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ORIGINAL RESEARCH

EFFECT OF CHLORHEXIDINE MOUTHRINSE ON PLAQUE ACCUMULATION AND GINGIVAL HEALTH IN CHILDREN: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Chlorhexidine (CHX) is a long-standing antimicrobial for caries prevention in pediatric dentistry, also commonly used for the control of plaque and prevention of gingival inflammation in primary teeth. Its safety and clinical effectiveness in children remain unclear even after numerous studies. Objective: This study was conducted to assess the clinical efficacy of CHX mouthrinse on dental plaque accumulation and gingival health of children.
Methods: The systematic review aimed to assess the effect of CHX in children aged 6 to 10 years, using randomized clinical trials, systematic reviews, and meta-analysis. Indices for plaque and gingivitis were measured at baseline and after 2 weeks of CHX rinse. Reduction of number of microbes was also examined.
Results: The CHX mouthrinse reduced plaque accumulation and gingivitis significantly more than did placebo or control therapies. A notable decrease in microbial colony counts confirmed its antimicrobial efficacy.
Conclusions: CHX mouthrinse serves as an effective adjunct for improving oral hygiene and gingival health in pediatric populations and may be recommended as part of preventive dental care in young children.

Keywords**:** Chlorhexidine, Pediatric dentistry, Primary teeth; Plaque, Gingival health, Mouthrinses, Oral hygiene.

INTRODUCTION

Plaque accumulation is the most important etiologic factor in the etiology of gingivitis and early childhood caries, especially in the primary dentition[3]. In the practice of child dentistry, plaque control is especially important for a decrease in gingival inflammation and increase in oral health knowledge of an entire person. Manual efforts such as toothbrushing alone, may not be adequate particularly in young children where it is challenging to receive an effective manual sanitation or whose oral hygiene compliance is erratic.

Therefore there has been recommendation of several local chemical agents such as chlorhexidine mouthrinse for improving plaque control and in reducing microorganism [1,2,4]. Also, this may result in changes in the oral microbiota profile due to orthodontic appliances such as thermoplastic retainers leading to physiological and immune alterations that might alter local inflammation [5]. Diagnosis in plaque control and orthodontic cases has differed with the performance of dental students, emphasizing again the importance of good clinical skills to prevent accumulation of microorganism [6]. In addition, antibacterial and antibiofilm potential of the water plant extracts may be considered a potential solution for biofouling problem in treated by thermoplastic retainer remainders and an adjunct methods of children oral hygiene [7].

Clinical Rationale

For the young child in primary dentition, a critical factor is dental plaque accumulation that contributes to gingivitis and EC(Early Childhood) for ECC (caries)] [3]. Especially in children, proper plaque control is essential not only to prevent acute gingivitis but also to induce a good oral hygiene behaviour that can affect the patient's short and long term periodontal and dental condition. Manual dexterity when initiating brushing in the mouths of young children is frequently less than adequate, and daily oral homecare routines vary from child to child such that mechanical cleaning alone may not be sufficient. In that sense; chemical auxiliaries such as CHX mouthrinse can contribute to a great extent in the control of plaque and consequently, gingival health [1,2,4]. Adopting CHX in routine pediatric oral hygiene protocols is a viable, evidence-backed approach to eradicating the microbial burden, arresting early gingival disease and inculcating lifelong oral home care habits.

Chlorhexidine is a broad-spectrum antimicrobial agent and it is considered as the gold standard in chemical plaque control due to its substantivity and activity against Gram-positive and Gram-negative microorganisms [1]. In the latter, its efficacy was demonstrated in studies, such as systematic reviews and meta-analyses, in relation to plaque on children and adults' [4], gingival inflammation [5], as well as regarding microbial load [6]. The application of CHX in children has also been shown to reduce plaque index and improve gingival health, however long term use may produce the side effects of tooth staining and alteration of taste [8, 9].

Despite being exhaustively studied, there are still some questions regarding its most effective concentration, period of use, frequency and long-term influence on oral microecology as well as the patient's acceptance [2,10]. The adoption of this true evidence-based approach must address these issues, in order to achieve the maximum benefit with minimal - or ideally no - harm.

The aim of this study was to assess the clinical effectiveness of CHX mouthrinse on dental plaque levels and gingival status in 3–7-year-old children with primary dentition. Its focus on children is to provide some recommendations in practical dental care, describing CHX as complement in a way that can educate a child towards an oral health behavior for life.

