

# CHLORHEXIDINE IN VARNISH AS A COMPLEMENT TO THE PREVENTION SCHEME OF DENTOBACTERIAL PLAQUE

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— Abstract—

Chlorhexidine and fluorine are treatments which have been used to prevent dental plaque formation and, subsequently, dental cavities. The objective of this study was to identify the effectivity of chlorhexidine in varnish to prevent dental plaque formation. A quantitative test was carried out, comparative-descriptive, transversal and observational. The sample observed was integrated by 13 children from 6 to 10 years old, to whom, a questionnaire about fermentable carbohydrates consumption was applied; they were identified to have dental plaque, registering it through the O'Leary index. Later, they were divided into two groups, the first group was applied fluorine varnish at 0.1%, and the second group was applied chlorhexidine varnish at 1% with Thymol at 1% as a homogenous mixture. Four weeks later, a second dental plaque identification was executed and registered in the same initial way. The data was analyzed establishing an average, standard deviation and Pearson correlation coefficient. The results obtained indicate that there is a weak negative correlation (-0.13) between the O'Leary index and fermentable carbohydrates consumption, a weak negative correlation (-0.065) when correlating the O'Leary index obtained after fluorine application and fermentable carbohydrate consumption; as well as a weak positive correlation (0.084) when correlating the O'Leary index obtained after chlorhexidine application and fermentable carbohydrate consumption. It is concluded that, in order to determine the effectiveness of this drug, it is necessary to augment the sample size, and deeper studies must be done having into consideration other factors not analyzed in this investigation since, apparently, chlorhexidine usage is not enough to impact positively on the presence of dental plaque and caries.

### Keywords

*Dental plaque; dental caries; chlorhexidine; fluorine.*

The main oral affection worldwide is dental cavities. This is a chronic, infectious and multifactorial transmissible disease of high prevalence at a regional and national level (Molina-Frechero: 2015, González: 2014). The World Health Organization (WHO) indicates that approximately 60 to 90% of the world population of school age and almost 100% of the adult population have suffered caries at some point in their lives (WHO: 2012). In Mexico it is considered that this disease occurs between 75 to 80% of children over 12 years of age (Medina-Aguilar: 2015).

Dental plaque constitutes itself a previous phase to the appearance of dental caries. On the other hand, Iñiguez-Tamayo and Méndez-Villavicencio (2014) indicate that dental plaque is an "organized, proliferating and enzymatically active entity that adheres firmly to the surface of the teeth due to its biochemical activity of metabolic type, it is the fundamental etiological factor of dental caries and parodontopathies". The causal factors that traditionally produce the presence of dental plaque and caries at an individual level are described in literature. These include aspects such as the susceptibility of the host, type and amount of cariogenic microbiota, the presence of fermentable carbohydrates and the time they remain on the tooth surface without being removed by tooth brushing (Moynihan: 2016; Molina-Frechero: 2015 González: 2014, Gupta: 2013).

To identify the number of dental surfaces with the presence of dental plaque, several methods have been used, among which the O'Leary index stands out. This allows establishing a percentage of the free and proximal surfaces with this biofilm, which must be previously identified clinically by the use of dental plaque revealing tablets; it is important to point out that the occlusal and incisal faces of the dental organs should be excluded from counting (Quiñones-Zárate and Barajas-Michel, 2015).

Since the etiology of dental plaque and subsequent dental caries is multifactorial, it has been identified that the strategies traditionally proposed to counteract them are insufficient. Hence the need to find alternatives that are efficient to reduce the incidence of caries and at the same time are acceptable and easy to give continuity to the public at large. This is because there has been a failure of certain proposals, such as a permanent modification on the diet with significant decrease in fermentable carbohydrates that promote tooth decay. It has been proposed that this has been due to the inability of individuals to rigorously submit to these types of situations for extended periods of time, despite the benefits (Moynihan & Kelly: 2014).

For this reason, emphasis has been placed on the administration of preventive supplements against dental caries, such as fluoride, which is applied massively in water and salt. However, it is not the only drug that is available for caries prevention, since there are others that do not have as much diffusion despite their proven anticariogenic effects, such as chlorhexidine.

