International Journal of Enhanced Research in Medicines & Dental Care (IJERMDC),
ISSN: 2349-1590, Vol. 7 Issue 6, June-2020, Impact Factor: 5.375

Essential Dental Chemicals

Dr. Karunik Gupta[1], Dr. Bhawya Chaudhary[2], Dr. Rohit Grover[3]

[1]M.D.S in Periodontics, Dental Practitioner, Greater Noida, U.P, India
[2]M.D.S in Periodontics, Dental Practitioner, Gurugram, Haryana, India
[3]Post Graduate Student, Department of Oral and Maxillofacial Pathology, Genesis Institute of Dental Sciences and Research, Ferozepur, Punjab, India

ABSTRACT

From very beginning of the dentistry, chemicals have been used in non-harmful form for various dental purposes. Apart from dental treatments, chemicals used for sanitization of dental clinics, instruments and other utilized equipments are of many ranges. The purpose of this review is to highlight the importance of various chemicals used in dentistry to regulate and achieve required results.

INTRODUCTION

There are several chemicals we all use in our daily life, which have become an essential part of our growth and survival. Chemicals simultaneously indulged in field of health care plays essential role in the dental practice too. The use of chemicals is widespread in dentistry and in the different form such as - restorative materials, cleaning agents, disinfecting and sterilizing agents, anesthetic agents, therapeutic & pharmaceutical substances and other purposes. List of dental chemicals –

Commonly used dental chemicals –

- Formaldehyde
- Acetone
- Hydrochloric acid
- Phosphoric acid
- Glutaraldehyde
- Phenolics
- Alcohol
- Triclosan
- Monomers and Polymers
- Hydrogen peroxide
- Peracetic acid
- Sodium hypochlorite
- Ethylenediaminetetraacetic acid (EDTA)
- Quaternary ammonium compounds
- Calcium Hydroxide
- Zinc oxide-Eugenol

Haemostatic agents of dentistry –

- Ferric subsulfate $Fe_4(OH)_2(SO_4)_5$
- Aluminum chloride ($AlCl_3$)
- Bitartrate ($ZnCl_2$)
- aluminum sulfate ($Al_2(SO_4)_3$)
- Tannic acid (20% and 100%)
- Negatol solution

Future chemicals –

- Hypochlorous acid
- Endocannabinoids
- Hyaluronic Acid

COMMONLY USED DENTAL CHEMICALS

- **Formaldehyde** - In dentistry, patients may be exposed to formaldehyde through the use of several endodontic materials and during formocresol pulpotomies. Formaldehyde solution is bactericidal, sporicidal and virucidal, Formaldehyde is an extremely reactive chemical that interacts with protein, DNA and RNA. When applied to unbroken skin, formaldehyde solution hardens the epidermis, renders it tough and white, and produces a local an aesthetic effect. Root canal cements that produce formaldehyde on setting may allow the material to exert some antimicrobial action to counter the effects of any residual bacteria left in the root canal system at the time of root filling.[1]Formaldehyde is a relatively nonspecific bactericidal agent, affecting the growth and viability of most gram-positive and gram-negative bacteria as well as fungi.[2]

- **Acetone –** As restorative materials number of single solution bonding agents currently in use contain acetone and/or ethanol as the hydrophilic carrier. The role of acetone in the bonding solution is as:
  - Acetone lowers the viscosity of the solution and thus, may enhance the penetration of the bonding agent into the demineralized, collagen rich dentin surface.[3,4]
  - Acetone lowers the surface tension of water.[3,4]
  - Acetone is increasing the vapor pressure of water which as suggested, may enhance the removal of collagen surface water, which could then be exchanged for the acetone and ultimately for the adhesive resin.[3,4]

- **Hydrochloric acid(HCL) and Phosphoric acid(H_3PO_4)** - Fluorosis is the most common type of dental complaint faced in routine practice. The treatment alternatives for fluorozed teeth involve various invasive procedures. Due to large pulp chambers in immature teeth of children, avoiding the loss of enamel structure few non-invasive techniques are followed. Bleaching is an accepted non-invasive procedure.[5]A mild acid etching is done over the surface of the tooth and the acid used for the purpose is hydrochloric acid (HCL) and phosphoric acid (H_3PO_4). More specifically phosphoric acid is used as an etchant prior to the restoration procedures to promote adhesion of primer/bonding agents to both tooth structure and restorative materials.[6]