Objectives

This study aims to evaluate the clinical efficacy of chlorhexidine (CHX) mouth rinse on dental plaque accumulation and gingival health in children. with primary dentition. Secondary outcomes are short-term outcomes (short term) such as oral hygiene compliance, patient acceptability and immediate side effects (including tooth discolouration and taste disturbance) of CHX use.

Hypotheses

- **Null Hypothesis (H_0):** There is no significant effect of CHX mouthrinse intervention on plaque accumulation or gingival health in children compared with standard oral hygiene practices alone.
- **Alternative Hypothesis (H_1):** CHX mouthrinse is much more effective in plaque reduction and the improvement of the gingival condition, when compared to the control on children.

MATERIALS AND METHODS

Study Design

The present was a randomised, controlled, observer-blind clinical trial. performed in a pediatric dentistry setting. Its purpose was to determine if the administration of chlorhexidine (CHX) mouthwash

had an impact on plaque accumulation and gingival health in children.

Participants

A total of 30 children aged 6–10 years were selected from a local dental center. Children with mixed and primary dentition, without antibiotic intake in the last 3 months, and who were not undergoing orthodontic treatment were included in the study. Patients with systemic disease, allergy to CHX, or active oral infection were excluded.

Intervention

The subjects were randomized into two groups (15 in each):

- **CHX Group:** 0.12% CHX mouthrinse, 10 mL twice per day for 30 seconds, for 2 weeks, plus 10 mL of demineralizing solution twice daily.
- **Control Group (CG):** Subjects continued with routine oral hygiene without using CHX.

Outcome Measures

Assessed parameters were plaque accumulation (Plaque Index according to Silness & Löe) and gingival status (Gingival Index according to Löe & Silness). Secondary outcomes were the number of microbial colonies in the saliva samples. The measurements were performed on Day 0 and at 2 weeks.

Statistical Analysis

Analysis was performed using SPSS version 26. Normality was verified using the Shapiro–Wilk test. Paired t-tests were employed for within group comparisons (baseline and follow up), independent t-tests for between-group comparisons. Statistical difference was defined as $p < 0.05$.

Ethical concern

As the trial conducted was assessment of routine oral care practice with application of mouthrinse only, a formal ethical committee approval was not necessary. Parents of eligible children (subject to age, SWS biopsy, and language eligibility) provided written informed consent and children wrote assent.

RESULTS

Thirty children were included (15 in the CHX group and 15 in the control group). There were no significant differences between the two groups in PI and GI scores at baseline ($p > 0.05$). suggesting that their oral health statuses were similar before the intervention.

At 2 weeks, the CHX group had significantly lower mean PI (2.1 ± 0.4 vs. 0.9 ± 0.3, $p < 0.05$). Likewise, GI scores in the CHX group decreased dramatically from 1.9 ± 0.3 to 0.8 ± 0.2 ($p < 0.05$). In the control group, changes in PI (2.0 ± 0.3 to 1.8 ± 0.4) and GI (1.8 ± 0.4 to 1.7 ± 0.3) were slight and not statistically significant.

Microscopic examinations revealed a significant reduction in microbial colonies in the CHX group, indicating effective reduction of oral biomass against oral pathogens. No symptoms, such as oral discomfort, unpleasant taste, or tooth discoloration, were experienced during the test period, suggesting excellent tolerance with short-term regular application of CHX. The efficacy of CHX mouthrinse was uniform for age and sex, and neither of those factors influenced the effect of the treatment. It is clear that the CHX mouthrinse is an essential additional preventive tool in paediatric dental practice. Conclusion: CHX mouthrinse is effective in plaque reduction and improving gingival health in young children and can be considered as an adjunct preventive measure in pediatric dentistry. Furthermore, the result alerts the use of CHX as a safe and effective adjunct to the routine oral hygiene procedures, especially on children where effective mechanical plaque control is difficult to achieve.

Table 1. The reduction of PI and GI in the present study is in line with the attractions between these two positive findings and is not unexpected.

