RESEARCH
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TO COMPARE THE EFFICACY OF CHLORHEXIDINE WITH TRICLOSAN AND ZINC CHLORIDE AS COMPARED TO CONVENTIONAL MOUTHWASH CONTAINING CHLORHEXIDINE AFTER SURGICAL REMOVAL OF IMPACTED TEETH- A PROSPECTIVE COMPARATIVE STUDY

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Abstract

Background: Mouthwashes are commonly used for oral care, either as routine use or in post-surgical oral hygiene maintenance especially in the case of various maxillofacial surgical procedures. There are many types of mouthwashes which have antimicrobial potential. This study is aimed to compare the efficacy of a mouthwash containing chlorhexidine, Triclosan, and zinc chloride with a conventional mouthwash containing chlorhexidine alone in the context of maintaining oral hygiene after surgical removal of an impacted teeth in terms of their antimicrobial activity and thereby reducing post-operative inflammation.

Aim: To compare the efficacy of chlorhexidine with triclosan and zinc chloride with conventional chlorhexidine mouthwash after surgical removal of impacted teeth

Materials and Methods: The study was done at Saveetha Dental College and Hospital in the Department of Oral and Maxillofacial Surgery. It included 650 individuals, divided into two groups of 325 patients each. Group A received mouthwash containing chlorhexidine, triclosan, and zinc chloride, and Group B received conventional mouthwash containing chlorhexidine. All the patients were evaluated post-operatively during days three, five, and seven from surgery respectively, in terms of gingival inflammation and the amount of plaque accumulated.

Results: Based on the results, it was found that study Group A patients showed a significantly greater reduction in plaque accumulation and gingival inflammation as compared to Group B patients who received conventional chlorhexidine. (p value< 0.001)

Conclusion: Triclosan and zinc chloride in addition to chlorhexidine improve its efficacy as a mouthwash not just by controlling plaque accumulation but also by reducing the gingival inflammation after surgical removal of an impacted teeth.

Keyword: Chlorhexidine, Oral Hygiene, Gingival Inflammation, Antimicrobial Effect, Chemotherapy

INTRODUCTION

For the success of any oral surgical procedure, oral hygiene maintenance plays a very important role. For this, an antiseptic mouthwash is prescribed. Chlorhexidine is the most commonly used mouthwash which has an antimicrobial effect and hence controls plaque formation. It is now scientifically proven that plaque formation is inevitable even after a thorough oral prophylaxis, that is scaling. However, we can control the microorganisms and reduce the ones causing infection by using an antiseptic solution. Chlorhexidine is one such antiseptic, which is prescribed all over the world as a mouthwash [1]. Chlorhexidine is also known to reduce oral mucosal inflammation that commonly occurs after the patient undergoes chemotherapy. Various studies have shown that chlorhexidine, cryotherapy, or both, can control oral mucositis, especially when the etiology is chemotherapy. From these studies, we can infer and try to use this post-surgically when the soft tissue inflammation is high [2]. Chlorhexidine rinsing helps to reduce plaque formation and gingival inflammation after surgery. It has its own side effects, most common being tooth staining and

discoloration. Patients have also reported taste alteration after rinsing their mouth with conventional chlorhexidine mouthwash. Long-term use of chlorhexidine brings about alteration in the taste sensation of people and causes brownish stains their teeth. Hence, there is a need to look out for a better antimicrobial agent or a combination of different agents along with chlorhexidine to bring down such side effects [3].

MATERIALS & METHODS

Study design

The study was carried out in Saveetha Dental College and Hospital, Chennai, in the Department of Oral and Maxillofacial Surgery from December 2022 to May 2023. The study consisted of 650 participants. Patients who were indicated for surgical removal of impacted teeth were the participants. Written performa and consent were obtained from each of the participants beforehand, for studying and publishing the data with respect to the complications that may arise after the procedure. The participants were randomly divided into two groups namely Group A and Group B consisting of 325 participants each. This allocation was done with the help of opaque envelopes. The labels from the mouthwashes were removed and were identified as 'A' and 'B'. The study was double-blinded and only the researcher was aware of Group A receiving Chlorhexidine, triclosan, and zinc chloride and Group B receiving conventional chlorhexidine mouthwash. There was no allocation bias nor any surgeon bias. The plaque index and gingival index of each patient were checked before the surgery. The teeth included were the buccal and distal surfaces of the second molars adjacent to the impacted teeth being removed. The surgical removal of the teeth was carried out on the patients. All the patients were instructed to use 10 ml of the mouthwash diluted in 50 ml of normal water. Post-surgery, the gingival or mucosal inflammation and amount of plaque were assessed on postoperative day seven using the Gingival Index (by Loe and Silness in 1963) and Turesky Modification of the Quigley-Hein dental plaque index (given by Turesky in 1970).