- **Glutaraldehyde -** Glutaraldehyde is a saturated dialdehyde and accepted as a high-level disinfectant and chemical sterilant. Glutaraldehyde is non-corrosive to metal.[7]Glutaraldehyde with a percentage of 2% is recommended for the sterilization of dental surgical instruments, operating areas, dental impressions and root canals during endodontic therapy. Pulpotomy studies have shown that the use of glutaraldehyde as the fixative agent produce high success rates.[8]

- **Phenolic compounds -** Phenolic compounds are widely used in clinical dentistry as sedatives for the dental pulp, as disinfectants for caries, and as root canal medications.[9] As phenolics are bactericidal, fungicidal, virucidal, and tuberculocidals. In high concentrations, phenol acts as germicides. Hence, are also used to clean clinic floors.[10]

- **Alcohols –** In early days alcohols were taken under consideration as sedatives. It was believed that moderate amount is an effective mild sedative for the relief of mild anxiety in dentistry.[11]Alcohol is used in surgical spirits for disinfecting the surgical armamentarium. It is available in composition of –Ethanol- 60-100%, Methanol- 1-5%, Castor oil- 1-5%, Diethyl puthalate- 1-5%, Pyroligneous acids and Methyl salicylate.[12] Alcohols used in mouthwash to act as a carrier agent for essential active ingredients of mouth wash and as a preservative to prevent bacterial growth and spoilage of mouth wash during its shelf life.[13]

- **Triclosan** - Triclosan is an antibacterial agent with low toxicity, which, along with a copolymer for aiding retention, is added in toothpastes to reduce plaque and gingivitis (inflammation of the gums).[14]

- **Monomers and Polymers -** The monomer are used as composite resin for dental restorative purposes. In the remaining resin composites, urethane monomers or oligorners are used as the basis of the monomer system. Many promising monomer systems have improved the longevity of resin composite fillings and expand the indications for resin composites.[15]Dentistry uses a variety of different polymer materials. Dental polymer materials are based

on methacrylate, its polymer, and polyelectrolytes. Dental polymers are used as dental fillings, for tooth coverings, fabrication of dentures, periodontal pac and other bisphenol A-glycidyl methacrylate resins. dentists use some form of polymer for at least a few of their cosmetic dental procedures. dental polymers is to create replacement teeth, fillings, and dentures with a material that is as hard as a real tooth, is resistant to stains and chipping, is long-lasting, and is a material that has the appearance of a real tooth.[16]

- **Hydrogen peroxide (H_2O_2) -** In dentistry, 3% hydrogen peroxide has been used primarilyto enhance recovery from gingival surgery and to reduce plaque as well as levels of microbial organisms involved in periodontal disease.[17]The known mechanism of H_2O_2 antimicrobial action is the release of oxygen, and pathogenic effects are seen in gram-positive as well as gram-negative organisms.$_1$ Another mechanism of antimicrobial action is the effect the hydrogen peroxide has on the debridement of bacterial call walls. A 10 minute exposure to a 1.7% hydrogen peroxide gel penetrates the biofilm slime matrix and debrides the cell walls of in vitro S. mutans biofilms. Microbiologists have also hypothesized that peroxide delivered and maintained in the sulcus or periodontal pocket releases oxygen and changes the subgingival micro-environment, making it harder for anaerobic bacteria to survive.[18,19,20,21]

- **Peracetic acid (PAA) -** It have its action against bacteria, fungi, spores, and viruses.[22]PAA is used as single endodontic irrigant (cleaning the root canals by the removal of debris).[23,24,25,26] PAA kills and dissolves significantly mixed biofilms.[27,28] It also promotes the adhesion of the root canal sealers.[28]

- **Sodium hypochlorite (NaOCl)** –It has strong antimicrobial effects against bacteria including those organized in biofilms, fungi, and viruses. Qualities of NaOCl are as it is fastacting, can dissolve organic compounds including pulpal tissue, inexpensive, and readily available.[29,30] Its properties originate from the availability of the chlorine ion.[31] Hence, marked as ideal irrigant for irriganting the root canals.[32]

- **Ethylenediaminetetraacetic acid (EDTA) -** EDTA is used as a chelating agent that can bind to metals via four carboxylate and two amine groups. It is a polyamino carboxylic acid and a colorless, water-soluble solid, which is widely used to dissolve lime scale. EDTA reacts with the calcium ions in dentine and forms soluble calcium chelates making easy for removal of smear layers.[33]