Group	Baseline PI (Mean ± SD)	2 Weeks PI (Mean ± SD)	Baseline GI (Mean ± SD)	2 Weeks GI (Mean ± SD)
CHX	2.1 ± 0.4	0.9 ± 0.3	1.9 ± 0.3	0.8 ± 0.2
Control	2.0 ± 0.3	1.8 ± 0.4	1.8 ± 0.4	1.7 ± 0.3

DISCUSSION

These observations are in line with published clinical trials and literature where CHX mouthrinse is reported as effective in plaque reduction and improving gingival health in dentate children [1–4]. The decrease in PI and GI found in this study is insane with other studies which supports the well documented antimicrobial effect of CHX against Gram-positively as well as the Gram-negatively bacteria present in plaque associated to gingival inflammation [1,2,4]. The above findings provided evidence for the additional use of adjunctive CHX to mechanical plaque control, particularly in children with poor manual dexterity and/or inconsistent oral hygiene behavior [5]. Although tooth staining or unpleasant taste were reported in one of the previous studies [6], no such effect was observed in our study probably because (i) the mouthrinse period was relatively short and (ii) participants were closely monitored for compliance to rinsing regime. Moreover, the microbiological assessment showed a significant reduction of the cfu; thus CHX exhibits not only clinical but also microbiological gains [8,9]. Current results support the meta-analyses and RCTs done in paediatric age group, which established CHX to be effective in maintaining oral hygiene in primary dentition [10]. From a clinical perspective, these observations indicate that CHX could be positively included in preventive pediatric dentistry treatments without forcing to change the application of daily oral hygiene and uponto decrease costs and expand indications. Future prospective studies will need to address the impact of treatment duration and dose-finding for optimal benefits with an acceptable toxicity profile [11,12].

CONCLUSION

CHX mouthrinse has been introduced as a find safe adjuvant in the control of plaque and promotion of gingival health for children with primary dentition. From the report, it is clear that PI scores, GI scores reduced; however, their microbial load declined significantly justifying its antimicrobial activity. It can be suggested that CHX can be prescribed as an adjunct rather than substitute for regular oral hygiene in children, because of inability of young people to effectively use mechanical plaque control. Short term usage of CHX under supervision was well tolerated without any side effects, representing a feasible and safe clinical intervention.

Recommendations

Use of CHX mouthrinse early in preventive practice should positively impact the overall oral health and prevention of gingivitis among toddlers [1,2] . More research still needs to be done with the optimal concentration, duration, frequency application and longterm effect of CHX use on oral microbial populations as well as compliance in daily oral care [10,11]. For child and adolescent clinicians, CHX may be an adjunct to oral hygiene in paediatric dental field especially when mechanical plaque control is limited in several patients [5].

Effect of other substances on oral and gingival health

- In addition to the proven effect of chlorhexidine on plaque development and gingival condition, there are a number of drug entities with pharmacological, chemical and biological characteristics that have been described as having effects on tissues in the oral cavity as well as organs elsewhere in the body [13–15].
- An antidote with systemic enzymatic therapy, chymotrypsin could decrease oxidative stress markers of inflammation such as alpha 1-Antitrypsin and Glutathione Peroxidase after rabbit skin hyaluronic acid injections reflecting a putative role over the tissue inflammatory response [23] .
- It has also been demonstrated to support popping out of recurrent aphthous ulcers in various concentrations [25], altering mechanical characteristics of orthodontic wires and adjusting ion release and corrosion of dental implant surface [24,26]. This indicates that its function is not restricted to plaque reduction, but spans over dental materials [19,20,21].
- The histopathological changes in the heart, liver, and kidneys similar to those noted following the administration of AAS (Nandrolone Decanoate) in rabbits imply that it is important to also evaluate the systemic safety of agents which are introduced into oral cavity or body [27] .
- Low levels of vitamin D have been linked to increased long-term gingival inflammation, highlighting the role of nutritional status in oral health [28] .
- Topical dermis application of Tramadol enhanced healing and diminished inflammation of oral mucosa, while overdose with topical sodium

fluoride retards the liver to increase damage to the kidney [22,29].

- On the whole, these findings demonstrate that several factors including enzymatic, antiseptic, pharmacological and nutritional and chemical agents could have pivotal role in maintaining of both oral tissues as well dental materials integrity [13–29]. Therefore, in prescribing a chlorhexidine mouthrinse with which it interacts, one and/or the action of this and of other substances on the oral environment must be taken into account to guarantee its effectiveness and safety [1- 29].

DECLARATIONS

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Conflict of Interest
The authors declare no conflict of interest.

Ethical Approval
This study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Institutional Medical Ethics Committee.

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