

Changing Dynamics of Dental Practice in COVID-19 Pandemic

Shahzad Ali Shah

BDS, FCPS Associate Professor/Head Department of Restorative Dentistry College of Dentistry in Ar-Rass Qassim University Saudi Arabia

Abstract:

Corona Virus Disease 2019 (COVID-19) is amongst the biggest impel of global change that has occurred since the last outbreak of Spanish Flu in 1918-20. COVID-19 was first reported in China in November 2019 & has since spread to all continents except Antarctica. World Health Organization (WHO) declared COVID-19 as a pandemic in March 2020. There has been loss of thousands of individuals and millions are infected around the globe.

The content of this review was mostly drawn from the online search using three search data bases PubMed, EMBASE and TRIP as well as CDC and ADA guidelines associated with COVID-19. The inclusion and exclusion criteria for the eligibility of articles were set according to Prevention, Intervention, Control and Outcome (PICO) format. Manual search for Journal of American Dental Association and New England journal of Medicine was also conducted as these are among the first to report the COVID 19.

The types of studies included for this review were published in peer review journals in English language, original research, cross sectional observational studies, case reports, case series, laboratory-based studies, published reviews and guidelines. The exclusion criteria include animal studies, pediatric practice studies, data from unpublished papers, randomized control trials and rapid communications. The studies which fulfill the inclusion criteria (N=60) were selected from a total of 1029 articles searched on selected data bases as well as manual search.

Dental practice in the future will never be the same due to COVID-19. The overall cost of the treatment will be increased due to number of reasons such as, frequent use of additional means such as PPE, practice modifications, decrease in number of patients and increase patient waiting time due to segregation and social distancing protocols applied in the waiting area.

Psychological impact of the corona virus on the practitioners is great due to occupational health risk. Severe COVID-19 cases have mortality rate of 2.3 to 5%. Recently there has been a vaccine trail available for public.

Due to the overall impact of COVID-19 lockdowns, dental practices will be closed for extended periods creating uncertainty, reducing income and more job loss.

KEY Words Corona virus, pandemic, dental practice, COVID-19, Vaccine

INTRODUCTION

On 17th November 2019, the first case of severe pneumonia of unidentified cause was admitted to the hospital in Wuhan city, China. The pathogen identified was a novel enveloped RNA beta-coronavirus 2, which has a phylogenetic similarity to SARS-CoV. The infection has now been controlled and eradicated from Wuhan city. (1-4)

Background

The clinical manifestations of the patients diagnosed with COVID-19 are high temperature, productive cough and fatigue with abnormal computed tomographic readings of the chest, head ache and diarrhea. This new virus is more prone to affect immune-compromised and old age people with severe respiratory symptoms warranting ICU admission and mechanical ventilation support. (5) (6) Chinese researchers had rapidly processed its genome (29,903 nucleotides), (7) and WHO named the virus as corona virus disease (COVID-19). COVID-19 was later declared as pandemic and the world were asked to take necessary steps to prevent further spread of disease without producing any panic. (8)

Properties of Novel corona virus (2019-nCoV) {Fig 1}

Corona viruses belong to a group of Corona viridae, comprising large, single, plus-stranded RNA as their genome. (9) Recently, four generations of corona viruses are isolated namely: α -CoV, β -CoV, γ -CoV, and δ -CoV. (10, 11) The α -CoV/ β -CoV mainly cause infections in humans and other mammals, while γ -CoV/ δ -CoV mainly infect birds. (12)

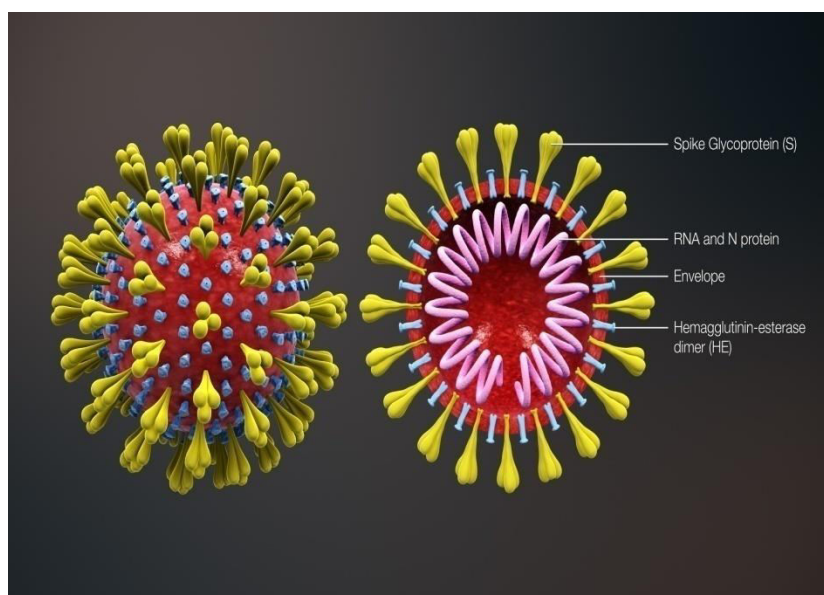


Figure 1: Novel corona virus 2019 (nCoV-2019) courtesy: (Google images)

