ).

On evaluating the data statistically using Unpaired t-test the mean maximum force (in Newton) was compared between Adper and Xeno-V. The mean maximum force (in Newton) was significantly more among Adper compared to Xeno-V.

**Material information: 7th generation bonding agents evaluated in the study.**

### Adper Easy bond (3M ESPE):

#### Content:

2-hydroxyethyl methacrylate (HEMA), Bis-GMA, Methacrylated phosphoric esters, 1,6hexanediol dimethacrylate, Methacrylate functionalized polyalkenoic acid, Finely dispersed bonded silica filler, ethanol, water, stabilizers, initiators based on camphorquinone.

PH 2.7 (ultra mild)

### Xeno V Single step self-etching adhesive (Dentsply)

#### Content

**Liquid A;** 2-Hydroxyethyl methacrylate (HEMA), purified water, Ethanol, 2,6-Di-tert-butyl-p hydroxyl toluene nanofiller

**Liquid B;** Tetramethacryloxyethyl pyrophosphate (Pyro-EMA)

Pentamethacryloxyethyl cyclophosphazene mono fluoride (PEM-F) Urethane dimethacrylate (UDMA) 2,6-Di-tert-butyl-p-hydroxy toluene (BHT) Camphorquinone p-Dimethylamino ethyl benzoate (EPD)

#### Discussion:

The maximum push-out bond strength was seen with Adper™ Easy bond as compared to Xeno V. The above results sheds light on the use of Adhesives with different composition. To compare, we



have used two different types of adhesives depending on the presence or absence of HEMA. Adper™ Easy Bond contains HEMA (2-hydroxyl ethyl methacrylate) which is absent in case of Xeno V11. Two bonding agents were selected for the study (Adper™ Easy bond and Xeno V) 11. We observed that Adper™ Easy Bond showed significant enhancement of push-out bond strength which ranges from 212.44.- 346.61 MPa as compare to Xeno V Self etch. The reason for superior adhesion properties of Adper™ Easy Bond is because of the presence of HEMA (2-hydroxyl ethyl methacrylate) which is not present in Xeno V Self etch 12. The higher potential of HEMA for hydrophilicity makes it potentially stronger adhesion promoting monomer. Another reason that promotes bonding strength to dentin is increasing substrate penetrability and diffusibility, the potential of Adper™ Easy Bond to attain higher bond strength is partly because of presence of ethanol as solvent. This favor solvent properties by keeping ethanol in hydroxide form, thereby allowing efficient removal of water from dentin spaces and collapsing of hydrogen, thus enlarging the inter-fibrillar spaces and allowing more resin infiltration. On the other hand Xeno V Self etch uses acetone as solvent. Acetone is poor in removing water from dentin spaces and also water is necessary for Xeno V Self etch

demineralization process leading to presence of excess water. Excess water seems to be reason for its poor bond strength<sup>12, 13</sup>.

The analysis of failure modes in this study revealed that maximum failures in Group A were Type IV (Cohesive dentin fracture) with 36.7% and minimum was Type III (Mixed fracture: pressure of fragments of dentinal tissues or resin composite adhered to interface) and Similarly the maximum failure in Group B were Type I (Adhesive failure between resin composite and dentin) 43.3% followed by Type II (Cohesive resin fracture) 13.3%. as seen in graph 1.

The mixed type of failures could be due to the lack of proper adaptation of the materials to cavity walls with void formation owing to its fluctuating viscosity combined with low shrinkage and contraction stress upon curing of composite. Adhesive type of failure may be attributed to the heavy viscosity of Filtek™ Bulk fill composite, which might hindered the appropriate adaptation of the material to the cavity walls, resulting in void formation at the tooth restoration interface and Cohesive type of failure as observed may be due to the incorporation of voids or contamination between composite layers<sup>14</sup>.

### **Conclusion:**

Within the limitations of this study, it can be concluded that the maximum push-out



bond strength was seen with AdperTM Easy bond as compared to Xeno V. When **Group A** i.e (AdperTM Easy bond) was compared with **Group B** i.e.(Xeno V) the maximum failure in **Group A** were Type IV with 36.7% and minimum was Type III and Similarly the maximum failure in **Group B** were **Type I** 43.3% followed by **Type II** 13.3%.

