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Research Paper

Chlorhexidine mouthwash in dentistry

Sonal GP Pillai[1], Lynn Johnson[2*], Hiroj Bagde[3]
[1]Ex-Student, Rungta College of Dental Science and Research Centre, Bhilai CG, India.
[2*]Associate Professor, Rama Dental College, Kanpur, UP, India.
[3]Associate Professor Rama Dental College, Kanpur, UP, India.

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ABSTRACT

Background: Chlorhexidine is a widely used antimicrobial mouthwash valued for its strong antibacterial and anti-plaque properties. It has remained an important agent in oral care and is commonly used by dental professionals to prevent and manage periodontal diseases and other oral infections.
Objective: This review aims to summarize the properties, cellular mechanism of action, and clinical applications of chlorhexidine as an antimicrobial agent in dentistry.
Methods: A narrative review was conducted focusing on the pharmacological characteristics of chlorhexidine, particularly its substantivity and broad antimicrobial spectrum. Its various formulations and applications across different dental specialties were also reviewed.
Results: Chlorhexidine demonstrates prolonged antimicrobial activity due to its high substantivity and broad spectrum of action against numerous oral microorganisms. It is frequently incorporated into mouthwashes for plaque control and management of oral diseases. Its antimicrobial effect involves an initial bactericidal action followed by sustained bacteriostatic activity. This prolonged effect is attributed to its ability to bind to oral tissues, tooth surfaces, enamel, and the acquired pellicle, allowing gradual release of the agent. Chlorhexidine is available in several formulations, including mouthwashes, gels, sprays, and restorative materials, and has applications across multiple areas of dentistry. A commonly recommended regimen involves rinsing with 10–15 mL of undiluted chlorhexidine gluconate oral rinse for approximately 30 seconds, followed by expectoration.
Conclusion: Chlorhexidine remains an effective and versatile antimicrobial agent in dentistry because of its substantivity, broad antimicrobial spectrum, and combined bactericidal and bacteriostatic effects. Its diverse formulations support its continued use in the prevention and management of periodontal and other oral diseases.

Corresponding Author:
Lynn Johnson
Associate Professor, Rama Dental College, Kanpur, UP, India.

Journal of Nursing Research, Patient Safety and Practise (JNRPSP)

Email: lynnjohnson380@gmail.com

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1. INTRODUCTION

A mouthwash is a flavored, usually antiseptic solution used for cleaning the mouth and freshen the breath. Mouthwash or mouth rinse is an antiseptic solution used as an effective home care system by the patient to enhance oral hygiene. Chlorhexidine is an ideal broad-spectrum antimicrobial agent. It is effective against Gram-positive and Gram-negative bacteria and fungi. For nearly 60 years, chlorhexidine has been used by hospitals and clinics as a disinfectant and antiseptic for topical and hard-surface applications. Chlorhexidine has become an integral part of the strategy to prevent the transmission of disease and nosocomial infections. It is found in many medicines that are applied directly to the affected area of the body. It is an antiseptic treatment. It is used to treat and prevent infections. In general, this drug is used where infections of the skin, mouth or throat are present or may arise. The treatment and prevention of infections of minor cuts, grazes, burns and scalds, athlete's foot, blisters, stings and insect bites, spots, chapped or rough skin and minor infections of the mouth or throat. It is also used for cleaning the skin before injections and small operations [1].

1.1 Chlorhexidine- History & Structure

Chlorhexidine is a bisbiguanide formulation with cationic properties. The molecule is symmetric with two chlorophenyle rings and two bigunide groups connected by a central hexamethylene chain. It is a strong base and is most stable in the form of salts. The most common preparation is the digluconate salt because of its water solubility. Chlorhexidine was developed in late 1940s as a result of search for antiviral agents. It was found that chlorhexidine does not possess antiviral activity but instead it possesses antibacterial activity. The use of chlorhexidine was begun as a general disinfectant with a broad antimicrobial spectrum. Its antimicrobial spectrum includes most of the microbials such as gram positive and gram-negative organism including bacterial spores, lipophilic viruses, yeasts and dermatophytes etc [2], [3]. Chlorhexidine is extensively used in various medical fields such as gynecology, urology, ophthalmology and treatment of burns etc. The first use of chlorhexidine in dental practice was in washing operation site and disinfecting root canals, subsequently reports appeared in the literature on the plaque control, prevention of caries, as a denture disinfectant, in the treatment of dry socket, apthous ulcers etc [4], [5], [6].