Corona viruses are zoonotic, that are transmitted between animal and humans. Foreknown corona viruses are found in animal's blood that has not diseased the humans so far. (13) Different corona viruses are responsible for minor respiratory disease symptoms; however, SARS-CoV and the Middle East respiratory syndrome corona virus (MERS-CoV) explored in 2002-03 and in 2012, respectively, caused severe respiratory diseases. (14, 15) 2019-nCoV explored in Wuhan belongs to the β -CoV family according to viral genome. (16)

Review Design

The purpose of this particular review was to ascertain a change in dynamics of dental practice due to Corona virus pandemic. The goal of this review was to provide information about the changes that have been occurred in the past seven months in dental practice all over the world, and also to find out the future scope of dental practice in light with COVID-19 pandemic.

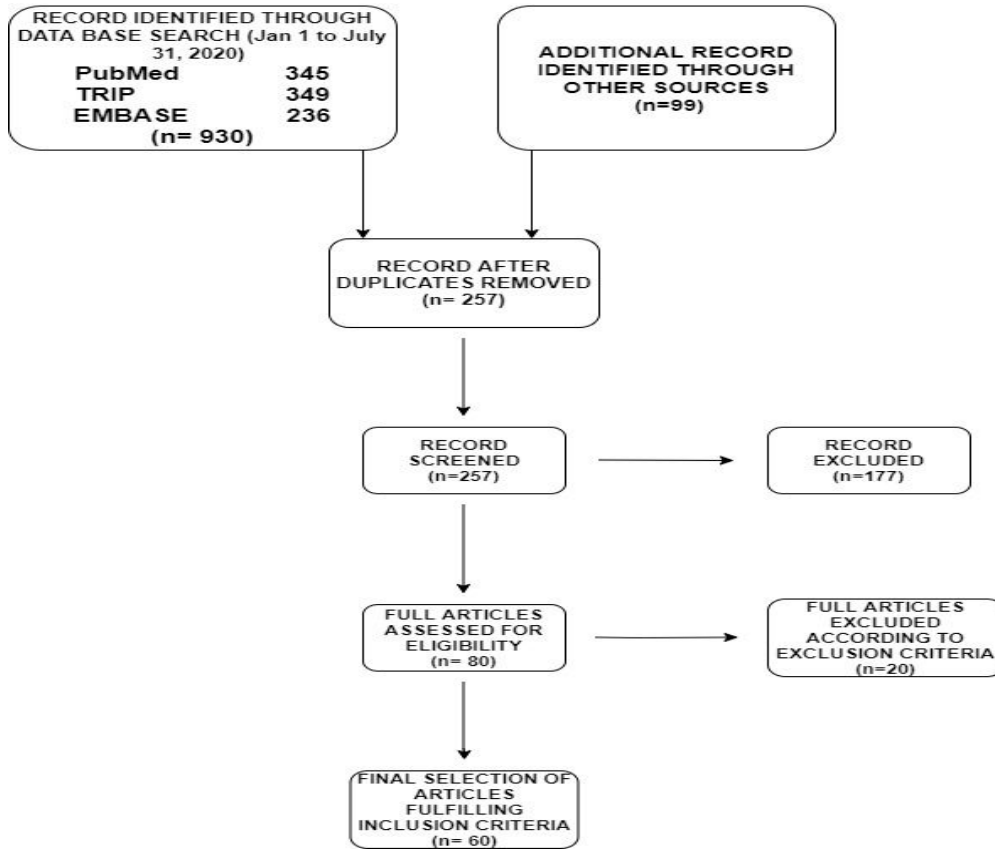
The study was designed by conducting an online search of three data bases namely PubMed, TRIP and EMBASE for early published, peer reviewed studies from 1st January 2020 to 31st July 2020 that showed the impact of corona virus on dental practices by using selected key words. Manual search for Journal of American Dental Association and New England Journal of Medicine was also conducted as these were among the first to report the COVID 19.

The types of studies included for this review were published in peer review journals in English language, original research, cross sectional observational studies, case reports, case series, laboratory-based studies, published reviews and guidelines. The exclusion criteria include animal studies, pediatric practice studies, data from unpublished papers, randomized control trials, commentaries, letter to the editors and rapid communications. Cross referencing was also conducted from the existing articles to find other researches for inclusion in this review.