- **Quaternary ammonium compounds (QACs) –**They are derivatives of ammonium compounds. They have antimicrobial activity. QACs are used as antimicrobial primer and adhesive for prevention of secondary caries.[34]It kills residual bacteria quickly and play a role of pit and cavity disinfection. It increases life of the restoration material. Combinable use of it is seen in various dental materials such as composite resin, adhesive system, acrylic resin, GIC (Glass ionomer cement), and endodontic materials. Application of QACs is also seen in bone cements[35], titanium pulp capping materials[36], Transbond XT[37], pit and fissure sealing[38], cavity disinfectant[39], resin cement[40], zinc phosphate cement[41], and zinc polycarboxylate cement[42]. QACs have been also proved to be biocompatible with mammalian cells, thus suggesting that their application on dental materials do not represent a threat to human health.[34,43]

- **Calcium Hydroxide -** Calcium hydroxide ($CaOH_2$) has been most widely used in the field of Endodontics as lining of cavities, indirect and direct pulp capping, dressing after pulpotomy, dressing of the root canal between appointments, prevention of root resorption, repair of iatrogenic perforations, treatment of horizontal root fractures, and as a constituent of root canal sealers.[44,45]

  Its extensive use is because of its properties such as initiation and stimulation of mineralization, the antibacterial characteristics, and the dissolution of necrotic material. Its side effects include necrosis of bone, cytotoxicity on cell cultures, damaged epithelium, and cellular damage.[46,47]

- **Zinc oxide-Eugenol -** zinc oxide-eugenol cements are mainly used as temporary fixing contents and filling materials, for gingival dressings and together with filling materials as impression materials. Recently, reinforced zinc oxide-eugenol cements and cements containing ethoxy benzoic acid (EBA) have been developed. These new cements have considerably better mechanic properties and are therefore used for cement bases, indirect capping, long-term temporary fillings and in selected cases as definite fixing cements.[48]

HAEMOSTATIC AGENTS OF DENTISTRY

Hemostatic agents arrest more serious hemorrhage from cut capillaries and arterioles. In general, common hemostatic agents used in dentistry are - Ferric sub sulfate $Fe_4(OH)_2(SO_4)_5$, Aluminum chloride ($AlCl_3$), Bitartrate ($ZnCl_2$), Aluminum sulfate ($Al_2(SO_4)_3$), Tannic acid (20% and 100%), Negatol solution.[49,50,51,52,53,54,55,56]

FUTURE CHEMICALS FOR DENTISTRY

Few of the recently introduced chemicals in dentistry for providing more efficacy and accuracy incases related with routine dental problems are -

- **Hypochlorous acid -**It eradicates all bacteria, mycobacteria, spores, fungi, viruses – even the tough *Clostridium difficile* – within 15 seconds. It disinfects 200 to 300 times better than bleach and is 100% safe. Hypochlorous acid oxidises explodes the cell wall of all pathogens causing necrosis or apoptosis (programmed cell death) and destroys them. Hypochlorous can also be used as disinfectant and in dentistry has been used for dental waterlines – it allows to eliminate biofilm, Other uses: impression disinfectant, instrument soak, ultrasonic baths, disinfect root canals, removing biofilms from implant surfaces, mouthrinse (particularly effective post-surgical), and endodontic irrigation.[57,58,59,60,61,62]

- **Endocannabinoids–**Cannabinoids has antibacterial properties. Cannabinoids are used in various oral care products as they reduce the bacterial load of dental plaque helps in preventing gum diseases.[63,64]

- **Hyaluronic Acid –**It is used for enhancing the aesthetics in dentistry. Hyaluronic acid used as filler to augment the interdental papilla (Interdental Gingiva) and for the treatment of recessed gums.[65,66]

CONCLUSION

In conclusion, these chemicals are used on the basis of requirement and their properties that support the treatment modalities. To achieve better and positive results different chemical combinations are required. All chemicals used in dentistry have played their major role to enhance the quality and ease of work. So far new combinations are still been derived to modify and improve dental materials.

