Journal of Dentistry and Dental Practices
ISSN: 2689-5994

Academic Strive
Researcher's perception is our reality

Review Article *Volume 6 Issue 2*

Chlorhexidine: Still the Antiplaque Agent of Choice in Dentistry

Singh S[1]*, Singh H[2], Bagadi S[1], Mulliqi A[1] and kaur A[3]

[1]Boston University Henry M. Goldman School of Dental Medicine, USA

[2]Division of Orofacial Pain, Department of Oral and Maxillofacial Surgery, Boston University Henry M. Goldman School of Dental Medicine, USA

[3]Oberoi dental clinic, India

***Corresponding author:** Sukhvinder Singh, Boston University Henry M. Goldman School of Dental Medicine, Boston, MA, USA, Email: drsukhvinder@gmail.com

Received Date: June 26, 2024; **Published Date:** July 12, 2024

Abstract

For a very long time, chlorhexidine has been regarded as one of the most efficient antibacterial agents in the field of dentistry. As far as the management of plaque is concerned, it is regarded as the gold standard. Gram-positive and Gram-negative bacteria are both susceptible to the effects of this biocide, which has a broad spectrum of activity. Initially, it was intended to be utilized for the purpose of providing patients with a temporary means of reversing gingivitis. When mechanical debridement could not be preformed, CHX is an excellent preventive agent because of its antibacterial qualities. It would appear that CHX mouthwash is more successful than gel in terms of its effectiveness. Any mouthwash with concentrations higher than 0.2% would needlessly enhance the undesirable side effects. It is advised that the concentration of CHX range from 0.12% to 0.2% for therapeutic purposes. This narrative review is to give an in-depth analysis of chlorhexidine, including topics such as its mechanism of action, effectiveness, safety, and therapeutic uses. This article investigates its capacity to lessen the presence of plaque and gingivitis, analyzes the possible adverse effects, and dives into its applicability in a variety of clinical contexts, such as periodontal treatment, implant care, and the prevention of caries. Generally speaking, chlorhexidine continues to be an essential component of oral care regimens, providing doctors with a potent instrument for the treatment of oral disorders.

Keywords: Antibacterial Agent; Chlorhexidine; Gingivitis

Introduction

Developed in the 1940s in the United Kingdom, chlorhexidine (CHX) is a bisbiguanide that has been promoted as a general disinfectant through its use in the market [1]. Following the discovery of its antiplaque properties in the 1970s, it became available for use as a mouthwash in the year 1976 [1,2]. The etiology of a number of oral disorders, such as halitosis, caries, gingivitis, and periodontitis, has been connected to oral biofilm and the bacteria that are affiliated with it [3-5]. It has been estimated that roughly 47.2% of persons aged 30 and older in the United States have been diagnosed with periodontal disease, while 70.1% of adults aged 65 and older have done so [6,7]. In order to prevent the development of such disorders, it is essential to regulate biofilm. More specifically, it is advised that people clean their teeth with a toothbrush, either manually or with an electric toothbrush, as the primary strategy for preventing plaque and gingivitis [3-8]. It is an anti-microbial drug that has a broad spectrum of activity and causes breakdown of cellular membranes [9].

At the moment, it is utilized as a disinfectant agent for the purpose of cleaning catheters and clinical surfaces that do not contain living organisms. Additionally, it is generally biocompatible, and dental professionals and the general public utilize it as an antiseptic mouthwash to avoid the building of plaque and bacterial biofilm in the mouth [10].

This review highlights the mechanism of action (MOA) of CHX and investigate the most successful procedures regarding the use of CHX in dentistry. Additionally, we will highlight major adverse drug reactions (ADRs) that are relevant to a dental environment based on the most recent literature and clinical trials.

Formulations and Uses

CHX is available in a variety of formulations that are intended for oral administration. CHX is approved for use as a mouthwash with a concentration of 0.12% in the United States (US). It is recommended that all mouth rinse formulations be rinsed with 10 milliliters twice day for thirty seconds; however, for children under the age of twelve, it is only to be used on the recommendation of a healthcare expert (in the United States, children under the age of 18). Additionally, it is recommended for usage for a limited time period, specifically between two and four weeks, and it is only licensed for use for a period of thirty days in the United Kingdom [11,12]. In individuals who have oral candida, it is also possible to soak dentures in Corsody lTM mouthwash for fifteen minutes once or twice a day [13].