Results

The studies which fulfill the inclusion criteria (N=60) were selected from a total of 1029 articles searched on selected data bases as well as manual search. The articles were individually screened for eligibility, after deleting duplicates via citation manager and screening articles by title, it was processed for in depth screening. 60 articles met the inclusion criteria. Screening and determination of inclusion eligibility was established using preferred Reporting Items for Systemic Review and Meta-analysis (PRISMA) guidelines. (17) Table 1

**Table 1. Study Design
(PRISMA FLOW)**



Current update on global spread of 2019-nCoV

Currently, the global situation of 2019-nCoV is highly infectious and rapidly spreading to other countries, exceeding 215 countries having COVID-19 active cases, and other areas recording suspected cases. (22,23) Globally around 11,586,471 confirmed cases had been reported as of July 5th 2020 and more than 5,52,371 reported deaths. Continents wise spread report more than 9 countries are involved in South America; millions of cases have been identified in the Central American region, USA and Canada. In Asia, more than 50 countries have confirmed COVID-19 reported cases. In Africa the number of countries with confirmed reported cases is more than 30. In Europe, 52 countries are infected with COVID-19. (18) (Fig 2)

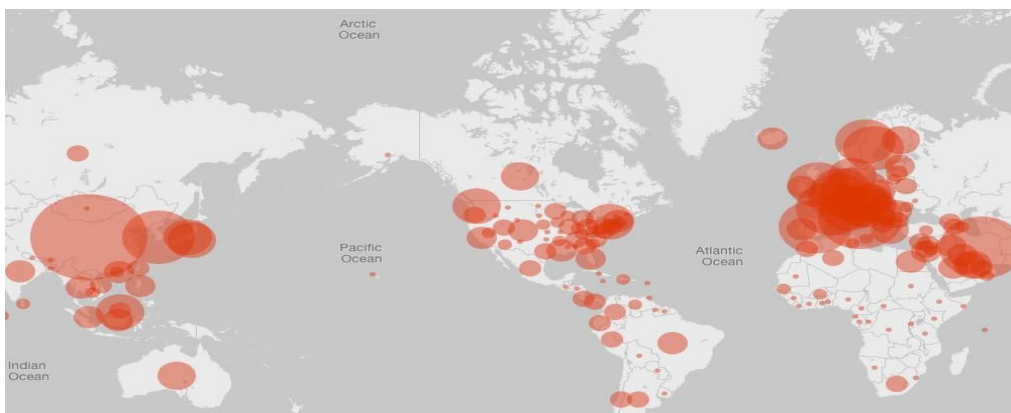


Fig 2. Corona virus map: Distribution of COVID-19 as of 5th July 2020 (WHO credit)
Image produced by permission of WHO

Updated July 5th, 2020

COVID-19 cases	Deaths	Recovered
11,586,471	5,52,371	6,553,100

Courtesy: worldmeters.info

Transmission course of 2019-nCoV

Among the most frequent modes of transfer of corona virus include; direct course (cough, sneeze and droplet inhalation) and contact transmission (oral, nasal and eye mucous membrane). The viral spread is also reported to be through direct contact with individuals having minimal signs and symptoms. Clinical manifestations of COVID-19 do not manifest any olfactory or ocular impairment but some studies reported temporary loss of smell. (19-21) Several studies have shown that this virus may be suspended in the air through aerosols formed during different dental practices such as cavity preparation in operative dentistry, access chamber opening in endodontics and crown cutting procedure. (22) Novel corona virus (2019-nCoV) is transmissible during airborne state for 3 hours, 24 hours on card board/wooden surfaces and 3 days on stainless steel and plastic surfaces making it is one of the highly contagious viruses ever known to humans. (23), (24) In addition, the normal incubation period of 2019-nCoV is approximately 7 to 24 days, the patient remains infectious even in the asymptomatic state and can spread the virus. (25-27)

COVID-19 in dental clinic

Since the announcement of COVID-19 from WHO as pandemic, health professionals are ranked at the highest risk of infection among which dentists are placed at top of the ranking. (28) Therefore, dental practitioners are advised to get familiar with the spreading pattern of 2019-nCoV, be able to identify the infectious patients and extra protective measures should be taken to avoid rapid viral spread among health practitioners (29), (30) There has been a direct effect of COVID-19 on dental practices due to its close proximity to patients, more than one instrument used during treatment, exposure to body fluids like saliva and blood. In those cases where dental impression has to be sent to the laboratory for crown/bridge fabrication, may also be the source of transmission to the laboratory persons. (31)