1.2 Mechanism of Action

As an antiseptic mouthwash, CHX has an anti-microbial effect on bacteria, fungus and viruses causative for a number of different oral diseases. In vitro, the anti-bacterial effects of CHX all relate to altered cell membrane permeability. At low concentrations (0.02%-0.06%) CHX causes displacement of Ca2+ and Mg2+ and loss of K+ from the cell wall, resulting in a bacteriostatic effect. At high concentrations (>0.1%) CHX causes leakage of all the main intracellular components out of the cell, resulting in a bactericidal (cell lysis and death) effect [2]. The anti-viral effects of CHX are also due to altered cell membrane permeability and ultimately CHX can inactivate enveloped viruses, such as herpes simplex virus, which are associated with cold sores. However, CHX has little virucidal activity on non-enveloped viruses, including human papilloma viruses (HPV), which may be associated with oral cancers. The anti-fungal effects of CHX however, relate to the prevention of biofilm formation on both biological and non-biological surfaces, by species such as Candida, rather than disrupting the structure or cellular membrane of the microbe. For example, CHX can reduce the amount of Candida albicans adhering to the surface of dentures, as well decrease the numbers of Candida albicans residing on soft tissues in vivo, such as the oral mucosa

[7]. The communities of bacteria, fungi and viruses residing within different niches of the oral cavity comprise the oral microbiome. A diverse oral microbiome is essential for maintaining good oral (and systemic) health. However, when it becomes less diverse, for example with antiseptics such as CHX, it can become dysbiotic [8]. Bacterial oral dysbiosis and has been linked to oral diseases, including caries, periodontitis, oral cancer, peri-implantitis and mucosal diseases. Thus, in recent years, the potential for CHX to induce dysbiosis, including increased prevalence of disease-causing species in vivo, has come to be considered just as important direct bactericidal effect of CHX reported in the laboratory in vitro [2].

1.3 Role in Dentistry

Chlorhexidine (CHX) is one of the most commonly prescribed antiseptic agents in the dental field. It has a long-lasting antibacterial activity with a broad-spectrum of action and it has been shown to reduce plaque, gingival inflammation and bleeding [9]. Its use is considered a powerful adjuvant to mechanical oral hygiene (brushing and flossing), especially in those cases in which it cannot be performed correctly. Available as mouthwash, gel, aerosol, spray and disks, CHX is considered a safe compound, with minimal and transitory local and systemic side effects. Data support its periodic use as an adjuvant to normal brushing and flossing in subjects unable to maintain proper oral hygiene due to physical and/or mental impairment, or lack of motivation, or decreased salivary rate. CHX is also a useful alternative to mechanical oral hygiene procedures in those cases in which they are contraindicated, e.g. after a surgical procedure, or as a preoperative rinse before procedures in which use of a dental dam is not possible. Chlorhexidine gluconate oral rinse can significantly reduce plaque bacteria and prevent the development of gingivitis [10], [11], [12]. The immediate antimicrobial activity of chlorhexidine gluconate can be beneficial to the dental professional as well as to the patient [13], [14]. Several studies support the use of a chlorhexidine gluconate pre-rinse to decrease bacterial aerosol contamination during in-office dental procedures.

1.4 Adverse Effects

The most common side effects associated with chlorhexidine gluconate oral rinses are: 1) an increase in staining of teeth and other oral surfaces; 2) an increase in calculus formation; and 3) an alteration in taste perception. Oral irritation and local allergy-type symptoms have been spontaneously reported as side effects associated with use of Chlorhexidine gluconate rinse despite anti-plaque properties, increased calculus formation has also been reported with 0.12% CHX mouthwash. Other less common side effects include burning sensations (glossodynia), desquamation of the oral mucosa, swelling of the parotid gland and oral paraesthesia [15]. However the most unwanted outcome, that deters patients using of CHX mouthwash, is probably tooth staining. This is common once usage exceeds more than several weeks, due to non-enzymatic browning (Maillard reaction) and the production of pigmented metal sulphide formation in the pellicle [16]. This in turn can also allow tin and iron binding reactions with dietary aldehydes and ketones that enhances precipitation of food components onto teeth. Nevertheless, formulations of CHX are now available to prevent tooth staining, for example 0.2% Curasept ADSTM, where an anti-discoloration system (ADS) has been added to reduce tooth surface staining, via inhibition of the Maillard reaction and protein denaturation. There is also now evidence from systematic review that ADS do not affect the ability of CHX to reduce to gingival inflammation and plaque scores [17]. The more potentially serious side effects associated with the oral use of CHX are the possible Type IV and Type I hypersensitivity reactions accompanied by severe anaphylaxis. For CHX, these are reported at an incidence of 0.78 per 100,000 exposures. There are also case studies reporting that CHX mouthwash can lead to respiratory arrest and death due to severe anaphylactic responses [18]. Hence, although rare, and of limited numbers, such reported allergic reactions have influenced the usage of CHX amongst clinicians in recent years, and must have some bearing when considering risk versus benefit for appropriate use of CHX in the management of all relevant oral conditions. It is unlikely that these reactions are associated with any other components within the mouthwash, which comprises of glycerol, macrogol glycerol hydroxy stearate, sorbitol liquid (non-crystallizing) and purified water, although some formations do contain menthols that does have the potential to irritate mucosal tissues in rare cases. It is suggested that mothers may choose to avoid CHX formulations containing alcohol by US and UK. The advice is more cautious in the US, as the Food