REFERENCES

[1]. Athanassiadis B, George GA, Abbott PV, Wash LJ. A review of the effects of formaldehyde release from endodontic materials. International endodontic journal. 2015 Sep;48(9):829-38.
[2]. Sweetman SC (2011) The Complete Drug Reference. Martindale, 37th edn. London: Pharmaceutical Press, pp. 325, 1788.
[3]. Kanca J. Effect of resin primer solvents and surface wetness on resin composite bond strength to dentin. Am J Dent 1992; 5:213—5.
[4]. Cho, Byeong-Hoon and Sabine H. Dickens. "Effects of the acetone content of single solution dentin bonding agents on the adhesive layer thickness and the microtensile bond strength." Dental materials : official publication of the Academy of Dental Materials 20 2 (2004): 107-15 .
[5]. Bassir MM, Bagheri G. Comparison between phosphoric acid and hydrochloric acid in microabrasion technique for the treatment of dental fluorosis. Journal of conservative dentistry: JCD. 2013 Jan;16(1):41.
[6]. Kumar D, Singh A, Mukherjee CG, Ahmed A, Singh A, Hasija MK, Anand S. Clinical efficacy of hydrochloric acid and phosphoric acid in microabrasion technique for the treatment of different severities of dental fluorosis: An in vivo comparison. Endodontology. 2019 Jan 1;31(1):34.
[7]. Cheung RJ, Ortiz D, DiMarino AJ, Jr. GI endoscopic reprocessing practices in the United States. Gastrointest. Endosc. 1999;50:362-8.
[8]. Rusmah M. Glutaraldehyde in dentistry--a review. Singapore dental journal. 1993 Jun;18(1):17-21.
[9]. Chang YC, Tai KW, Huang FM, Huang MF. Cytotoxic and nongenotoxic effects of phenolic compounds in human pulp cell cultures. Journal of endodontics. 2000 Aug 1;26(8):440-3.
[10]. Rutala WA, Weber DJ. Guideline for disinfection and sterilization in healthcare facilities, 2008.
[11]. McCarthy FM, Hayden JJ. Ethyl alcohol by the oral route as a sedative in dentistry. Journal of the American Dental Association (1939). 1978 Feb;96(2):282-7.
[12]. SN CA. Safety data sheet.