The gingival index used for evaluation was given by Loe and Silness in 1963. Here the scoring is based upon the level of inflammation present clinically in the gingiva of the tooth being assessed. Here the score is given from "0" to "3", where "0" means normal and a healthy gingiva, "1" means mild inflammation with slight color changes and mild swelling, "2" means moderate inflammation with bleeding on probing, and "3" means severe inflammation and tendency for spontaneous bleeding of the gingival tissue being examined.

The plaque index used for evaluation in the study was the Turesky Modification of the Quigley-Hein dental plaque index. The scoring is done from "0" to "5". Here "0" means, no visible plaque, "1" stands for separate flecks of plaque over the cervical third of the tooth, "2" means a thin continuous band of plaque at the cervical third (less than 1mm), "3" stands for plaque over cervical third covering less than one-third of the crown but thicker than 1mm, "4" means plaque covering more than one third and less than two third of the crown and "5" means plaque covering more than two-thirds of the crown.

The data was analyzed using the software Statistical Package for Social Sciences (SPSS) version 27.0 (SPSS Inc., Armonk, NY, USA) for statistical analysis. The post-operative evaluation was done by the same clinician who had done the procedure.

Inclusion/ Exclusion criteria

Participants indicated for surgical removal of mandibular impacted teeth which were 18 years or older were included who did not have any periodontal disease before the procedure.

Patients with systemic diseases, like diabetes mellitus, hypertension, etc were excluded from the study. Patients who showed signs of oral infection or a pre-existing periodontal disease were also excluded.

Surgical Procedure

Standard scrubbing and draping was carried out for all the patients. The patient's intra-oral surgical site was prepared with betadine. 2% lignocaine with adrenaline with 1:80,000 concentration was administered as a nerve block on the side of the extraction. After the surgical extraction, a 3-0 silk suture was used for suturing. No post-operative complications occurred in any of the patients. Identical and standard medications (antibiotics and analgesics) were given to all the patients. Double blinding was followed. Both the clinician and the patient were not aware of their allotted group. Mouthwash with 0.12% chlorhexidine gluconate, zinc chloride, and triclosan was given to patients in Group A, and conventional 0.12% chlorhexidine mouthwash was given to the patients of Group B for 7 days after the procedure. All the patients in both groups were instructed to use 10 ml of mouthwashes twice a day.

Follow-up

All the patients chosen for the study were followed up on postoperative days three, five, and seven. All patients were assessed in terms of two parameters that is, level of plaque formation and gingival inflammation. The level of plaque was calculated via the Plaque index and gingival health was calculated by the Gingival Index on the seventh day. The site chosen for the assessment was the buccal and distal aspect of the second mandibular molars.

Statistical Analysis

The data collected on Day five was considered for evaluation. The data was collected and analyzed using the SPSS software. A Student T-test was used to compare the groups. Kolmogorov-Smirnov test was used to calculate the Normality. A P-value of less than 0.05 was considered to be of significance. (Table 1 and 2)

Table 1: Mean comparison of Plaque Index values between Group A and Group B

	Pre Operative Mean±SD	Day 3 Mean±SD	Day 5 Mean±SD	Day 7 Mean±SD
Group A	3.15±1.04	1.89±0.91	1.23±0.42	1.50±0.65
Group B	2.92±0.96	1.96±0.89	2.33±0.48	1.86±0.78
p-value	0.337	0.003*	0.015*	<0.001*

Table 2: Mean comparison of Gingival Index values between Group A and Group B

	Pre Operative Mean±SD	Day 3 Mean±SD	Day 5 Mean±SD	Day 7 Mean±SD
Group A	2.00±0.74	2.28±0.46	1.23±0.42	0.34±0.48
Group B	1.96±0.73	2.46±0.51	2.33±0.48	2.12±0.35
p-value	0.989	<0.001*	<0.001*	<0.001*

RESULTS

The present study population included a total of 650 participants where 325 were treated with chlorhexidine with triclosan and zine chloride mouthwash (group A) and the remaining 325 were treated with conventional chlorhexidine mouthwash after surgical removal of impact teeth. There was no significant difference in the mean plaque index and gingival index values between both the groups at baseline. A significant difference was observed in the mean plaque index score between the two groups at day 3, day 5 and day 7. Table *1* and Graph 1 depicts the mean comparison of Plaque Index score between group A and group B. The mean gingival index score was also found to have significant difference at day 3, day 5 and day 7. Table *2* and graph 2 depicts the mean comparison of Gingival Index score between group A and group B. The present study results show that the mouthwash containing chlorhexidine with triclosan and zinc chloride is more effective than conventional chlorhexidine mouthwash.