CHX mouthwash is a solution that is almost neutral in pH (ranging from 5-7), and it is only recommended for topical use; it should never be administered systemically. Because it is cationic, it forms bonds with the mucosa, tissues, and skin, which has the effect of reducing its ability to be absorbed via these membranes. There is a possibility that thirty percent of the drug will remain in saliva for up to five hours and on the oral mucosa for up to twelve hours after a single rinse, while the plasma levels will remain undetectable [14,15]. Because CHX is poorly absorbed from the gastrointestinal system, even when huge quantities are consumed, this is the reason why this is the case. In general, it is thought to be safe for oral consumption; nonetheless, there have been reports of a few adverse effects and complications, as was mentioned in the following sentence.

Gel versions of CHX digluconate are also available for oral use. For instance, 1% CHX, 0.2% CHX, and 0.5% CHX gel are all commercially available for oral use in the United Kingdom, including over-the-counter (OTC) products. It is also possible for these gels to contain other compounds that aid in muco-adhesion, such as carboxymethyl- (CMC), hydroxypropylmethyl- (HPMC), and hydroxypropyl- (HPC) cellulose, in a variety of different combinations. It is possible to apply 2% CHX gels or ointments to the skin, and this may actually be preferred to the use of 70% alcohol or povidone-iodine prior to the insertion of venous catheters [16]. In a manner similar to that of mouthwash, these oral gels can be applied topically for the management of caries, as an adjunct to mechanical plaque control for gingivitis and periodontitis, and for the treatment of oral candida (including denture stomatitis, which can be applied to the surface of the denture or the oral mucosa), as well as aphthous ulcers.

In addition, oral and dental physicians have access to a product called PeriochipTM or PerioColTM-CG. These products are biodegradable 'chips' that are soaked in 2.5 mg of CHX digluconate. These chips can be put into periodontal pockets in conjunction with sub-gingival debridement. Despite the fact that the success of these medications has not yet been fully clarified [17,18], it is possible that they will create superior clinical outcomes for individuals suffering from periodontitis. Toothbrushes and floss that have been coated with CHX are also now available for purchase in the market.

Mechanism of Action

Please refer to Figure for further explanation. The mechanism of action (MOA) starts with the fast binding of a cationic CHX molecule to the surface of a negatively charged bacterial cell that contains phosphates and sulfate groups [18-20]. Because of its cationic characteristics, CHX forms a link with negatively charged sites inside the biofilm. These sites include the bacteria, extracellular polysaccharides, and glycoproteins [18,21]. Adsorption to phosphate-containing components that are found on the surface of the bacterial cell is induced as a result of this, and it is both selective and powerful [19,22].

Passive diffusion is responsible for the process of penetration through the bacterial cell wall. This process attracts the cytoplasmic membrane of the cell, which causes damage to the membrane and compromises its integrity. This occurrence makes it possible for CHX to penetrate the inner cell membrane, which ultimately leads to an increase in permeability [18,19]. An outflow of low-molecular-weight molecules and cytoplasmic components, such as potassium ions, escapes from the microorganism as a consequence of this process. This results in the inhibition of activity of certain enzymes that are connected with the cytoplasmic membrane [18,19,21].

Although the antimicrobial action of CHX is still in the bacteriostatic stage at this time, it is possible to reverse it if CHX is withdrawn from the environment [18,19,22]. On the other hand, if the concentration of CHX remains unchanged

over time or even increases, this will result in irreversible cell damage and a stage that is bacteriocidal [18,22]. During the bacteriocidal stage, cytoplasmic coagulation and precipitation take place as a result of the formation of complexes with phosphorylated substances. These molecules include nucleic acids and adenosine triphosphate [18,19,22]. Because the majority of oral surfaces, such as mucous membranes, teeth, and salivary glycoproteins, have a negative charge, the cationic character of CHX molecules demonstrates high adherence to these surfaces. As a result, it interferes with the adhesion of germs, allowing for substantivity for a period of up to twelve hours [18,21].

Uses in Dentistry

CHX products are utilized in dentistry for both curative and preventative purposes with equal efficacy [12,23]. To achieve these goals, the optimal dosage of CHX for each application is between 18 and 20 milligrams, which allows for maximum effectiveness while simultaneously minimizing adverse effects [24,25].

The oral microbiome is one of the most complicated habitats, consisting of bacteria, fungus, viruses, and protozoa that are arranged in intricate biofilms with several structures. These biofilms are constantly interacting with one another, as well as with the immune system of the host and with external influences. It is essential for one's health to keep the conditions in a state of equilibrium. To put it another way, any disturbances or distortions to this equilibrium have the potential to result in oral and systemic disorders inside the body. It was found by Bescos, et al. [26] that CHX had the potential to alter the oral microbiome, which would lead to a reduction in the concentration of saliva nitrate. This could potentially have a potentially devastating effect on people who suffer from high blood pressure. In addition, they found that the microbiota shift that is associated with CHX can alter the levels of lactate and glucose in saliva, hence raising the concentration of these substances. Furthermore, the latter is of utmost significance in the recently developed proteome salivary assays, in which the use of CHX for an extended period of time has the potential to produce false positive positive results [27].