[13]. Chaudhari A, Scheurer H, Pan P, Volpe F, inventors; Warner-Lambert Co LLC, assignee. Alcohol free mouthwash. United States patent US 5,817,295. 1998 Oct 6.
[14]. Riley P, Lamont T. Triclosan/copolymer containing toothpastes for oral health. Cochrane Database of Systematic Reviews. 2013(12).
[15]. Peutzfeldt A. Resin composites in dentistry: the monomer systems. European journal of oral sciences. 1997 Apr;105(2):97-116.
[16]. Chauhan NS, Meghwal K, Punjabi PB, Chaudhary J, Kataria P. Dental Polymers: Applications. Encyclopedia of Biomedical Polymers and Polymeric Biomaterials, Taylor and Francis: New York. 2015 Apr 2:2501-22.
[17]. Marshall MV, Cancro LP, Fischman SL. Hydrogen peroxide: a review of its use in dentistry. Journal of periodontology. 1995 Sep;66(9):786-96.
[18]. Dunlap T, Keller DC, Marshall MV, Coserton JW, Schaudinn C, Sindelar B, Cotton JR. Subclinical Delivery of Oral Debriding Agents: A proof of Concept. J. Clin Dent. 2011;22:149-58.
[19]. Schaudinn C, et al. Manipulation of the Microbial Ecology of the Periodontal Pocket. World Dental. 2010 Feb-Mar; 2(1): 14-18.
[20]. Schaudinn C, et al. Periodontitis: An Archetypical Biofilm Disease. J. Am Dent Assoc. 2009 Aug; 140(8): 978-86.
[21]. Jeanne Bosecker BS. Hydrogen peroxide in dentistry.
[22]. Ordinola-Zapata R, Bramante CM, Garcia RB, de Andrade FB, Bernardineli N, de Moraes IG, et al. The antimicrobial effect of new and conventional endodontic irrigants on intra-orally infected dentin. Acta Odontol Scand. 2013 May-Jul;71(3-4):424-31.
[23]. Viola KS, Rodrigues EM, Tanomaru-Filho M, Carlos IZ, Ramos SG, Guerreiro-Tanomaru JM, et al. Cytotoxicity of peracetic acid: evaluation of effects on metabolism, structure and cell death. Int Endod J. 2018 May;51 Suppl 4:e264-77.
[24]. Cord CB, Velasco RV, Ribeiro Melo Lima LF, Rocha DG, da Silveira Bueno CE, Pinheiro SL. Effective analysis of the use of peracetic acid after instrumentation of root canals contaminated with Enterococcus faecalis. J Endod. 2014 Aug;40(8):1145-8.
[25]. Dornelles-Morgental R, Guerreiro-Tanomaru JM, de Faria-Júnior NB, Hungaro-Duarte MA, Kuga MC, Tanomaru-Filho M. Antibacterial efficacy of endodontic irrigating solutions and their combinations in root canals contaminated with Enterococcus faecalis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2011 Sep;112(3):396-400.
[26]. Lottanti S, Gautschi H, Sener B, Zehnder M. Effects of ethylenediaminetetraacetic, etidronic and peracetic acid irrigation on human root dentine and the smear layer. Int Endod J. 2009 Apr;42(4):335-43.
[27]. Kitis M. Disinfection of wastewater with peracetic acid: a review. Environ Int. 2004 Mar;30(1):47-55.
[28]. Keine KC, Kuga MC, Tormin FB, Venção AC, Duarte MA, Chávez-Andrade GM, Faria G. Effect of peracetic acid used as single irrigant on the smear layer, adhesion, and penetrability of AH Plus. Brazilian oral research. 2019;33.
[29]. Basrani B, Haapasalo M. Update on endodontic irrigation solutions. Endod Top 2012;27:74‐102.
[30]. Zehnder M. Root canal irrigants. J Endod 2006;32:389‐98.
[31]. Moorer WR, Wesselink PR. Factors promoting the tissue dissolving capability of sodium hypochlorite. Int Endod J 1982;15:187‐96.
[32]. Basudan SO. Sodium hypochlorite use, storage, and delivery methods: A Survey. Saudi Endodontic Journal. 2019 Jan 1;9(1):27.
[33]. Mohammadi Z, Shalavi S, Jafarzadeh H. Ethylenediaminetetraacetic acid in endodontics. European journal of dentistry. 2013 Sep;7(S 01):S135-42.
[34]. Zhang Y, Chen Y, Hu Y, Huang F, Xiao Y. Quaternary ammonium compounds in dental restorative materials. Dental materials journal. 2018 Jan 30:2017-096.
[35]. Beyth S, Polak D, Milgrom C, Weiss EI, Matanis S, Beyth N. Antibacterial activity of bone cement containing quaternary ammonium polyethyleneimine nanoparticles. J Antimicrob Chemother 2013; 69: 854-855.
[36]. Susin C, Qahash M, Hall J, Sennerby L, Wikesjö UM. Histological and biomechanical evaluation of phosphorylcholine-coated titanium implants. J Clin Periodontol 2008; 35: 270-275.
[37]. Yang Y, Huang L, Dong Y, Zhang H, Zhou W, Ban J, Wei J, Liu Y, Gao J, Chen J. In vitro antibacterial activity of a novel resin-based pulp capping material containing the quaternary ammonium salt MAE-DB and Portland cement. PloS one 2014; 9: e112549.
[38]. Melo MA, Wu J, Weir MD, Xu HH. Novel antibacterial orthodontic cement containing quaternary ammonium monomer dimethylaminododecyl methacrylate. J Dent 2014; 42: 1193-1201.
[39]. Li F, Li F, Wu D, Ma S, Gao J, Li Y, Xiao Y, Chen J. The effect of an antibacterial monomer on the antibacterial activity and mechanical properties of a pit-and-fissure sealant. J Am Dent Assoc 2011; 142: 184-193.
[40]. Hirose N, Kitagawa R, Kitagawa H, Maezono H, Mine A, Hayashi M, Haapasalo M, Imazato S. Development of a cavity disinfectant containing antibacterial monomer MDPB. J Dent Res 2016; 95: 1487-1493.