Chlorhexidine digluconate is a drug that was originally introduced as a topical antiseptic and disinfectant, and it also has the ability to inhibit the formation and development of dental plaque (Papas: 2012). Its utility in the chemical control of bacterial plaque has been used in the population at high risk of dental caries (Walsh: 2015).

Children are a particularly susceptible group to caries development, so it is essential to work actively in a preventive way in this population. According to Robertson, et al. (2013), the application of preventive agents in them is more effective because the young enamel behaves like a semipermeable membrane, allowing the slow passage of water and substances of low molecular weight through the pores that are found between the crystals; in addition, these researchers identified that in mature enamel this permeability decreases. Despite this, the risk of caries decreases due to changes in diet and improvement in oral hygiene habits. This was determined given the evidence that carbohydrates can facilitate the presence of acids produced by bacteria of the oral cavity, promoting the destruction of the hard tissues of dental organs (Moynihan: 2016; Mulu: 2014).

These results are in line with those of García-Santos and Rioboo-García (2004), who affirm that in children of six to eight years of age it is possible that in a period of one year new caries lesions develop in the first permanent molars.

In Mexico, there have not been enough studies in this regard, since public policies for dental caries prevention have focused on the use of other preventive elements, such as the fluoridation of water and salt, but so far a significant epidemiological impact of such actions has not been reported. That is why the objective of this study is to clinically identify the effectiveness of chlorhexidine in varnish for the prevention of dental plaque formation in children from 6 to 8 years of age.

## METHODOLOGY

The study was quantitative, comparative-descriptive, cross-sectional, and observational. 13 children participated, all of them students of the primary school "Aguiles Serdán", in Cuernavaca, Morelos. They fulfilled the following

selection criteria: being students of the aforementioned educational institution, indistinct sex, that their parents accepted their voluntary participation in the study and whose age is between 6 and 8 years of age. For the management of the children, students of the Dentist Surgery Degree of the Universidad Latinoamericana (ULA) Cuernavaca Campus participated, where they were previously trained in the field activities to be carried out.

The information was collected in four phases, after having obtained the parent's consent and acceptance of the study subjects:

**First phase:** A questionnaire was applied in which the participating children were asked about the consumption of foods rich in fermentable carbohydrates. For counting the following score was determined: For the consumption of fermentable carbohydrates once a week a point was assigned; two points if consumed twice a week, and three points if the food was consumed three or more times per week. This way, it was considered that the minimum score to reach could be zero points, and the maximum 27.

**Second stage:** An intraoral examination was performed, after having applied bacterial biofilm revealing tablets for the identification of dental plaque, which was recorded by counting surfaces stained with the plant pigment. After that, the number of stained surfaces was written down on a record sheet, where each dental organ is divided into 4 sectors (mesial, vestibular, distal and lingual faces); this was done based on the O'Leary index (Quiñones-Zárate and Barajas-Michel: 2015). To determine the final score, the total number of faces with plaque was added, and subsequently it was divided by the total number of palatal, vestibular and interproximal faces present in the mouth (Smutkeeree: 2011). This way, a possible minimum score of zero and a maximum of 96 was considered, considering the presence of approximately 24 dental organs in the mouth (20 temporary and four permanent molars), which would give 96 dental surfaces to be analyzed per subject. The absent dental organs were marked in the diagram with a red diagonal line, and those restored with complete crowns with a blue diagonal line, so as not to count them within the number of stained surfaces.

**Third phase:** All children were given oral hygiene instructions, including a tooth brushing technique for the removal of dental plaque and the vegetable paint with which it was identified. Subsequently, the subjects were randomly divided, in order to obtain two groups (group 1 and group 2). Group 1 was applied a 0.1% fluoride varnish, while group 2 chlorhexidine in varnish

was applied in 1% concentration with 1% thymol in homogeneous solution, giving them the appropriate instructions for maintenance in the mouth.

**Fourth phase:** Four weeks after the application of the varnishes, all subjects were visited once again, to administer the dental plaque revealing tablets and thus be able to identify it by means of the O'Leary index, as was done in the second phase of the field work. This way, the possibility of performing a comparative analysis between the measurements obtained between the second and fourth phases was established, in order to identify the differences between groups 1 and 2, and finally, correlate it with the consumption of fermentable carbohydrates and oral hygiene.