and Drug Agency (FDA) state that CHX may be best avoided, due to the lack of evidence confirming its use is safe during pregnancy and breast feeding. Another emerging issue with CHX is that of antimicrobial resistance (AMR), whereby the micro-organisms it is designed to kill, adapt and become resistant, which means that the mouthwash becomes less effective. There are several mechanisms by which this may occur, including mutation in or the addition of genetic material, leading to changes in cell membrane structure (increased expression of efflux pumps) and promoting the cross-resistance of other bacteria to antibiotics, including amongst the most multi-drug-resistant species [6].

1.5 Deactivation

Chlorhexidine is deactivated by forming insoluble salts with anionic compounds, including the anionic surfactants commonly used as detergents in toothpastes and mouthwashes, anionic thickeners such as carbomer, and anionic emulsifiers such as acrylates/C10-30 alkyl acrylate cross polymer, among many others. For this reason, chlorhexidine mouth rinses should be used at least 30 minutes after other dental products. For best effectiveness, food, drink, smoking, and mouth rinses should be avoided for at least one hour after use. Many topical skin products, cleansers, and hand sanitizers should also be avoided to prevent deactivation when chlorhexidine (a topical itself or the residue from a cleanser) is meant to remain on the skin.

1.6 Evidence Supporting Current Use and Future Studies

There is an evidence base to suggest that CHX may be effective for plaque control and gingivitis, alveolar osteitis (not caused by microbes), prevention of bacterial aerosolization and symptomatic management of some viral infections of the oral cavity. However, these indications must always be weighed alongside staining of teeth, emerging antimicrobial resistance and the rare anaphylactic reactions to CHX. Conversely, the effectiveness of CHX (alone) for preventing or managing chronic periodontitis, dental caries, ANUG, peri-implantitis, infections associated with extraction and aerosolization of viruses is less well supported by the literature [9].

2. CONCLUSION

Chlorhexidine is not only an excellent antiplaque agent but it also possesses very good antimicrobial properties. Its broad antimicrobial spectrum can be considered as boon for maintaining overall oral health. A wealth of research supports its use in various forms and in wide variety of oral disorders. Though its use is restricted because of its known side effects, a new formulation with anti-discoloration system has shown promising results. More importantly chlorhexidine has shown promising results in controlling caries. Hence it is serving in the field of dentistry in manifolds.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Sonal GP Pillai	✓	✓	✓	✓		✓		✓	✓	✓		✓		
Lynn Johnson	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓
Hiroj Bagde		✓	✓		✓	✓	✓		✓		✓		✓	✓

C : **C**onceptualization
M : **M**ethodology
I : **I**nvestigation
R : **R**esources
Vi : **Vi**sualization
Su : **Su**pervision

So : **So**ftware	D : **D**ata Curation	P : **P**roject administration
Va : **Va**lidation	O : Writing - **O**riginal Draft	Fu : **Fu**nding acquisition
Fo : **Fo**rmal analysis	E : Writing - Review & **E**diting	

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

Not Applicable.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

[1] T. Guthner, Guanidine and Derivatives, Ullman's Encyclopedia of Industrial Chemistry. Wiley, 2007. doi.org/10.1002/14356007.a12_545.pub2

[2] Denton G W. Disinfection, sterilization and preservation.1991, 4 th ed 274-289

[3] K. S. Lim, 'Chlorhexidine pharmacology and clinical applications anaesthetic intensive care', vol. 36, pp. 50-62, 2008. doi.org/10.1177/0310057X0803600404

[4] O. Fardal and R. S. Turnbull, 'A review of the literature on use of chlorhexidine in dentistry', Journal of American Dental Association, vol. 18, pp. 863-869, 1986. doi.org/10.14219/jada.archive.1986.0118

[5] B. T. Johnson, 'Uses of chlorhexidine in dentistry', General Dentistry, vol. 43, pp. 126-132, 1995.