Figure 1: Gingival inflammation on Day 7 in a subject of Group A

Figure 2: Gingival inflammation on Day 7 in a subject of Group B

The Mean ±SD value of the Gingival Index for Group A is 2.28±0.46 and Group B is 2.46±0.51 at day 3. Similarly, at day 5, the mean gingival index score of Group A is 1.23±0.42 and Group B is 2.33±0.48. The mean gingival index score of Group A and B at day 7 is 0.34±0.48 and 2.12±0.35, respectively. This shows that gingival inflammation is lower in participants belonging to group A when compared to the participants in group B. A statistically significant difference was found between the mean gingival index scores of group A and group B (p value< 0.001). (Figure 1-4)

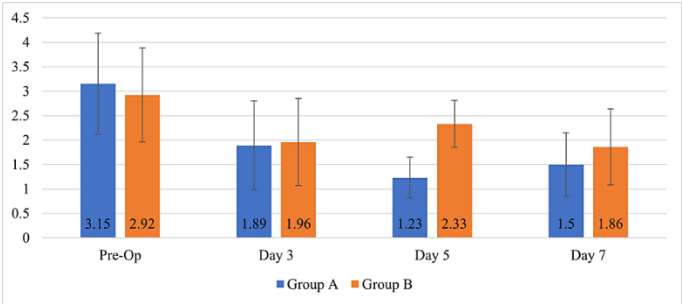

Figure 3: Mean comparison of Plaque Index values between Group A and Group B

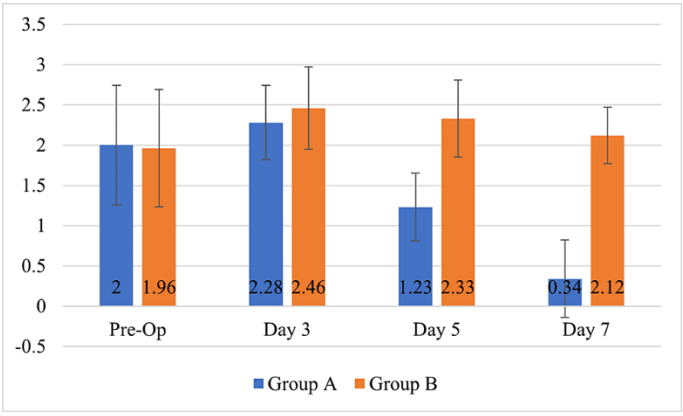

Figure 4: Mean comparison of Gingival Index values between group A and group B

DISCUSSION

Although the surgeries are done following a standard protocol of sterilization, still the chances of occurrence of infection are never nil. This is because of biofilm formation by the microorganisms. Hence, post-operative care and wound care are very important after oral surgical procedures, no matter how minor they are. To achieve this, usually, the patients are advised warm saline rinses and prescribed a mouthwash 24 hours after the procedure. This prevents and reduces plaque accumulation and further infection in the surgical site. Infections occurring after oral surgeries are usually seen in patients who are already immuno-compromised. In a study conducted by Matias Dallasera et al, in January 2020, 532 patients were assessed after undergoing minor surgical procedures, and the incidence of post-surgical complications was assessed [4]. Post-surgical management and wound care are as critical as the surgical management itself. There are chances of post-operative inflammation, infection, and altered tissue healing especially in patients who are not maintaining oral hygiene or immune-compromised. During post-operative care, three factors need to be taken into consideration. They are- patient comfort, wound stability, and plaque control. The level of postoperative care and hygiene maintenance will determine the rate of wound healing. The teeth in the operated area especially, need to be flossed and

kept clean to avoid plaque accumulation in the area. The accumulated plaque will compromise the wound healing at the surgical site. This makes the use of mouthwash mandatory twenty-four hours after the surgical procedure. In an article mentioned by Amit Mani in 2021, to achieve the desired results, it is recommended to use rinse mouth with 0.12% to 0.2 % Chlorhexidine for one minute at least two times in one day [5].