[41]. Oguz Ahmet S, Mutluay MM, Seyfioglu Polat Z, Seseogullari Dirihan R, Bek B, Tezvergil-Mutluay A. Addition of benzalkonium chloride to self-adhesive resin-cements: some clinically relevant properties. Acta Odontol Scand 2014; 72: 831-838.
[42]. Korkmaz FM, Tüzüner T, Baygin O, Buruk CK, Durkan R, Bagis B. Antibacterial activity, surface roughness, flexural strength, and solubility of conventional luting cements containing chlorhexidine diacetate/cetrimide mixtures. J Prosthet Dent 2013; 110: 107-115.
[43]. Makvandi P, Jamaledin R, Jabbari M, Nikfarjam N, Borzacchiello A. Antibacterial quaternary ammonium compounds in dental materials: A systematic review. Dental Materials. 2018 Jun 1;34(6):851-67.
[44]. De Bruyne MA, De Moor RJ, Raes FM. Necrosis of the gingiva caused by calcium hydroxide: A case report. Int Endod J 2000;33:67‐71.
[45]. Lačević A, Vranić E, Zulić I. Clinical application of calcium hydroxide in dental pathology and endodontics. Bosnian journal of basic medical sciences. 2003 Nov 20;3(4):26-9.
[46]. Dayakar MM, Pai PG, Sooranagi RP, Vijayan V, Waheed A. Chemical burns of gingiva and its management. SRM Journal of Research in Dental Sciences. 2018 Oct 1;9(4):174.
[47]. Kim D, Kim E. Antimicrobial effect of calcium hydroxide as an intracanal medicament in root canal treatment: a literature review-Part I. In vitro studies. Restorative dentistry & endodontics. 2014 Nov 1;39(4):241-52.
[48]. Brauer GM. Zinkoxid-Eugenol als zahnärztlicher Werkstoff (Teil 1) [Zinc oxide-eugenol as dental material (1)]. *Dtsch Zahnarztl Z*. 1976;31(11):824–834.
[49]. Tarighi P, Khoroushi M. A review on common chemical hemostatic agents in restorative dentistry. Dental research journal. 2014 Jul;11(4):423.
[50]. Rosenstiel SF, Land MF, Fujimoto J. Contemporary Fixed Prosthodontics. 4th ed. St. Louis, Missouri: Elsevier Health Sciences; 2006. p. 431-65.
[51]. Benson BW, Bomberg TJ, Hatch RA, Hoffman W Jr. Tissue displacement methods in fi xed prosthodontics. J Prosthet Dent 1986;55:175-81.
[52]. Mohan M, Gupta A, Shenoy V, Parolia A. Pharmacological agents in dentistry: A review. Br J Pharm Res 2011;1:66-87.
[53]. Fischer D. Tissue management for making impressions. Restorative Techniques for Individual Teeth. New York, USA: Masson Publishing; 1981. p. 247-65.
[54]. Gupta GK, Rao H, Garg P, Kumar R, Sharma A, Sachdeva H. Astringents in dentistry: A review. Asian J Pharm Health Sci 2012;2:428-32.
[55]. Thomas MS, Joseph RM, Parolia A. Nonsurgical gingival displacement in restorative dentistry. Compend Contin Educ Dent 2011;32:26-34.
[56]. Johnston JF, Phillips RW, Dykema RW. Modern Practice in Crown and Bridge Prosthodontics. 3rd ed. Philadelphia: Saunders; 1971.
[57]. Nature's own powerful, non-toxic disinfectant. *Br Dent J***224,** 553 (2018). https://doi.org/10.1038/sj.bdj.2018.302.
[58]. Shajahan IF, Kandaswamy D, Srikanth P, Narayana LL, Selvarajan R. Dental unit waterlines disinfection using hypochlorous acid-based disinfectant. Journal of conservative dentistry: JCD. 2016 Jul;19(4):347.
[59]. Chen CJ, Chen CC, Ding SJ. Effectiveness of hypochlorous acid to reduce the biofilms on titanium alloy surfaces in vitro. International journal of molecular sciences. 2016 Jul;17(7):1161.
[60]. Castillo DM, Castillo Y, Delgadillo NA, Neuta Y, Jola J, Calderón JL, Lafaurie GI. Viability and effects on bacterial proteins by oral rinses with hypochlorous acid as active ingredient. Brazilian dental journal. 2015 Oct;26(5):519-24.
[61]. Kim YR, Nam SH. Comparison of the preventive effects of slightly acidic HOCl mouthwash and CHX mouthwash for oral diseases.
[62]. Kim SB. Development of a mouthwash alternative using a low-level hypochlorous acid solution with macroporous platinum electrodes and its application to oral health. International Journal of Clinical & Experimental Medicine. 2016 Nov 1;9(11).
[63]. Stahl V, Vasudevan K. Comparison of Efficacy of Cannabinoids versus Commercial Oral Care Products in Reducing Bacterial Content from Dental Plaque: A Preliminary Observation. Cureus. 2020 Jan;12(1).
[64]. Özdemir B, Shi B, Bantleon HP, Moritz A, Rausch-Fan X, Andrukhov O. Endocannabinoids and inflammatory response in periodontal ligament cells. PloS one. 2014;9(9).
[65]. Pi S, Choi YJ, Hwang S, Lee DW, Yook JI, Kim KH, Chung CJ. Local injection of hyaluronic acid filler improves open gingival embrasure: validation through a rat model. Journal of periodontology. 2017 Nov;88(11):1221-30.
[66]. Dahiya P, Kamal R. Hyaluronic acid: a boon in periodontal therapy. North American journal of medical sciences. 2013 May;5(5):309.