#### References:

- 1.Dewaele M, Asmussen E, Devaux J, Leloup G. Class II restorations: influence of a liner with rubbery qualities on the occurrence and size of cervical gaps. Eur J Oral Sci.2006 Dec;114(6):534-41.
- 2.Divakar KP, Regish KM, Bawa S. Polymerization Shrinkage of Composites Resin: A New Perspective to an old problem- A review. International journal of Healthcare and Pharmaceutical Research.2014 Mar;(3):25-8.
- 3.Jang JH, Park SH, Hwang IN. Polymerization Shrinkage and Depth of Cure of Bulk-Fill Resin Composites and Highly Filled Flowable Resin. Oper Dent.2015 Mar-Apr;40(2):172-80.
- 4.Eldarrat AH, High AS, Kale GM. Investigated age related changes in ac-impedance spectroscopy studies of normal human dentin: further investigations J Master Sci; Mater Med.2010; 21:45-51.
- 5.Ellen KW. Adsorption theory of adhesion. Theories of adhesion. In: Packham D.E. Handbook of Adhesion, ed 1. Essex, England: Longman, 1992:39, 473.
- 6.Van Meerbeek B, Vargas S, Inoue S, Yoshida Y, Peumans M and Lambrechts P. Adhesives and cements to promote preservation dentistry, Oper Dent 2001; 26: S119-S144.
- 7.Van Meerbeek B, J. De Munck, Y. Yoshida, S. Inoue, M. Vargas and P. Vijay. Buonocore memorial lecture. Adhesion to enamel and dentin: current status and future challenges, Oper Dent 2003; 28: 215-235.
- 8.Eick JD, Gwinett AJ, Pashley DH, Robinson SJ. Current concepts on adhesion to dentin. Crit Rev Oral Biol Med 1997; 8(3):306-335.
- 9.Davidson CL, de Gee AJ, Feilzer A. The competition between the composite dentin bond strength and the polymerization contraction stress. J Dent Res. 1984 Dec; 63(12):1396-9.
- 10.Swift EJ, Perdigao J, Heymann OH. Bonding to enamel and dentin: A brief



history and state of the art. Quintessence Int. 1995; 34:849-853.

11.Carrigan PJ, Morse DR, Furst ML, Sinai IH. Scanning electron microscopic evaluation of human dentinal tubules According to Age and location. Journal of Endo. 1984;10 (8) :359-63.

12.Nikhil V, Singh V, Chaudhry S. Comparative evaluation of bond strength of three contemporary self-etch adhesives: An ex-vivo study. Contemporary Clinical Dentistry. 2013July;2(2):94-7.

13.Junior M, Carneiro K, Lobato M, Souza P, Goes M. Adhesive systems: important aspect related to their composition and clinical use. J Appl Oral Sci.2010;18(3):207-14.

14.Fahad F, Majeed R. Fracture resistance of weakened premolars restored with sonically-activated composite, bulk-filled and incrementally - filled composites: A comparative in vitro study. J Bagh Collrge Dentistry. 2014; 26 (4):22-27



## Case Report

**Endodontic Management of Carious Lower Second Molar with Single Root and Single Canal**

Dr H C Baranwal<sup>1</sup>, Dr Amrita Kumari<sup>2</sup>

Conservative Dentistry and Endodontics, BHU, Varanasi

**Corresponding Author:** Dr Amrita Kumari

**ABSTRACT**

Root canal morphology is boundless in its variability and clinicians must be aware that anatomic variations constitute a tough challenge to endodontic success. Knowledge of variations in internal anatomy of teeth is imperative for success of endodontic therapy. Aim of this case report is to present endodontic management of relatively rare case of mandibular second molar with single root and a single root canal. Uncertainty in the canal morphology of the second molar is quite common.

**Keywords:** Mandibular second molar; Sealapex; Single canal

**Introduction :**

A comprehensive understanding of the anatomy of teeth involved in root canal therapy is essential for successful endodontic therapy<sup>1</sup>. Clinicians should be familiar with the morphology and the associated intricate root canal anatomy of the teeth, otherwise effective debridement, and obturation may not be possible.

Usually, the mandibular second molar presents with two distinct roots: a mesial root with two canals and a distal root with one or two canals. Disparities in the form, configuration, and number of root canals in mandibular molars have been deliberated widely in endodontic literature<sup>2, 3</sup>. Reading of periapical radiographs in routine practice is essential as it helps to consider



the number, length, curvature and aberration of the root canal system of the tooth and supporting structure. Vertucci *et al.*<sup>5</sup> by exploiting cleared teeth that had their pulp cavities stained with hematoxylin dye, and found a considerable more complex canal system and recognised eight pulp space configurations. Weine *et al.* reported in a study 1.3% of mandibular second molars had Single Canal Configuration<sup>6</sup>. The purpose of this case report is to report endodontic management of single canal in single rooted mandibular second molars.