For the analysis of the data, descriptive statistics tools were used, such as average and standard deviation, and the determination of correlation was through the Pearson test. This is an index that measures the degree of covariation between different variables related linearly, establishing the intensity of the linear relationship between X, considering it as an independent variable, as well as Y, as a dependent variable. With this, the coefficient of determination of the population to be studied was obtained, considering the presence of values between 0 and 1, being a positive relationship when positive values were obtained; and a negative relationship when negative values were obtained (González: 2017, Spiegel: 2014).

The parents and/or guardians of the children who met the established selection criteria were previously provided with information about the objective of the project, emphasizing that they could decline to participate or not in it, without retaliation of any kind. An informed consent form was provided, ensuring the participation of the children in an anonymous, voluntary and informed way, explaining to the participants the purpose and benefits of the study. For this, a number was assigned to the questionnaires, so that only the research team could identify them, thus guaranteeing their anonymity.

Given the present investigation involved the participation of living subjects as a primary source of information, the ethical and safety aspects contemplated in the Regulation Of The General Health Law In The Field Of Research For Health (General Health Law: 2016) were considered; and those by the Bioethics Committee of the Universidad Latinoamericana (ULA) Cuernavaca Campus.

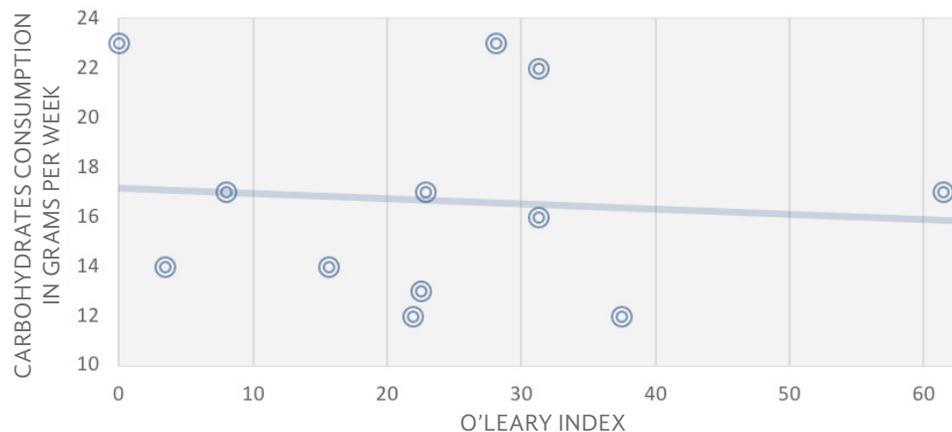
## RESULTS

The fermentable carbohydrate intake questionnaire was applied to a total of 13 children; of them, 5 were applied fluoride in varnish (group 1), the other 8 were applied chlorhexidine in varnish (group 2).

The results obtained from the correlation analysis indicate that there is a weak negative correlation (-0.13) between the O'Leary index and the consumption of fermentable carbohydrates. This means that there is no sustainable correlation between the increase in the O'Leary index and the increase or decrease in the score obtained by the consumption of fermentable carbohydrates.

In Graph 1, it can be seen that the trend is negative; this means that the higher the O'Leary index, the lower the carbohydrate consumption. It can also be seen that there is a great dispersion among the data, which can be attributed to the probability that each child has a different diet, and, therefore, different consumption of fermentable carbohydrates; the regression line is attached to the graph, which verifies the negative trend.