[6] F. Cieplik, N. S. Jakubovics, W. Buchalla, T. Maisch, E. Hellwig, and A. Al-Ahmad, 'Resistance Toward Chlorhexidine in Oral Bacteria - Is There Cause for Concern?', Frontiers in Microbiology, vol. 10, 2019. doi.org/10.3389/fmicb.2019.00587

[7] G. Mcdonnell and A. D. Russell, 'Antiseptics and disinfectants: activity, action, and resistance', Clin Microbiol Rev, vol. 12, pp. 147-179, 1999. doi.org/10.1128/CMR.12.1.147

[8] M. Kilian et al., 'The oral microbiome - an update for oral healthcare professionals', Br. Dent. J., vol. 221, no. 10, pp. 657-666, Nov. 2016. doi.org/10.1038/sj.bdj.2016.865

[9] Z. L. S. Brookes, R. Bescos, L. A. Belfield, K. Ali, and A. Roberts, 'Current uses of chlorhexidine for management of oral disease: a narrative review', J. Dent., vol. 103, no. 103497, p. 103497, Dec. 2020. doi.org/10.1016/j.jdent.2020.103497

[10] C. D. Overholser, T. F. Meiller, L. G. Depaola, G. E. Minah, and C. Niehaus, 'Comparative effects of 2 chemotherapeutic mouthrinses on the devopment of supragingival dental plaque and gingivitis', J Clin Periodontol, vol. 17, no. 8, pp. 575-579, 1990. doi.org/10.1111/j.1600-051X.1990.tb01108.x

[11] H. Loe and C. R. Schiott, 'The effect of mouthrinses and topical application of chlorhexidine on the rdevelopment of dental plaque and gingivitis in man', J Periodont Res, vol. 5, pp. 79-83, 1970. doi.org/10.1111/j.1600-0765.1970.tb00696.x

[12] J. Gultz, J. M. Kaim, J. Deleo, and W. Scherer, 'An in vivo comparison of the antimicrobial activities of three mouthrinses', J Clin Dent, vol. 9, pp. 43-45, 1998.

[13] D. D. Logothetis and J. M. Martinez-Welles, 'Reducing bacterial aerosol contamination with a chlorhexidine gluconate pre-rinse', J Am Dent Assoc, vol. 126, pp. 1634-1639, 1995. doi.org/10.14219/jada.archive.1995.0111

[14] A. E. Veksler, G. A. Kayrouz, and M. G. Newman, 'Reduction of salivary bacteria by pre-procedural rinses with chlorhexidine 0.12%', J Periodontol, vol. 62, pp. 649-651, 1991. doi.org/10.1902/jop.1991.62.11.649

[15] S. S. Block, Disinfection, sterilization and preservation, 5th edn. Philadelphia, PA: Lippincott Williams and Wilkins, 2000.

[16] G. M. Tartaglia, S. K. Tadakamadla, S. T. Connelly, C. Sforza, and C. Martín, 'Adverse events associated with home use of mouthrinses: a systematic review', Ther. Adv. Drug Saf., vol. 10, no. 2042098619854881, Jan. 2019. doi.org/10.1177/2042098619854881

[17] M. Addy and J. Moran, 'Mechanisms of stain formation on teeth, in particular associated with metal ions and antiseptics', Adv. Dent. Res., vol. 9, no. 4, pp. 450-456, Dec. 1995. doi.org/10.1177/08959374950090041601

[18] B. W. M. Van Swaaij, G. A. (fridus) van der Weijden, E. W. P. Bakker, F. Graziani, and D. E. Slot, 'Does chlorhexidine mouthwash, with an anti-discoloration system, reduce tooth surface discoloration without losing its efficacy? A systematic review and meta-analysis', Int. J. Dent. Hyg., vol. 18, no. 1, pp. 27-43, Feb. 2020. doi.org/10.1111/idh.12402

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BIOGRAPHIES OF AUTHORS

	**Sonal GP Pillai,** is an ex-student of Rungta College of Dental Science and Research Centre, Bhilai, Chhattisgarh, India. She has received her dental education and training with an interest in contemporary dental practice and academic development. Her professional background includes exposure to clinical dentistry and scholarly activities. She remains interested in advancing her knowledge and contributing to the field of dentistry through continued learning, research, and professional engagement. Email: gsonalpillai@gmail.com
	**Lynn Johnson,** is an Associate Professor at Rama Dental College, Kanpur, Uttar Pradesh, India. She is actively involved in dental education, academic teaching, and research. Her professional interests include contemporary developments in dentistry and the integration of evidence-based approaches into dental practice and education. Through her academic and professional activities, she contributes to the development of dental students and promotes scholarly research aimed at improving clinical knowledge and patient care. Email: lynnjohnson380@gmail.com
	**Hiroj Bagde,** is an Associate Professor at Rama Dental College, Kanpur, Uttar Pradesh, India. He is engaged in undergraduate and postgraduate dental education, clinical training, and academic research. His professional interests include contemporary dental practices, evidence-based dentistry, and the advancement of dental education. Through teaching, research, and professional activities, he contributes to the development of clinical knowledge and encourages academic excellence among dental students and practitioners. Email: hirojbagde8@gmail.com