The most primary concern of airborne spread of 2019-nCoV in dental clinics is via aerosol and droplet transmission that may be contaminated. The mode of viral transmission and the protection modification involved to combat this is summarized in table 2. In dental practice, usually large amount of droplet and aerosol production cannot be avoided due to the presence of blood droplets in patient saliva and bleeding during dental procedure may be the source of infection. (32, 33)

S.No	Mode of Transmission	When to use while treating COVID + ve	Protective Gear
1	Contact precautions	2-meter distance	Face mask, Gloves
2	Droplet precautions	Within 2-meter distance	Surgical Face mask, gloves, eye protection, Face shield
3	Aerosol precautions	Aerosol producing procedures	N95 mask, gloves, eye protection, disposable gowns, Face shield

Table 2. Treatment modifications in dental clinic for 2019-nCoV

Effect of COVID-19 on Dental practitioners:

According to American Dental Association (ADA), COVID-19 is spreading across the United States and every dental setup has been directed to limit their dental care procedures to urgent care cases only. A recent survey involving more than 15 thousand US dentist is showing more anguish and little faith on future of clinical practice. (34) Dental patients visiting the facility and personnel’s working in dental clinics are invariably at greater risk of corona virus. (23) Center for disease control (CDC) has released an informational hand out for the dentist on the coronavirus disease (COVID-19). (35)

General Dental Council (GDC) in United Kingdom has published SOP’s for remote consultation and prescription for patients in case of cold cases and it was stressed that safety of the patient is of prime

importance. (36) During the outbreak of the virus, establishment of body temperature pre-check and record of all staff and new patients every day is of prime importance. (9) A preprint questionnaire should be prepared for the patient asking questions about their health status and history of contact or travel. The accompanying persons with patients should have their temperature check and they should wear a medical mask all the time once they are in the facility.

It is generally advised that the dentist should follow standard precautions at all times. Patient visiting the dental clinic should first be received at the reception with thermal scan. No handshakes are advised with verbal greetings only. The history of the patient includes any signs of respiratory distress, recent travel history and fever in past 14 days. In case of any suspected case of 2019-nCoV infection, the patient be relieved immediately, quarantined and report to the infection control department. (28)

Hand hygiene is among the most recommended measures indicated by WHO and health care authorities to restrict cross infection with corona virus. (37) (Fig 3) It is usually a common practice for the dentist to wash their hands before and after every procedure that includes contact with patient mucosa, body fluids, blood, saliva, dental equipment and surroundings without disinfection. (38) Hand sanitizers (60% ethanol) are also documented to be effective cross infection control technique and used as a substitute to hand washing in certain cases. (39, 40)

Operative Dentistry & Endodontic Clinics

A Preoperative antimicrobial mouth rinse is recommended that reduces the microbial load in the oral cavity significantly. (41-43) During cavity preparations, face mask and eye protection with transparent side shield as an extra protection for mucous membrane of the eyes, nose and mouth from the mist generated from the high-speed hand piece should always be placed. Protective eyewear may consist of goggles or glasses with solid side-shields. A surgical mask is loosely fitted around the face and do not protect against leakage from the sides, so an N95 mask or FFR's (filtering Facepieces) are strongly recommended in high-risk situations (44-46) (Fig-4). Face shields are appropriate for heavy spatter, but a mask still is required to protect against aerosol that drift behind the shield. (47) Spatter also can pass under the edge of a short shield and strike the mouth. Antifog solution for eyewear can be obtained from opticians or product distributors. The CDC guidelines clearly stated that a single used disposable facemask and body gowns should be used once for every patient and then discarded. (35)

Barrier technique should be fully followed on all surfaces which comes in contact with the patient and the operator like the dental chair, marble surfaces, operator's stool, and unit's instrument tray. It should be thoroughly disinfected after each patient and prepared for the new barrier to be applied for the next patient. (48, 49)

In cases with symptoms of respiratory infection, the operator may consider postponing non-emergency patient or elective dental procedures until the patient is fully recovered with confirmed corona PCR negative test. (Table 3) In case of an emergency like dental sensitivity or reversible/irreversible pulpitis, the dental personnel should first decide whether the facility is designed for the specific procedure or not, in order to prevent any potential viral spread. It is advised to adhere to the universal precautions at all times. (50)

Emergency situations are more common in Endodontic clinics and care must be taken in order to cope with them without getting an infection. Except for true emergency situations, all other patients should be rescheduled for later, especially in case of an outbreak. (Table 3) Airborne COVID-19 spread is possible and risky in some clinical settings and ventilation is essential. (51) Over gloves must be worn on regular gloves to prevent contamination of dental surgery surfaces such as table tops, X-ray handle knobs and history charts. Hand hygiene SOP's must be followed all the time before and after removal of Personal protective Equipment (PPE). Rubber dam, anti-retraction hand piece and high Vacuum suction units can help minimize aerosol. (52) PPE's and face protection are essential with the use of high or low-speed drilling with water spray. If a tooth is diagnosed with painful irreversible pulpitis; access chamber be prepared with chemo mechanical and hand instruments for caries removal under rubber dam isolation and a high-vacuum saliva ejector. The intermediate restorative material (IRM) should be removed gently using hand instrument without the use of ultrasonic instruments. A dentist assistant sharing technique (4-handed dentistry) is important for containment of the infection.