**Graph 1.** Correlation between the O'Leary index and the fermentable carbohydrates consumption



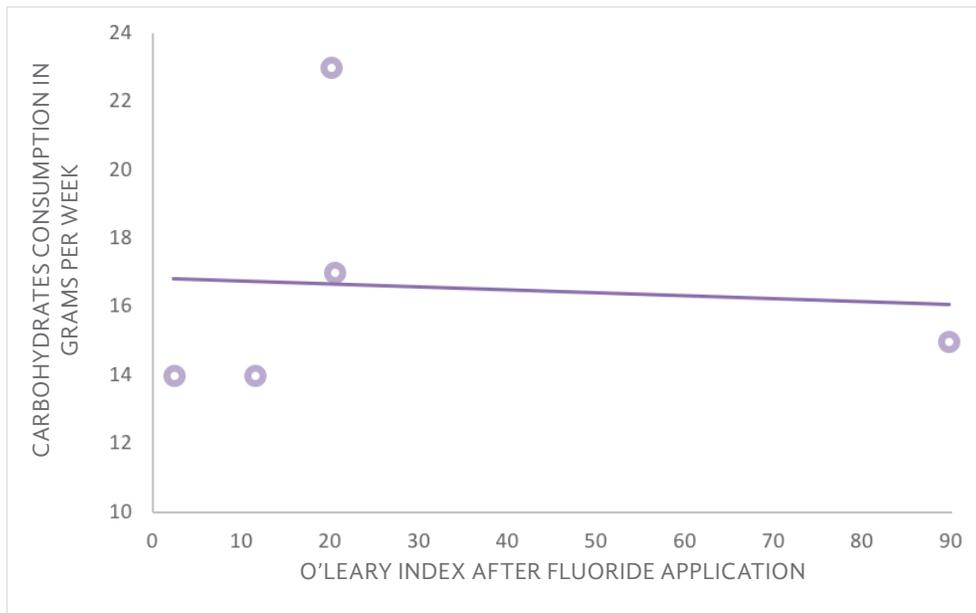
Source: Own elaboration based on obtained data

Another correlation analysis was performed between the O'Leary index obtained after the application of fluorine and the consumption of fermentable carbohydrates, which resulted in a weak negative correlation (-0.065).

In graph 2, it can be seen that there is a weak negative correlation, which can be attributed to the fact that the data present a high degree of dispersion.

This allows us to corroborate that each child has a different type of diet and, therefore, it can be said that the application of fluoride possibly indicates a decrease of the dental plaque only in this case, although we consider that it cannot be taken into account as an only factor for the decrease of the existence of bacteria in the mouth, as later referred to in the discussion. The regression line is attached to the graph, which verifies the negative trend.

**Graph 2.** Correlation between the O'Leary index after the application of flour and the fermentable carbohydrates consumption

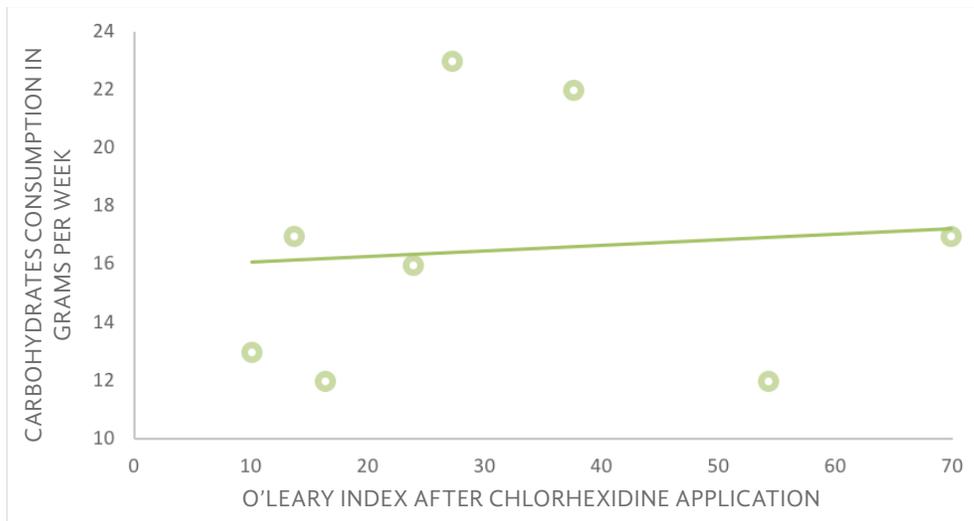


Source: Based on data obtained by researchers

Finally, a correlation analysis was performed between the O'Leary index obtained after the application of chlorhexidine and the consumption of fermentable carbohydrates, which gave a weak positive correlation (0.084). This result would apparently indicate that despite the presence of this drug there is an increase in the rate of dental plaque.

Graph 3 shows the positive result that emerges from this correlation analysis. That is, the presence of dental plaque was not generated when applying only chlorhexidine, and even in appearance, in some cases it increased despite this treatment, the regression line is attached to the graph, which verifies the positive trend.