### Case Report

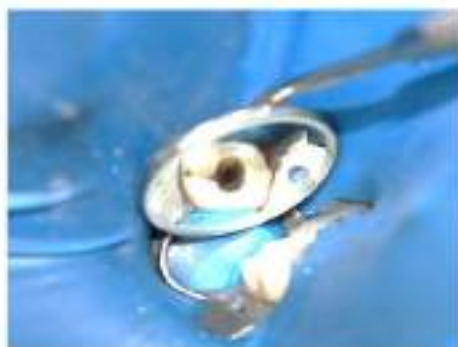
A 23 year old male patient reported to the department of conservative dentistry and endodontics with the chief complain of pain with cold and hot sensitivity in lower right back tooth region. On clinical examination, there was caries with respect to #47. Radiographic examination (figure-a), IOPA reveals radiolucency in crown involving enamel, dentin and reaching into pulp. Also, the root canal morphology showed a fused conical root with a wide canal, constricting toward the apex. Diagnosis of acute irreversible pulpitis was confirmed and root canal therapy was planned. After adequate anaesthesia, under rubber dam isolation access cavity was prepared (figure-b) and the pulp extirpated. Dental loupe (Zumax 3.5) with LED headlight was

used for aided magnification and better visualization. DG #16 explorer was used to explore the pulpal floor and it revealed a single round shaped orifice whereas classical c-shaped canal orifice configuration or any other canal orifices could not be located. After gaining access, the canal patency was established with a suitable ISO K file. Working length (figure-c) was determined with the help of electronic apex locator (Coltene canal pro 2) and confirmed using a radiograph. Cleaning and shaping was done using a step back technique using suitable sized ISO K file and copious irrigation with a combination of irrigants, that is, sodium hypochlorite and saline was done throughout the procedure. After drying the canal with paper point, Sealapex was coated in the canal wall through master apical gutta-percha (figure-d) and canal was obturated using BeeFill 2in1 (VDW) obturation device for Downpack and Backfill technique. Post-obturation restoration was done with light cure composite (figure-e).



a. Pre-operative





**b. Access cavity under rubber dam isolation**



**c. Working length IOPA**



**d. Master cone**



**e. Post Operative**

### Discussion

Complete knowledge of the root canal anatomy and its anomalies is essential. The disparity of root canal morphology, especially in multirooted teeth, is a constant challenge for diagnosis and successful endodontic therapy. Extra or missing canal, apical ramifications, apical deltas, or lateral canals are commonly encountered variations in canal morphology and their incidence and significance have been well documented<sup>7</sup>. One of the commonest variations in the mandibular second molar is the occurrence of C-shaped canals while other variations comprise two or four canals instead of the commonly occurring three canals, supernumerary roots, taurodontism<sup>8</sup>, additional or lesser number of canals in one or more of the roots. Gopi Krishna et al. 2006 reported a rare case of maxillary first molar with a single root and single root canal using spiral CT<sup>9</sup>. On observation of the pulpal floor only one canal with a round orifice was located, indicative of the presence of a single canal<sup>10</sup>. Further exploration with DG #16 explorer reveal absence of any additional orifice opening of the pulpal floor. The canal orifice of the tooth was wide and tapering towards the apex. Biomechanical preparation with hand file with copious irrigation and agitation was done to ensure



complete removal of debris. Thermoplastized obturating technique along with warm vertical compaction which helps in better flow of gutta-percha is used, as it ensures compact obturation of the wide canal and any unusualness present in canal system without voids. Endodontic loupes are helpful adjuncts to manage c-shaped canal complexity.

### Conclusion :

A thorough knowledge and recognition of the basic and intricacy of canal configuration can facilitate more effective canal identification and unnecessary removal of healthy tooth structure in an attempt to search for missing canals.

### References :

1. Jafarzadeh H, Wu YN. The C-shaped root canal configuration: A review, J Endod 2007; 33:517-23.
2. Vertucci FJ. Root canal anatomy of the human permanent teeth. Oral Surg Oral Med Oral Path. 1984; 58(5):589-99.
3. Skidmore AE, Bjorndal AM. Root canal morphology of the human mandibular first molar. Oral Surg Oral Med Oral Pathol. 1971; 32:778-84.
4. Weine FS. Endodontic Therapy. 5th ed. St. Louis: Mosby-Yearbook Inc.; 1996. p. 243.
5. Vertucci F, Seelig A, Gillis R. Root canal morphology of the human maxillary second premolar. Oral Surg Oral Med Oral Pathol 1974; 38:456-64.
6. Sujith R, Kiranmurthy D. Mandibular second molar with single root single canal: A case report. IJCD. 2011; 2(5).
7. Jung IY, Seo MA, Fouad AF. Apical anatomy in mesial and mesiobuccal roots of permanent first molars. J Endod. 2005; 31:364-8.
8. Sert S, Bayirli GS. Taurodontism in six molars: a case report. J Endod. 2004; 30:601-02.
9. Gopikrishna V, Bhargavi N, Kandaswamy D. Endodontic management of a maxillary first molar with a single root and a single canal diagnosed with the aid of spiral CT: a case report. J Endod. 2006; 32(7):687-91.
10. Neeta Shetty, Vimmi Singh, Sujan Rijal. Single Rooted Mandibular Second Molars With Single Canal: Rare Occurrence. Endodontology.