Chlorhexidine is one of the most commonly used antimicrobials and is recommended during post-operative care. It works as an antiseptic to prevent post-operative infection. Chlorhexidine reduces the number of bacteria, fungi, and viruses intra-orally by destroying the cell walls. It is a broad-spectrum antimicrobial. As per the article published by Peterson DE on Oral hygiene practices, in 2011, chlorhexidine is effective against gram-positive as well as gram-negative bacteria. It can be either bacteriostatic or bacteriocidal, depending upon the concentration in which it is used. Chlorhexidine acts within 20 seconds and it is positively charged and gets attached to the negatively charged cell walls of bacteria, which further hampers the process of osmosis, causing cell death. In case of the absence of a cell wall, chlorhexidine enters the semi-permeable cell membrane and causes leakage of the cellular contents which again causes cell death. In higher concentrations, it causes solidification of the cytoplasm. There is another unique property of chlorhexidine. It binds to the proteins in the human tissues and cell membranes. This protein-bound chlorhexidine is released slowly in the oral cavity causing a long-lasting action. This property is called Substantivity, which is shown by chlorhexidine [6]. Poppolo et al in 2022, published an article on "Chlorhexidine in Dentistry". He stated that Chlorhexidine is an ideal mouthwash especially where mechanical debridement is not possible. It is used in concentrations of 0.12% to 0.2%. If a higher concentration of chlorhexidine is used, the chances of unwanted side effects like tooth discoloration, will increase. Studies have shown that chlorhexidine mouthwash is more effective than the gel form. Chlorhexidine is also used in the form of chips, in cases of periodontitis, implant mucositis, and peri-implantitis. For long-lasting effects, chlorhexidine chips are used. However, there are some common side effects of using chlorhexidine for long periods, the most common being tooth discoloration. Apart from this, patients experience an alteration in the taste sensation after long-term use of chlorhexidine. Excessive use of chlorhexidine can in turn cause plaque accumulation and calculus formation [7]. Hence there has been an on going search for alternatives for chlorhexidine.

The efficacy of Zinc Chloride has been studied especially in patients with severe and debilitating oral mucositis after they have undergone chemotherapy. It can be used as a mouthwash to reduce the inflammation of the soft tissues and oral mucositis. Zinc enhances protein synthesis and improves membrane stability. This was studied by Khodayar Oshwandi et al on cancer patients. He also said that zinc chloride can be used to maintain weight in cancer patients undergoing chemotherapy and hence facing the brunt of severe inflammation and mucositis intra-orally [8]. Zinc is an element that is naturally found in the oral cavity. That is in saliva, plaque, and hard tissue. In a study conducted by Anne Marie Uwitonze in 2020, it was found that zinc is associated with gingival and mucosal health. Zinc deficiency is also associated with aphthous ulcer formation. In another study conducted, it was found that patients who were prescribed zinc-containing mouthwash had a reduced plaque content and lower gingival indices. Zinc supplementation is known to fight against Fusobacterium nucleatum, Prevotella intermedia, Porphyromonas gingivalis, and Campylobacter species which are responsible for gingivitis. Zinc maintains periodontal health, by having an immunological impact on the oral soft tissues. It is also known to combat halitosis in the patients [9]. In a study conducted in 2014 by Syed Ali et al, involving rats, it was found that plaque index and gingival index were lower in rats that were given zinc supplementation than those rats that were zinc deficient diet. Aphthous ulcers were also found in rats that were given a zinc-deficient diet. It was also found that there is a zinc-dependent amino acid (A20) which is responsible for preventing inflammatory diseases. This study confirms that zinc has a very significant impact on periodontal health and oral mucosa [10].

As mentioned above, long-term use of Chlorhexidine is associated with taste alteration and tooth discoloration. Hence Triclosan can be used as an alternative. In a study conducted by Philip Riley et al in 2013, it was suggested that using Triclosan/co-polymer reduces plaque as well as gingival bleeding when used for a period of six to seven months. There is evidence suggesting that it brings down the level of gingival inflammation. However, there is a lack of evidence to show if it combats periodontitis as well or not [11]. In a study conducted by Erry Mochamad Arief, it was inferred that Triclosan is not as effective in controlling plaque as much as Chlorhexidine. But because of its antibacterial, antiviral, and antifungal properties, it can be used in combination with chlorhexidine, to decrease its concentration and further decrease the chances of emergence of the side effects of chlorhexidine [12]. Another study has shown that toothpaste containing triclosan allows a reduction in plaque accumulation, gingival bleeding, and inflammation as compared to toothpaste containing fluoride. It helps in reducing soft tissue inflammation when used as a mouthwash. Although it is not as effective as Chlorhexidine in reducing plaque when compared to Chlorhexidine, it does show a significant reduction in soft tissue inflammation intra-orally [13]. Using Chlorhexidine mouthwash has been found to reduce the adherence of microorganisms to the sutured surgical wound. In one study conducted in December 2022 by Jaishree Garg et al, the effectiveness of Chlorhexidine mouthwash was compared to that of an herbal mouthwash. It was found that the microbial load drastically decreased after using chlorhexidine mouthwash over the periodontal surgery site. This was not statistically significant when the herbal mouthwash was used after the periodontal surgery in the patients. It was found that the bacterial colonies were far less in the group of patients who were given chlorhexidine mouthwash [14].