**Graph 3.** Correlation between the O'Leary index after the application of chlorhexidine in varnish and the fermentable carbohydrates consumption



Source: Based on data obtained by researchers

In addition, it should be taken into account that when analyzing the data obtained, it was identified that the children of group 2 were, on average, the ones with the highest scores within the O'Leary index. That is, children who consume more fermentable carbohydrates were analyzed, which could be a factor that significantly influences the presence of dental plaque.

## DISCUSSION AND CONCLUSION

Chlorhexidine is a drug whose effectiveness has been studied by several researchers. Although its application and effects have been analyzed in children (Walsh: 2015; Robertson: 2013), these type of studies have also been carried out in the adult population (Papas: 2012). On the other hand, Junco and Baca (2005) have identified that the effectiveness of chlorhexidine is related to its concentration and the frequency of application. Given this, the results of this study are not sufficient to conclusively determine the effectiveness of this drug, so it is suggested to take into account other factors not included in this research.

That is, although, based on the literature reviewed, it has been proven that chlorhexidine is a drug with bactericidal and bacteriostatic properties; apparently its mere presence is not enough to decrease the rate of dental plaque. An example of this is the results obtained in this study about the negative tendency in the correlation between the O'Leary index and the

consumption of fermentable carbohydrates, which is contrary to what was indicated by some authors (Moynihan: 2016; Moynihan & Kelly: 2014).

Therefore, we consider that, preferably, the sample size and age ranges of the subjects studied should be increased for a greater certainty of the results. In addition, it is necessary to have a follow-up of them for a longer period of time, since in this investigation the limitation was made to apply varnish and follow its effects only after 3 months. In the same way, it is necessary to have a more reliable record of the children's eating habits, among other possible factors that may influence the occurrence of dental plaque. The latter is confirmed by Ramos-Gómez (2012) who identified that, while both chlorhexidine and fluoride are drugs that affect the formation of plaque and tooth decay, it is important not to consider them as the only factors that can influence its presence or absence. That is to say, in addition to the application of chlorhexidine and fluorine, it is necessary to reinforce aspects such as oral hygiene habits as well as those of dietary control, mainly the consumption of fermentable carbohydrates with a sticky texture.

Nevertheless, the results showed a weak negative correlation ( $-0.065$ ) between the O'Leary index obtained after the application of fluorine and the consumption of fermentable carbohydrates. Therefore, in appearance, it can be mentioned that the use of fluoride in varnish is a factor that helps in the decrease of dental plaque. This substance itself does not have the function of inhibiting the presence of dental plaque, which gives an indication that reinforces the idea of the need to analyze other factors that may be influencing this result, including a more in-depth study on children's eating habits.

We recognize that the analyzed aspects should be deepened, performing other types of clinical activities, such as proposing a workshop to raise awareness and monitor the subjects studied on aspects related to the type and frequency of oral hygiene as well as the basic care of the dental organs, in order to have more vigilance and obtain more reliable results. Likewise, it is necessary to analyze other factors that are involved in the formation of dental plaque and tooth decay, and that were not considered in this study. The clinical elements, such as the muscle mass index (Hooley: 2012), gender (Shaffer: 2015), or even belonging to the Latin American race (Morrison: 2016), apparently influence the high prevalence of dental plaque and tooth decay. In the same way, some social determinants of health, such as lifestyle and home environment (Watanabe: 2014), socioeconomic level (Costa: 2012) and literacy (Haghdoost: 2017), among others, have been studied and showed that they are also predisposing the development of dental caries. This indicates that the presence of this disease is not only due to the causes

that had traditionally been identified and analyzed, and previously referred to at the beginning of this document, such as a diet rich in fermentable carbohydrates, oral hygiene, type of present bacteria and the time factor. Thus, a great biological and socioeconomic multicausality that intervenes so that dental caries continues to be a disease of high prevalence may be identified, and, whose effective prevention and/or its definitive cure are still far from being achieved.

Therefore, we should consider the results and discussion of this study as a basis to promote studies aimed at identifying in more depth elements involved in the day to day life, which have the ability to favor the presence of dental plaque and subsequent caries. That is to say, that future research on the causes, treatment and prevention of these entities take into account both the biological conditions and the social determinants of health, as well as new ones that are identified in order to face them adequately and, thus, benefit the population.

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