**Book Review****Modern Concepts in Aesthetic Dentistry and Multidisciplined Reconstructive Grand Rounds****Dr. Isha Sajjanhar**

Senior Lecturer

Department of Conservative Dentistry &amp; Endodontics

Subharti Dental College &amp; Hospital, Meerut

This book published by Elsevier publication in 2015 as a part of the project for the Dental Clinics of North America. This is the third book in the series and provides an in-depth knowledge about the recent concepts pertaining to aesthetic dentistry. This book has certain unique features that makes it stand out and will be widely appreciated by the readers with keen interest in aesthetic dentistry. This book is divided into 17 sections each dealing with a unique combination of clinical scenario and gives an evidence based solution to each problem. Another important feature of this book is that all the case reports, case studies or scientific concepts are precisely supported by extremely clear and good quality clinical photographs. This serves as a visual treat for the readers and leaves a detailed mental picture of the clinical situation. One of the most noteworthy highlight of this book is that it suggests treatment plan for cases not only based on the aesthetic requirements but also taking into account the physiological and functional concepts.

In my opinion this book gives an insightful knowledge on the concepts of aesthetics which will help the clinicians to provide quality and long lasting aesthetic restorations to their patients.





## Letter to the Editor

Has Covid-19 Exposed our Business Sense/Financial Planning/Understanding of Economics?**Dr. Mohit Seth**

With the COVID-19 pandemic affecting one and all in any business it is absolutely clear that most of our visions and business plans have proved to be unsustainable. Have we wondered why we started struggling with our finances the very next month i.e. the second month of "lockdown?"

It has various reasons, most of us are in a rat race, without thinking of the broader economic picture. We are investing in technologies, interiors, marketing etc. This drains most of our finances and what we are left with is meagre savings which are hardly enough to invest in a structured manner. Either we are overcharging or undercharging to survive or to maintain our status.

The term 'USEFUL TECHNOLOGY' means we buy only that technology which provides good results in terms of work quality and early economic breakeven without putting much pressure on ourselves and our patients.

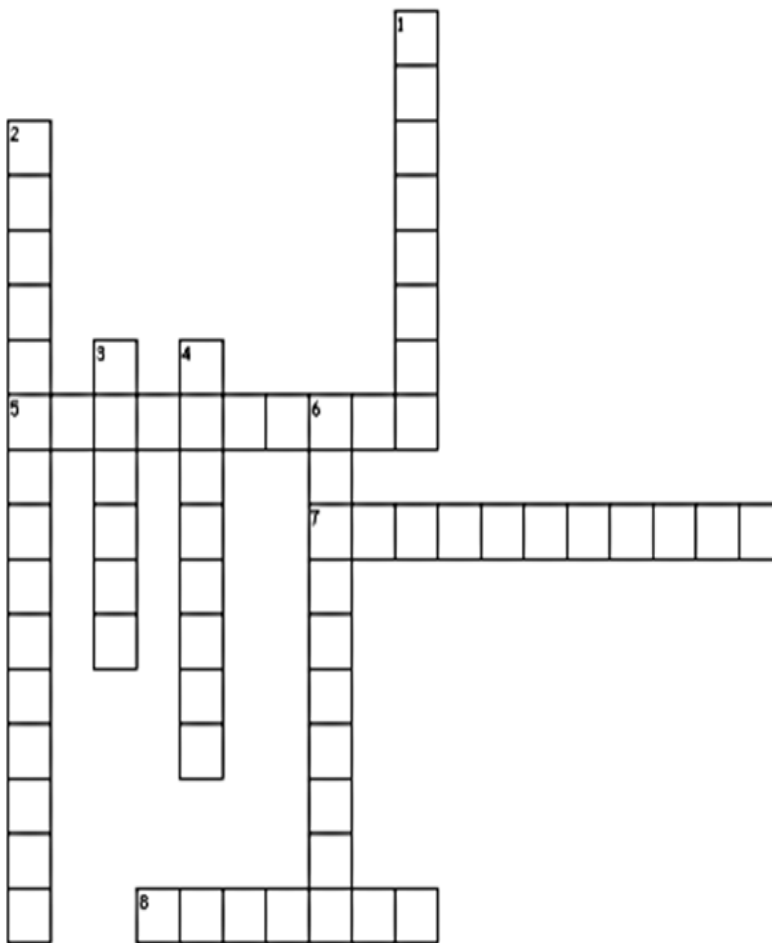
We need not buy machines which are so called next generation without much returns in our dental practices. As the best in economics say, *"you invest in something irrelevant today and you do not have money for necessities tomorrow."*

Finally we have to realise that smiling everyday is good for our physical quotient and good financial planning is a must for a pleasing smile.