Furthermore, Tribble et al. discovered that cleaning the mouth twice daily with a 0.12% CHX solution for a week resulted in a considerable increase in one's blood pressure in healthy people [28]. It was also discovered by Joshipura and colleagues that individuals who used mouthwash twice a day had a considerably increased chance of developing pre-diabetes or diabetes in comparison to those who used it less frequently [29].

Alterations in the microbiome and the interactions between it and biomaterials can also have a negative impact on certain features of the biomaterials and, as a result, the biological response of the host [30].

In addition, chronic gingivitis and chronic periodontitis have different oral pH levels; hence, CHX may be more effective in the alkaline environment of gingivitis as opposed to the acidic environment of periodontitis [26].

As stated by the manufacturers of dental products that include CHX, particularly mouth rinses, the suggested duration of usage is anywhere from two weeks to six months, with a one-month break in between each use [31]. Following the application of 0.2% CHX rinse three times a day for a period of five days, the researchers reported a peak in saliva concentration on the fourth day, which continued to be detectable twelve hours after the final application. Additionally, they found a significant quantity of p-chloroaniline, which is a substance that has the potential to cause cancer to develop [32]. As a result, the advice made by the FDA (Federal Drug Administration) is to restrict the usage of CHX mouthwash to a maximum of six months [32]. Before recommending mouthwash to our patients, it is important to take into consideration the fact that commercially available mouthwash solutions may include as much as 2.5 milligrams of p-chloroaniline-L-chlorhexidine [34].

Conclusion

Chlorhexidine stands as the gold standard in plaque control, owing to its potent antimicrobial properties, substantivity, and clinical efficacy. Despite its long-standing use, ongoing research continues to elucidate its mechanisms of action and explore innovative applications in oral health management. While chlorhexidine remains indispensable in clinical practice, future endeavors aim to refine its formulations and optimize therapeutic protocols to maximize its benefits while minimizing potential adverse effects. Overall, chlorhexidine remains a cornerstone in oral care regimens, offering clinicians a powerful tool in combating oral diseases and promoting periodontal health.

References

1. Raszewski Z, Nowakowska-Toporowska A, Wezgowiec J, Nowakowska D (2019) Design and characteristics of new experimental chlorhexidine dental gels with anti-staining properties. Adv Clin Exp Med 28(7): 885-890.

2. Balagopal S, Arjunkumar R (2013) Chlorhexidine: the gold standard antiplaque agent. J Pharm Sci Res 5(12): 270-274.

3. Farah CS, McIntosh L, McCullough MJ (2009) Mouthwashes, 32. Australian Prescriber. Australian

Government Publishing Service pp: 162-164.

4. Chye RML, Perrotti V, Piattelli A, Iaculli F, Quaranta A (2019) Effectiveness of different commercial chlorhexidine-based mouthwashes after periodontal and implant surgery. Implant Dent 28(1): 74-78.

5. Joshipura KJ, Munoz-Torres FJ, Morou-Bermudez E, Patel RP (2017) Over-the-counter mouthwash use and risk of pre-diabetes/ diabetes. Nitric Oxide 71: 14-20.

6. (2020) Periodontal Disease. Oral Health Conditions. Center for Disease Control and Prevention.

7. Poppolo Deus F, Ouanounou A (2021) Mouthwashes and their use in dentistry: a review. Oral Health 2021: 22-34.

8. Chapple ILC, Van Der Weijden F, Doerfer C (2015) Primary prevention of periodontitis: managing gingivitis. J Clin Periodontol 42: S71-S76.

9. Gilbert P, Moore L (2005) Cationic antiseptics: diversity of action under a common epithet. Journal of Applied Microbiology 99: 703-715.

10. Janakiram C, Venkitachalam R, Fontelo P, Iafolla TJ, Dye BA (2020) Effectiveness of herbal oral care products in reducing dental plaque & gingivitis - a systematic review and meta-analysis. BMC Complement Med Ther 20(1): 43.

11. British Periodontal Society (2016) The Good Practitioner's Guide to Periodontology.

12. James P, Worthington HV, Parnell C, Harding M, Lamont T, et al. (2017) Chlorhexidine mouthrinse as an adjunctive treatment for gingival health. Cochrane Database Syst Rev 3(3): CD008676.

13. (2020) National Institute for Health and Care Excellence (NICE) publication of British National Formulary (BNF). Chlorhexidine.