Fixed Prosthodontics Clinics

When preparing crown and bridge cases, rubber dam isolation is not possible, high-speed hand piece abutment preparation increases the chances of aerosol and spatter. Since most fixed dental prosthesis cases does not come under emergency, it should be delayed for minimum two weeks. In case of compromised cases where chances of

crown fractures are high, abutment preparations should be done in a well-ventilated room, with saliva ejector and high vacuum suction. (51)

Digital scanning of hard tissues in oral cavity can be used in all the patients using CAD/CAM technology. It will reduce the number of contacts with patient oral tissues as well as reduction in number of materials and repetitions of procedures. The digital impression can directly be submitted to the laboratory for further processing without any human intervention but overall cost of the procedure will increase. (53)

In situations where CAD/CAM is not available, care must be taken to prevent cross infection in making impressions and associated bite registrations. Barrier protection should be universally applied for personnel against contamination from the mucosa, saliva, and blood. Before making the impression and associated bite registrations, one should use clean, gloved hands to dispense as many materials and disposable items as possible. For infection control, Impression taken in irreversible hydrocolloids should be disinfected following manufacturer instructions before dispensing. Custom resin trays for impressions made with silicon impression materials should be used once and then discarded. Likewise, stock trays should be used only once and discarded. The tray size should be indicated on the patient’s chart to eliminate further try-ins. (49)

For shipping of impressions and associated bite registration assembly to remote laboratory should be regulated by OSHA’s specifications, which states; “Potentially infectious materials such as 2019-nCoV shall be placed in a container which prevents leakage during collection, handling, processing, storage, transport, or shipping to the laboratory. Labeling or color-coding is required when such specimens/containers leave the dental/lab facility.” (54, 55)

Conclusion

Dental practice in the future will never be the same due to COVID-19. The overall cost of the treatment will be increased due to number of reasons such as, frequent use of additional means such as PPE, changes in dental practice style, decrease in number of patients treated per day and increase in patient waiting time due to social distancing protocols applied in the waiting area.

Psychological impact of the corona virus on the practitioners is great due to occupational health risk. There will also be a decrease in elective treatments and patients may choose to perform a one visit emergency treatment or extraction.

Due to the overall impact of COVID-19 lockdowns, dental practices will be closed for extended periods creating uncertainty, reducing income and more job loss.

The pandemic COVID-19 is highly infectious and high levels of precautions are advised in dental practice to prevent its transmission from patient to patient as well as to the dental team. Care must be taken in patient selection and adapting to high level of disinfection. Dentists are advised to attend continuing education programs to expand and update their infection control information in context to COVID-19.

Limitations of the study

- 1.The study search duration is limited to six months, leading to decrease in the number of search items. The study inclusion criteria were restrictive resulting in many studies filtered during the screening.
2. This study does not discuss the effect of COVID-19 on dental education and research.

Conflict of interest

There is no conflict of interest for this article.

Funding

This work is self-funded.

Ethical Approval

No ethical approval is required for this article.

Table 3: Essential and Non-Essential Procedures in Restorative Dental Clinics

Specialty	Procedure Type	Essential	Non-Essential	Additional Remarks
Operative Dentistry	Fillings/restorations		√	
	Incipient caries		√	
	Caries with mild/moderate/severe sensitivity	√		
	Crown fractures (enamel)		√	

	only)			
	Crown fractures (enamel and dentin only)	√		
	Complicated crown fractures	√		
	Crown root fractures (all types)	√		
	Periodontal trauma (all types except concussion)	√		
Endodontics	Bleaching/ Irreversible (symptomatic) pulpitis	√	√	For postoperative pain, acetaminophen is a preferred choice
	Acute periapical periodontitis	√		
	Acute apical abscess	√		
	Cellulites	√		
	Elective RCT		√	
	Surgical endodontics	√		Better delayed if asymptomatic
Fixed prosthodontics	Regenerative endodontic procedures	√		Better delayed if asymptomatic
	Crown preparation for compromised tooth structure	√		
	Crown/veneer/bridge preparation		√	
	Inlays/Onlays		√	
	Other cosmetic procedures		√	