-Jai Hind



## Cross Word



### Across

- 5 gum disease
- 7 focibly wedges food
- 8 cleanliness

### Down

- 1 hard deposit
- 2 important for crown margin
- 3 hardest substance
- 4 gap between teeth
- 6 occlusal



## Activities of IDA Moradabad Branch (July-Aug 2020)

On 12<sup>th</sup> July 2020, IDA Moradabad branch conducted **third executive meeting** of the branch through **"Zoom App"**. In the meeting it was decided to conduct IDA UP State CDE on 23<sup>rd</sup> August 2020 through Zoom App. The speakers for the CDE will be Dr. Himanshu Airen Sir and Dr. Rajiv Kumar Chugh Sir if they give their confirmation for us.



On 23<sup>rd</sup> July 2020 IDA Moradabad Branch distributed **"Covid-19 Protocols"** posters for the clinic purpose to all the members of Moradabad branch and wishes to all the members for safe and healthy work.



On 02<sup>nd</sup> August 2020, IDA Moradabad branch organises a **"Talk Program"** with respected **Mr. Piyush Chawla (International Indian Cricket Player)**.





On **15<sup>th</sup> August 2020**, IDA Moradabad branch celebrates "**Independence Day**" by doing a campaign on "**Wearing Masks Saves Life**". In the event Moradabad branch distributed **1000 mouth masks** and **100 hand sanitizers** to the needy people of the city in various locations.



On **16<sup>th</sup> August 2020**, IDA Moradabad branch conducted **Fourth executive meeting** of the branch through Zoom app. In the meeting it was decided to conduct **IDA UP State CDE** on 6<sup>th</sup> September 2020 at 6pm onwards. The guest speakers finalized are respected **Dr. Rajiv kumar Chugh** sir on the topic "**Endodontic Failures**" and **Dr. Cleopatra Nacopoulos** mam on the topic "**Pre Aesthetic Cleopatra Techniue**".



**INDIAN DENTAL ASSOCIATION UP STATE**

PRESENTS  
**UP STATE CDE**

**HOSTED BY: IDA MORADABAD BRANCH**

**GUEST SPEAKERS**

**ON**  
**"ENDODONTIC FAILURES"**



**Dr. Rajiv K. Chugh**  
Sec. General, ICD  
India, Sri Lanka, Nepal Section



**Dr. Cleopatra Nacopoulos**  
President  
WAUPS Aesthetics, France

**ON**  
**PRF AESTHETICS-  
CLEOPATRA TECHNIQUE™**

**On 06th September 2020 At 06:00 pm**

**THROUGH "ZOOM APP"**







12- आई टी व गवर्नाइ के जगह गवर्नाई को अनिवार्य करने की वेबसाइट  
[www.mahatma.org.in/2017/03/04/आईटी-गवर्नाई-को-अनिवार्य-करने-की-वेबसाइट/](http://www.mahatma.org.in/2017/03/04/आईटी-गवर्नाई-को-अनिवार्य-करने-की-वेबसाइट/)

[3.3] यह विषय गणना विषय पर लोगों की अभिरूपा के अनुसार है। अपेक्षित अधिकतम माना गया है।



14-3-2020 को 16-प्रश्नोत्तर सत्र में डॉ. प्रमोद यादव और डॉ. अश्विनी कुमार शर्मा ने सहभागिता जताई।



President (Hon.)  
Dr. Akshay Tripathi  
Joint President  
Dr. Shreyas Shrivastava  
Hon. President  
Dr. Nishat Mithal  
Dr. B. S. Gauri

Prof. Jyoti Bhatnagar  
Dr. Vinod Kumar  
Prof. Anil Kumar  
Dr. Rajesh Singh  
Prof. Shrivastava  
Dr. Nilesh Jaiswal  
Prof. S. S. S. S.  
Dr. G. K. Tripathi

Dr. G. S. Singh  
Dr. A. P. Singh  
Dr. J. R. Puri  
Dr. G. S. Singh  
Dr. A. P. Singh  
Dr. J. R. Puri  
Dr. G. S. Singh  
Dr. A. P. Singh  
Dr. J. R. Puri

Dr. Shreevastava  
Dr. Vikas Patel  
Dr. Sunil Mehta  
Dr. Ranjan Baghel  
Dr. Gurpreet Singh  
Dr. Anshu Sharma

8. प्रति व्यक्ति आय का एक अनुमान यह है कि भारत वर्ष में प्रति व्यक्ति वार्षिक आय 1000 रु. है। प्रति व्यक्ति आय का अनुमान करने के लिए प्रयुक्त सूचकांक है—