Some studies have been conducted, determining the effect that chemical mouthwashes may have over the different types of suture materials that are used intra-orally. Although not much research has been conducted in the area. In a study conducted by Mohammed Alsarhan et al, it was found that the tensile strength of vicryl sutures is drastically affected when immersed in a solution of Chlorhexidine as well as alcohol-based mouthwashes. Monocryl sutures lose their tensile strength mainly by alcohol-based mouthwashes. Hence after the minor surgical procedures are carried out, we have to be conscious of the concentration and frequency of mouthwash usage we are prescribing to our patients [15]. In a study conducted by Abullais SS in 2016, 288 suture samples were chosen and studied using various mouthwashes. It was found that betadine mouthwash had the worst effect on the tensile strength of the sutures. Hence, we as clinicians should avoid prescribing betadine mouthwash, post-surgical procedures [16]. In another study conducted by Naman Awasthi et al in 2022, the tensile strength of polyglactin, polyglycolic acid, and poliglecaprone was compared using

fluoridated mouthwash. Tensile strength was studied for all the samples on the fourteenth day after immersing the knots in fluoridated mouthwash. As per the results obtained, it was found that fluoridated mouthwash had more negative effects on the mechanical properties of polyglycolic acid and poliglecaprone than those of polyglactin [17]. All these studies provide us with information on the effects that different mouthwashes have on different suture materials. Various studies have been conducted to compare different types of suture materials and to find out which one is most prone and attract bacterial colonization. It has been found that Nylon sutures allow a minimum level of bacterial colonization on them. Maximum biofilm formation is seen over silk and vicryl [18]. Recently many studies have been done to look out for herbs that promote wound healing. This was an attempt to make the mouthwashes more effective post-surgically. One such study was done using Commiphora molmol as a mouthwash. In the study done by Raniah Abdullah in 2019, it was found that this extract improves the rate of wound healing in the initial phase after tooth extraction [19]. In another study, postoperative wound healing was assessed and compared for chlorhexidine mouthwash and myrrh mouthwash, but no statistically significant result was found. This study was done on 35 patients by Wael Ibraheem et al in 2022 [20].

Using a combination of chlorhexidine, triclosan and zinc chloride will be more beneficial than using a conventional chlorhexidine mouthwash. Using this combination lowers the concentration of chlorhexidine and hence the side effects caused by using chlorhexidine alone gets reduced. The soft tissue inflammation and discomfort that is caused after the surgical removal of impacted teeth is also controlled with the addition of zinc chloride to the mouthwash. In our study, we have used two parameters for comparison, that is Gingival Index (by Loe and Silness in 1963) and the Turesky Modification of the Quigley-Hein dental plaque index (given by Turesky in 1970). The gingival index given by Loe and Silness is one of the commonly used indices to assess the gingival condition and the qualitative changes occurring in it [21]. The Turesky Modification of the DPI is a quantitative, objective and a very sensitive plaque index [22]. Hence these indices were chosen to do the study.

Out of all the antimicrobial agents available in the market, in this study, Triclosan was used in combination with chlorhexidine along with zinc chloride in an attempt to create a superior mouthwash. Looking at the results obtained in the studies mentioned above, and from the results we obtained from this study, it can be clearly pointed out that a combination of chlorhexidine, triclosan and zinc chloride is far more effective as a mouthwash than conventional chlorhexidine mouthwash, when given in patients who have undergone surgical removal of mandibular impacted teeth.

Limitations of the study

More studies need to be done with a much larger sample size so that the results obtained can be better analyzed and corroborated.

CONCLUSIONS

It can be concluded that Triclosan and Zinc Chloride in addition to Chlorhexidine improve its efficacy as a mouthwash by reducing the mucosal inflammation after surgical removal of impacted teeth far more effectively as compared to the conventional Chlorhexidine mouthwash. This was attributed to the addition of Zinc Chloride. Triclosan also has plaque-controlling properties and can be used in combination with Chlorhexidine to bring down plaque significantly, which in turn is responsible for delay in post-operative healing, and infection.

Scope for future research

More studies could be done to understand the long-term effects of each medication and whether these can be used in other treatment modalities.

Ethical Approval

This study has been approved by our Institutional Human Ethical Committee (IHEC/SDC/OMFS-2206/22/339).

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