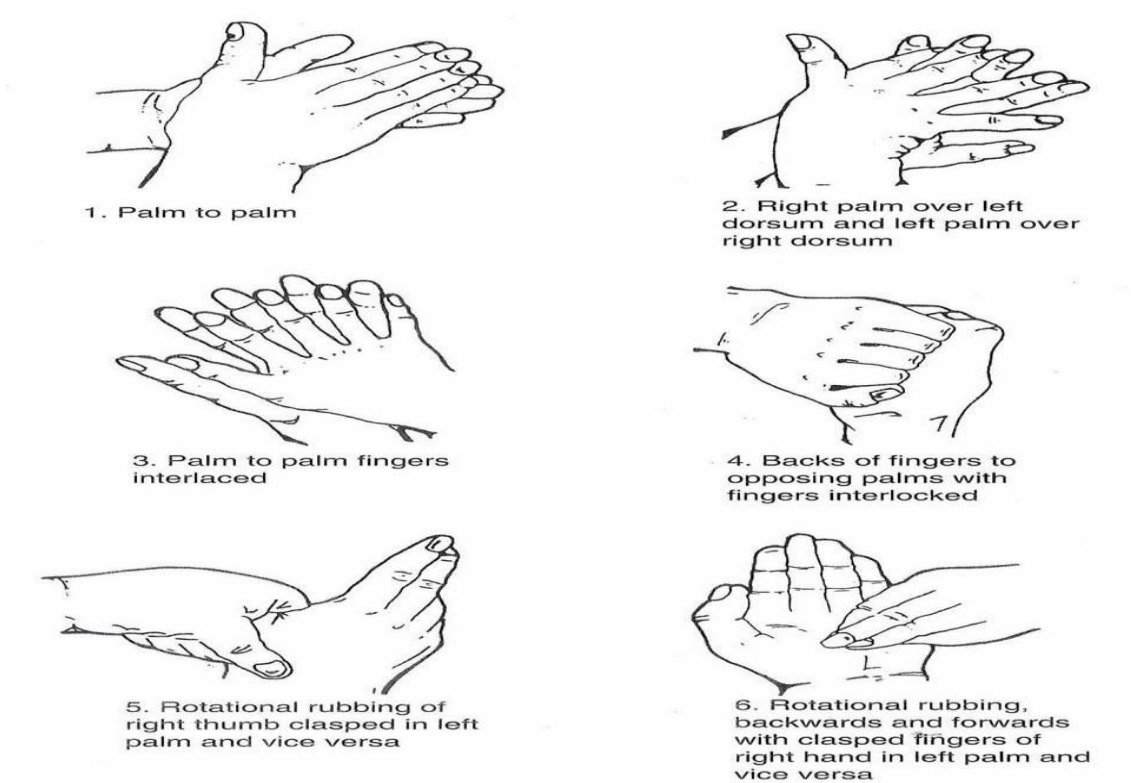


Figure 3: Effective hand washing technique



Figure 4: Mask against N 95 Respirator

References:

1. Chan JF, Yuan S, Kok K, To KK, Chu H, Yang J, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. *The Lancet (British edition)*. 2020;395(10223):514-23.
2. Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, et al. Genomic characterisation and epidemiology of 2019 novel coronavirus: implications for virus origins and receptor binding. *The Lancet (British edition)*. 2020;395(10224):565-74.
3. Zhao W, Song S, Chen M, Zou D, Ma L, Ma Y, et al. The 2019 novel coronavirus resource. *Yíchuán*. 2020;42(2):212-21.
4. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet (British edition)*. 2020;395(10223):497-506.
5. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *The Lancet (British edition)*. 2020;395(10223):507-13.
6. E GA, C BS, S BR, de Groot Raoul J, Christian D, A GA, et al. The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2. *Nature microbiology*. 2020;5(4):536-44.
7. Thao TTN, Labroussaa F, Ebert N, V'kovski P, Stalder H, Portmann J, et al. Rapid reconstruction of SARS-CoV-2 using a synthetic genomics platform. *Nature (London)*. 2020;582(7813):561-5.
8. World Health Organization. Coronavirus disease (COVID-19) outbreak [Internet]. [].
9. Guan W, Ni Z, Hu Y, Liang W, Ou C, He J, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. *N Engl J Med*. 2020;382(18):1708-20.
10. Fan Y, Zhao K, Shi Z, Zhou P. Bat Coronaviruses in China. *Viruses*. 2019 Mar 2;11(3):210.
11. Yin Y, Wunderink RG. MERS, SARS and other coronaviruses as causes of pneumonia. *Respirology (Carlton, Vic.)*. 2018 Feb;23(2):130-7.
12. Perlman S, Netland J. Coronaviruses post-SARS: update on replication and pathogenesis. *Nature reviews. Microbiology*. 2009 May 11;7(6):439-50.
13. Gordon CJ, Tchesnokov EP, Woolner E, Perry JK, Feng JY, Porter DP, et al. Remdesivir is a direct-acting antiviral that inhibits RNA-dependent RNA polymerase from severe acute respiratory syndrome coronavirus 2 with high potency. *The Journal of biological chemistry*. 2020 May 15;295(20):6785-97.
14. Phan LT, Nguyen TV, Luong QC, Nguyen TV, Nguyen HT, Le HQ, et al. Importation and Human-to-Human Transmission of a Novel Coronavirus in Vietnam. *The New England journal of medicine*. 2020 Jan 28;382(9):872-4.
15. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A Novel Coronavirus from Patients with Pneumonia in China, 2019. *The New England journal of medicine*. 2020 Jan 24;382(8):727-33.
16. Weiss SR, Leibowitz JL. *Coronavirus Pathogenesis*. United States: Elsevier; 2011.
17. Campbell M, McKenzie JE, Sowden A, Katikireddi SV, Brennan SE, Ellis S, et al. Synthesis without meta-analysis (SWiM) in systematic reviews: reporting guideline. *BMJ*. 2020;368: 16890.
18. worldmeters.info [Internet]. []. Available from: <https://covid-19.cdc.gov.sa/ar/daily-updates-ar>.