8-पूरा प्रमाण प्रमाणित है कि वर्ष 2022 से शीतल को संलग्नित नए व पुराने पत्रों के माध्यम से प्रमाणित किया गया है।



29. जलवायु के परिवर्तन, जलिक से जलिक सतह में आई है व की लहरों में उदयनित करने का समय सतह किता सतह जो कि जलवायु आई है और जलवायु

11-**सिद्धि** (1) जब स्थिति समझी है और निष्कर्ष-सिद्धि का निर्धारण हो जाता है तो वह सिद्धि ही वास्तविकता के साथ मेल खाती है।

President: **Dr. H. S. Dhillon**  
Vice President: **Dr. H. S. Dhillon**  
Secretary: **Dr. H. S. Dhillon**  
Treasurer: **Dr. H. S. Dhillon**

Prof. Jyoti Bhatnagar  
 Dr. Vinod Kumar  
 Prof. Arun Samal  
 Dr. Mahesh Singh  
 Mrs. Indira  
 Dr. Shashi Kumar  
 Mrs. Ritu  
 Dr. Anand Prasad

**Editorial Board**

Dr. Deepak Singh  
Kirti Chaurasia  
Dr. Anshu K. Ghoshal  
Executive, Government Revenue  
Dr. A.P. Singh  
Dr. Jit Yadav  
Dr. S.K. Srivastava  
Dr. Pawan Thakur

Dr. Nitin Wadhvani  
Dr. Navin Mishra  
Dr. Rajan Bajaj  
Dr. Ganesh Singh  
Dr. Sandeep Gupta

६. प्रत्यक्ष - यहाँ से जाते ही व. राजा काकाजी के दुखाने सिने गये प्रत्यक्ष जहाँ के सिने में ही, व. राजा काकाजी से सम्बन्धित सिने गये।

4. 29 फरवरी 2020 को सुप्रीम कोर्ट ने निर्देश दिया कि सभी को 5 फीस पर सड़क से जाने वाले ठिकाने पर जाने से बचाव के लिए 10 मीटर की दूरी बनाए रखनी चाहिए।

[illegible]

Dr. Mark Treppe  
Dr. Sheng Wu  
Dr. Ronald Smith  
Dr. S.B. Towner

Dr. Harold Krummel  
Phys. and Astron.  
Dr. Arthur H. Wright  
Phys. Astronomy  
Dr. David Johnson  
Chem. Physics  
Dr. Robert Krummel

Dr. Dhanraj Singh  
Gifted Curriculum  
Dr. Rajesh Choudhary  
Paradise Curriculum  
Dr. R.R. Singh  
Dr. J.R. Puri  
Dr. R.K. Sharma  
Dr. Ramesh Choudhary

Dr. Nitin Datta Singh  
Dr. Sushil Mathur  
Dr. Rajesh Singh  
Dr. Sarjany Singh  
Dr. Sushant Mathur

कृपया ध्यान दें कि निम्नलिखित सूची केवल सूचना के लिए है। इस सूची में सूचीबद्ध सूचनाएं हमारे द्वारा प्राप्त की गई हैं। सूची में सूचीबद्ध सूचनाएं हमारे द्वारा प्राप्त की गई हैं। सूची में सूचीबद्ध सूचनाएं हमारे द्वारा प्राप्त की गई हैं।

[illegible]

7-सं की समता के ली एक संकेत को एक हीसाँ से आकार के समान समझाते हैं।

काली जीने, ब्रह्मदेव काशी के सभी शरीरों का संस्कार करके वहीं रुक गयीं। ब्रह्मदेव काशी में रुक गये। ब्रह्मदेव काशी में रुक गये। ब्रह्मदेव काशी में रुक गये।

[illegible][illegible][illegible][illegible]

आई टी व ब्रान्चिंग टावर के अलावा ही आईटी, एडमिन व एडिजि के माध्यम से आप अपने प्रशासनिक काम ऑनलाइन कर सकते हैं। आई टी व ब्रान्चिंग टावर के लिए भी प्रशिक्षण है।

डॉ. पट्टीन अय्यंगर  
अध्यक्ष  
आर्य समाज

डॉ. मनीष कुमार शिन्हा  
अध्यक्ष  
राष्ट्रीय पत्रकारता आयोग

President (Hon.  
Dr. Bala Vengalil)  
Vice President (Dr. George Mathew)  
President (Hon.  
Dr. B. B. Pillay)

Prof. J. J. van der Vliet  
 Dr. M. J. J. van der Vliet  
 Prof. A. J. J. van der Vliet  
 Dr. A. J. J. van der Vliet  
 Prof. J. J. J. van der Vliet  
 Dr. M. J. J. van der Vliet  
 Prof. A. J. J. van der Vliet  
 Dr. A. J. J. van der Vliet