14. Hoffmann T, Bruhn G, Richter S, Netuschil L, Brecx M (2001) Clinical controlled study on plaque and gingivitis reduction under long-term use of low-dose chlorhexidine solutions in a population exhibiting good oral hygiene. Clin Oral Investig 5(2): 89-95.

15. Roberts WR, Addy M (1981) Comparison of the in vivo and in vitro antibacterial properties of antiseptic mouthrinses containing chlorhexidine, alexidine, cetyl pyridinium chloride and hexetidine. Relevance to mode of action. J Clin Periodontol 8: 295-310.

16. Maki DG, Ringer M, Alvarado CJ (1991) Prospective randomised trial of povidone-iodine, alcohol, and chlorhexidine for prevention of infection associated with central venous and arterial catheters. Lancet 338: 339-343.

17. Kondreddy K, Ambalavanan N, Ramakrishna T, Kumar RS (2012) Effectiveness of a controlled release chlorhexidine chip (PerioCol™-CG) as an adjunctive to scaling and root planing when compared to scaling and root planing alone in the treatment of chronic periodontitis: A comparative study. J Indian Soc Periodontol 16: 553-557.

18. Cosyn J, Wyn I (2006) A systematic review on the effects of the chlorhexidine chip when used as an adjunct to scaling and root planning in the treatment of chronic periodontitis. J Periodontol 77: 257-264.

19. Łukomska-Szymańska M, Sokołowski J, Łapińska B (2017) Chlorhexidine-mechanism of action and its application to dentistry. J Stomatol 70: 405-417.

20. (2020) Lexicomp-Chlorhexidine Gluconate (Oral).

21. Zanatta FB, Antoniazzi RP, Rösing CK (2007) The effect of 0.12% chlorhexidine gluconate rinsing on previously plaque-free and plaque-covered surfaces: a randomized, controlled clinical trial. J Periodontol 78(11): 2127-2134.

22. Thangavelu A, Kaspar S, Kathirvelu R, Srinivasan B, Srinivasan S, et al. (2020) Chlorhexidine: an elixir for periodontics. J Pharm Bioallied Sci 12(5): 57.

23. Shrimathi S, Kemparaj U, Umesh S, Karuppaiah M, Pandian P, et al. (2019) Comparative evaluation of cocoa bean husk, ginger and chlorhexidine mouth washes in the reduction of Steptococcus mutans and Lactobacillus count in saliva: a randomized controlled trial. Cureus 11(6).

24. Lang N, Lindhe J (2015) Clinical periodontology and implant dentistry. In: 6th (Edn.), Wiley-Blackwell; Chichester, UK.

25. Brookes ZLS, Bescos R, Belfield LA, Ali K, Roberts A (2020) Current uses of chlorhexidine for management of oral disease: a narrative review. J Dent pp: 103.

26. Bescos R, Ashworth A, Cutler C, Brookes ZL, Belfield L, et al. (2020) Effects of Chlorhexidine mouthwash on the oral microbiome. Sci Rep 10(1): 5254.

27. Pappa E, Vastardis H, Mermelekas G, Gerasimidi-Vazeou A, Zoidakis J, et al. (2018) Saliva Proteomics Analysis Offers Insights on Type 1 Diabetes Pathology in a Pediatric Population. Front Physiol 9: 444.

28. Tribble GD, Angelov N, Weltman R, Wang BY, Eswaran

SV, et al. (2019) Frequency of Tongue Cleaning Impacts the Human Tongue Microbiome Composition and Enterosalivary Circulation of Nitrate. Front Cell Infect Microbiol 9: 39.

29. Joshipura KJ, Muñoz-Torres FJ, Morou-Bermudez E, Patel RP (2017) Over-the-counter mouthwash use and risk of pre-diabetes/diabetes. Nitric Oxide 71: 14-20.

30. McLean JS (2014) Advancements toward a systems level understanding of the human oral microbiome. Front Cell Infect Microbiol 4: 98.

31. Below H, Assadian O, Baguhl R, Hildebrandt U, Jäger B, et al. (2017) 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. Br J Oral Maxillofac Surg 55(2): 150-155.

32. Pitten FA, Kramer A (1999) Antimicrobial efficacy of antiseptic mouthrinse solutions. Eur J Clin Pharmacol 55(2): 95-100.

33. Kolahi J, Soolari A (2006) Rinsing with chlorhexidine gluconate solution after brushing and flossing teeth: a systematic review of effectiveness. Quintessence Int 37(8): 605-612.

34. Elkerbout TA, Slot DE, Bakker EW, Van der Weijden GA (2016) Chlorhexidine mouthwash and sodium lauryl sulphate dentifrice: do they mix effectively or interfere?. Int J Dent Hyg 14(1): 42-52.