19. Ocular Symptoms of SARS-CoV-2: Indication of Possible Ocular Transmission or Viral Shedding. *Ocul Immunol Inflamm*. 2020;1-11.
20. Bertoli F, Veritti D, Danese C, Samassa F, Sarao V, Rasso N, et al. Ocular Findings in COVID-19 Patients: A Review of Direct Manifestations and Indirect Effects on the Eye. *Journal of ophthalmology*. 2020;1-9.
21. Kumar R, Gupta D. COVID-19: The significance to recognize initial ocular evidence and protective eyewear. *Journal of medical and allied sciences*. 2020;10(2):133-5.
22. Ather A, Patel B, Ruparel NB, Diogenes A, Hargreaves KM. Coronavirus Disease 19 (COVID-19): Implications for Clinical Dental Care. *Journal of endodontics*. 2020 May;46(5):584-95.
23. Peng X, Xu X, Li Y, Cheng L, Zhou X, Ren B. Transmission routes of 2019-nCoV and controls in dental practice. *International journal of oral science*. 2020;12(1):9.
24. van Doremalen N, Bushmaker T, Morris DH, Holbrook MG, Gamble A, Williamson BN, et al. Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1. *N Engl J Med*. 2020;382(16):1564-7.
25. HARREL SK, MOLINARI J. Aerosols and splatter in dentistry: A brief review of the literature and infection control implications. *The Journal of the American Dental Association*. 2004 Apr 1;135(4):429-37.
26. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus–Infected Pneumonia. *The New England journal of medicine*. 2020 Mar 26;382(13):1199-207.
27. Rothe C, Schunk M, Sothmann P, Bretzel G, Froeschl G, Wallrauch C, et al. Transmission of 2019-nCoV Infection from an Asymptomatic Contact in Germany. *The New England journal of medicine*. 2020 Jan 30; 382(10):970-1.
28. Baghizadeh Fini M. What dentists need to know about COVID-19. *Oral oncology*. 2020 Jun; 105:104741.
29. Rupf S, Hannig M. Changes of the patient management in dentistry during the pandemic caused by the SARS-Coronavirus 2-initial perspectives of a clinic of operative dentistry in Europe. *Clin Oral Investig*. 2020;24(7):2537-9.
30. Li G, Chang B, Li H, Wang R, Li G. Precautions in Dentistry Against the Outbreak of Corona Virus Disease 2019. *Journal of infection and public health*.
31. Papi P, Di Murro B, Penna D, Pompa G. Digital prosthetic workflow during COVID-19 pandemic to limit infection risk in dental practice. *Oral diseases*. 2020 May 27.
32. Caly L, Druce J, Roberts J, Bond K, Tran T, Kostecki R, et al. Isolation and rapid sharing of the 2019 novel coronavirus (SARS-CoV-2) from the first patient diagnosed with COVID-19 in Australia. *Medical journal of Australia*. 2020 Jun;212(10):459-62.
33. Wei J, Li Y. Airborne spread of infectious agents in the indoor environment. *American journal of infection control*. 2016 Sep;44(9): S102-8.
34. HPI poll examines impact of COVID-19 on dental practices. [Internet].; 2020 [updated Published on 01 April]. Available from: <https://www.ada.org/en/publications/ada-news/2020-archive/april/hpi-poll-examines-impact-of-covid-19-on-dental-practices>.
35. Clinical Care Guidance for Healthcare Professionals about Coronavirus (COVID-19) [Internet]. []. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-criteria.html>.
36. High Level Principles for Good Practice in Remote Consultations and Prescribing Safeguards for Patients Accessing Healthcare Remotely. [Internet].; 2020 [updated 7 May].
37. Huang GKL, Stewardson AJ, Grayson ML. Back to basics: hand hygiene and isolation. *Current opinion in infectious diseases*. 2014 Aug;27(4):379-89.
38. Yu X, Sun X, Cui P, Pan H, Lin S, Han R, et al. Epidemiological and clinical characteristics of 333 confirmed cases with coronavirus disease 2019 in Shanghai, China. *Transbound Emerg Dis*. 2020;67(4):1697-707.
39. Cruz JP, Bashtawi MA. Predictors of hand hygiene practice among Saudi nursing students: A cross-sectional self-reported study. *Journal of Infection and Public Health*. 2015 Dec 1;9(4):485-93.
40. Hammerschmidt J, Manser T. Nurses' knowledge, behaviour and compliance concerning hand hygiene in nursing homes: a cross-sectional mixed-methods study. *BMC health services research*. 2019 Aug 5;19(1):547.
41. Derde LPG, Dautzenberg MJD, Bonten MJM. Chlorhexidine body washing to control antimicrobial-resistant bacteria in intensive care units: a systematic review. *Intensive Care Med*. 2012;38(6):931-9.
42. Below H, Assadian O, Baguhl R, Hildebrandt U, Jäger B, Meissner K, et al. Measurements of chlorhexidine, p-chloroaniline, and p-chloronitrobenzene in saliva after mouth wash before and after operation with 0.2% chlorhexidine digluconate in maxillofacial surgery: a randomised controlled trial. *British Journal of Oral and Maxillofacial Surgery*. 2017 2016;55(2):150-5.
43. Bashaw, Marie A, DNP, RN, Keister, Kathy J., PhD,RN, CNE. Perioperative Strategies for Surgical Site Infection Prevention. *AORN Journal* (2018-). 2019;109(1):68-78.
44. SAMARANAYAKE LP, PEIRIS M. Severe acute respiratory syndrome and dentistry. *The Journal of the American Dental Association* (1939). 2004 Sep;135(9):1292-302.