100% Insurance  
 Dr. Anupam Singh  
 100% Insurance  
 Dr. Anupam Singh  
 Resident Coordinator, Hyderabad  
 Dr. A.P. Singh  
 Dr. J.R. Yadav  
 Dr. R.P. Sharma  
 Dr. Pawan Singh

**Dr. Wilkes-Kapling**  
**Dr. Susan Mader**  
**Dr. Margot Siegel**  
**Dr. Emily Singh**  
**Dr. Kenneth Strick**



## **Activities of IDA Purvanchal Branch (May-2020- July-2020)**

*Author- Dr. Rajeev Gulati, Vice Chairman, Purvanchal Institute of Dental Sciences, Gorakhpur*

It's been over 6 months since COVID-19 has been relentlessly spreading havoc across the globe and brought our country to a standstill. Times have been tough and our collective patience, determination and solidarity to see this through has been tested throughout these past 6 months. Purvanchal Institute of Dental Sciences has been at the forefront of fight against COVID-19 in Eastern Uttar Pradesh.

### **AS A QUARANTINE CENTRE AND LEVEL-1 HOSPITAL (May 2020-July 2020)**

On 28<sup>th</sup> of April, we received a call from the Gorakhpur district authorities to start a special joint operation at our institute by converting it into a dedicated **Level-1 COVID Hospital and Quarantine facility**. After a thorough inspection conducted by a team including the District Magistrate (DM), Senior Superintendent of Police (SSP) and the Chief Medical Officer (CMO), we recognized the areas of the institute which could be converted into a quarantine facility and decided to use the lecture theatres, library and seminar halls for this purpose, and our in-campus 100 bed hospital to be converted into a Level-1 COVID Hospital to treat mild COVID positive cases.

After a deep sanitization, procuring PPE'S, thermal scanners, diagnostic kits, recruiting doctors and paramedical staff, mattresses and pillows, basic daily requirements and food catering, we started the facility on 1<sup>st</sup> of May during the peak of migrant movement across India. Gorakhpur is home to thousands of people who move to bigger cities seeking better employment opportunities. With many of them heading back home, especially from badly affected states such as Maharashtra and Gujarat, they were required to undergo a mandatory 14 days institutional quarantine. Over a period of two and a half months, we have played host to over 2000 people returning home, out of which many were diagnosed positive for COVID-19, treated at the facility and sent home thereafter.



*DM Shri K. Vijendra Pandian, SSP Dr. Sunil Gupta and SDM Smt. Anuj Malik inspecting the facility*



*Lecture halls being converted into a quarantine facility*





Hospital being prepared as per Level-1 health facility standards to treat mild COVID positive cases.



*Dr. Ayush Gulati- MD along with the District Magistrate Shri K. Vijendra Pandian and Sub Divisional Magistrate Smt. Amj Malik at the inauguration.*

### **AS A DEDICATED 100 BED LEVEL-3 HOSPITAL (August 2020- Present)**

As COVID-19 cases started growing exponentially in Uttar Pradesh, the government hospitals got



overwhelmed with large influx of cases. In August, we were requested by the government to handover our hospital to a private group specializing in COVID treatment protocol to convert it into a Level-3 COVID Hospital. Keeping in mind the current unprecedented situation and for the benefit of society at large, we happily agreed to handover the hospital free of cost and without any conditions until such time colleges are allowed to reopen by the government. After an overhauling of the existing hospital infrastructure to match COVID-19 hospital standards and protocol, the facility was started in the

last week of August. Since then, more than 300 patients of COVID-19 have been treated.





# Key

## Across

- 5 Gingivitis
- 7 Plungercusp
- 8 hygiene

## Down

- 1 Calculus
- 2 vBiologicalwidth
- 3 Enamel
- 4 Diastema
- 6 TopSurface



## **SUBMISSION GUIDELINES**

The IDA U.P. State Dental Journal is a peer reviewed online journal published quarterly with the aim of publishing original full-length research articles, reviews and case reports pertinent to dentistry. Issue contents are available online.

### **Submission of manuscripts :**

Manuscripts that are being submitted should be complete in all respects, and deal with original material not previously published, or being considered for publication elsewhere. The original, written in English, complete with tables and/or figures, should be uploaded on the website along with the mandatory submission form. The preferred storage medium is a file in MS Word (Windows) format, although other systems may also be welcomed. If accepted, the manuscript should not be published elsewhere in the same form, in either the same or another language, without the consent of the Editor. Manuscripts should accompany mandatory submission form signed by all the authors. The form is available for download from the website of the journal.