45. Seto W, Tsang D, Yung R, Ching T, Ng T, Ho M, et al. Effectiveness of precautions against droplets and contact in prevention of nosocomial transmission of severe acute respiratory syndrome (SARS). *The Lancet* (British edition). 2003 May;361(9368):1519-20.
46. Chua MH, Cheng W, Goh SS, Kong J, Li B, Lim JYC, et al. Face Masks in the New COVID-19 Normal: Materials, Testing, and Perspectives. *Research* (Washington). 2020 Aug 7; 2020:1-40.
47. Public Health Service guidelines for the management of health-care worker exposures to HIV and recommendations for postexposure prophylaxis. Centers for Disease Control and Prevention. *MMWR. Recommendations and reports*. 1998 May 15;47(RR-7):1-33.
48. Hu T, Li G, Zuo Y, Zhou X. Risk of hepatitis B virus transmission via dental handpieces and evaluation of an anti-suction device for prevention of transmission. *Infection control and hospital epidemiology*. 2007 Jan;28(1):80-2.
49. Bonner AM, Davidson P. Technical Tips: Keeping It Clean during COVID-19. *The Neurodiagnostic journal*. 2020;60(3):195-207.
50. Harte JA. Standard and Transmission-Based Precautions an Update for Dentistry. *J Am Dent Assoc*. 2010;141(5):572-81.
51. Ventilation in the Dental Clinic: An Effective Measure to Control Droplets and Aerosols during the Coronavirus Pandemic and Beyond. *The Chinese journal of dental research: the official journal of the Scientific Section of the Chinese Stomatological Association (CSA)*. 2020;23(2):105-7.
52. Samaranyake LP, Reid J, Evans D. The efficacy of rubber dam isolation in reducing atmospheric bacterial contamination. *ASDC journal of dentistry for children*. 1989 Nov;56(6):442-4.
53. Basith A, Bhojaraju N, Mathew M, Subash A, Mohan A, Aboobacker F. Computer-aided designing, and computer-aided manufacturing in prosthodontics: The trendsetter. *International Journal of Oral Care and Research*. 2019;7(1):24.
54. Laboratory Safety Guidance (OSHA) [Internet]. Ann Arbor: ProQuest; 2010 [updated Nov 17;]. Available from: <https://search.proquest.com/docview/1938462906>.
55. control and prevention [Internet]. []. Available from: <https://www.osha.gov/SLTC/covid-19/controlprevention.html#health>.