### **Ethics :**

Manuscripts that reveal a lack of proper, ethical consideration for human subjects or experimental animals will not be accepted for publication. Manuscripts should be accompanied by a statement that all efforts were made to minimize animal suffering, to reduce the number of animals used, and to utilize alternatives to in vivo techniques, if available.

### **Conflict of Interest :**

All authors are requested to disclose any actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations.

### **Style of manuscripts :**

#### **General**

Manuscripts should be typewritten with double-spacing (at least 6 mm between lines) on A4 size (21 × 29.5 cm) with ample margins (at least 2.5 cm) on all four sides. Number pages at bottom, as follows:

Page 1. Title Page: complete title; first name, middle initial, surname of each author with academic affiliations; mailing address, phone and FAX numbers, and e-mail address of corresponding author for editorial correspondence.

Page 2. Abstract: not more than 200 words, followed by 3 to 6 keywords. Beginning on page 3: Introduction, Materials and Methods, Results, Discussion, Acknowledgments,

References, Tables, Figures with legends. All pages should be numbered consecutively and stored in one file, the title page being page 1.

#### **Methods**

Give manufacturer's name and location (city, country) in parentheses for reagents and instruments. Quantitative results must be supported by appropriate experimental design, statistical tests, and P values.

#### **References**

References should be numbered consecutively in the order in which they appear in the text. References should include the beginning and ending page numbers. Identify references in the text, table and figure legends by Arabic numbers in parentheses such as (1), (2,3), and (1,3,4-8). Use the style of the examples below. Abbreviations of journals should conform to those of Index Medicus.

Manuscript accepted but not published may be cited in the reference list by placing "(in press)" after the abbreviated title of the journal. Manuscripts written in languages other than English should be limited. Cite unpublished work as such in the text. Personal communication should be acknowledged in the text and accompanied by written permission. The author(s) has(ve) the responsibility for correct citation of the references.



## Sample References

### [ Journals ]

1. De Jager N, Pallav P, Feilzer AJ (2005) Finite element analysis model to simulate the behavior of luting cements during setting. *Dent Mater* 21, 1025-1032.
2. Mikami A (2007) Comparative evaluation of metal priming agents applied for bonding of magnetic stainless steel with acrylic repair resin. *J Oral Sci.* (in press)
3. Avoid referencing abstracts if possible. If unavoidable, reference as follows: Ando M, Eckert GJ, Zero DT (2008) Longitudinal assessment of dynamic process of caries lesion with microfocus computed tomography. *Caries Res* 42, 1204. (Abstract) [ Books ]
4. Sternberger LA (1979) *Immunocytochemistry*. 2nd ed, John Wiley & Sons, New York, 5-31.
5. Mastronarde DN, Laninsky MS, McIntosh JR (1997) Superthin serial sectioning for high-resolution 3-D reconstruction of cellular structures. In: *Proceedings of microscopy and microanalysis 1997*, Vol 3, Suppl 2, Bailey GW, Dimlich RVW, Alexander KB, McCarthy JJ, Pretlow TP eds, Springer, New York, 221-222.

### [ Others ]

6. International Organization for Standardization (2000) *Dentistry -- Polymer-based filling, restorative and luting materials*. ISO 4049:2000, Geneva.
7. Health Policy Bureau Ministry of Health and Welfare, Japan (1995) *Reports on the survey of dental disease*. Oral Health Association, Tokyo, 156-258. (in Japanese)
8. Ibaragi K, Kazama H, Oguri M (2003) Dental catalyst for chemical polymerization and use thereof. US Patent 6660784, Dec 9.

### Figures and tables

Each illustration should be numbered consecutively with Arabic numbers and accompanied by a legend clearly describing it. All illustrations must be submitted in a form and condition suitable for reproduction. Each table should be clearly titled and provided with a comprehensive legend. Statistical measures of variation, SD, SEM etc. should be identified. Tables should be numbered separately in Arabic numbers (Table 1, 2 etc.).

### Case reports

The journal also publishes case reports dealing with novel approaches towards restorative treatment or represent new disease entities or cases with a highly unusual appearance or extremely rare cases. The authors should describe in the discussion section of the report about what makes the case interesting and novel from past reports. Include the necessary documentations (clinical photograph, radiograph, microscopic figure, etc.).

### Proofs

Proofs will be sent to the corresponding author. Only printer's errors must be corrected; no change in, or additions to, the edited manuscript will be allowed at this stage. The corrected proofs must be returned within 2 days of receipt by e-mail accompanied by high quality photograph of the author. If the Editor receives no reply after approximately 2 weeks, the assumption will be made that there are no errors to correct and the article will be published after in-house correction.

## DISCLAIMER

- All the articles and opinions published in this journal are solely those of the author (s).
- The Journal / editor bears no responsibility what so ever.
- All suggestions and comments are welcome.

**Hon. Editor**  
UPSDJ