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Storage Conditions of Sodium Hypochlorite

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Abstract

Sodium hypochlorite is considered the most widely used irritant solution worldwide, its characteristics and low cost make it considered the gold standard as a complement for endodontic instrumentation. The objective of this research is to determine the criteria of dentistry students from seventh to tenth semester regarding the handling and storage of sodium hypochlorite prior to the start of their pre-professional practices. Through a survey carried out using Google Forms, an opinion poll was carried out to find out the most frequent storage conditions of sodium hypochlorite, with 7 closed and multiple-choice questions, the process of the information collected was tabulated through the platform software. Dentistry students from eighth to tenth semester have discrepancies in certain aspects in their knowledge about the storage conditions of sodium hypochlorite In this study,36.8% of students do not store sodium hypochlorite correctly , since in the survey carried out it was obtained that containers are used that do not protect the irrigant from ambient light, there is a discrepancy regarding the concentration that should be used for instrumentation.

Keywords: *Sodium Hypochlorite, Storage, pH, Light, Concentration, Temperature.*

1. Introduction

Sodium hypochlorite has been defined by the American Association of Endodontists as a clear, pale, green-yellowish liquid, which presents a solvent action of organic tissue, in addition to being a potent antimicrobial agent (Cárdenas et al., 2012). Sodium hypochlorite has been used historically and with great acceptance, recommended by Labarraque (1777-1850) to prevent puerperal fever. During World War I, it was used in a 0.50% concentration (Dakin's solution) for disinfection of open and infected wounds. Spread the use for irrigation of root canals, years later (1936) Blass introduces sodium hypochlorite in a concentration of 5.0% as an irrigant for (Figueroa, 2015; P.O.A, 2014) pulps with diagnosis of necrosi, concluded that dilution of 5% sodium hypochlorite with water, in equal parts (2.5%), does not appreciably affect its solvent action (Cárdenas et al., 2012).

The goal of endodontic treatment is to remove pulp tissue diagnosed with pathology. Mechanical instrumentation together with irrigation are fundamental pillars to complement the treatment, this process is cataloged by many authors as insufficient, since 35% to 40% of the walls of the root canal system remain untouched, this is produced by anatomical variations and the complex configuration of the interior of the teeth, together with mechanical factors such as the shape and distribution of instrument grooves that despite the constant technological evolution are not enough to eliminate all the tissue. Among the main characteristics of sodium hypochlorite is that it penetrates in microns (μm) within the dentinal tubules and serves as a lubricant in the walls of the duct when instrumented complementing the instrumentation (P, O. A, 2004).

Currently, endodontic irrigation protocols are based on the use of sodium hypochlorite, in its different concentrations at 1%, 2.5% and 5.25%. Due to its low cost, high effectiveness and availability, it consists of one sodium atom (Na), one chlorine atom (Cl) and one oxygen atom (O), therefore, its chemical formula is NaClO. Sodium hypochlorite does not have great chemical stability, so it tends (Ministry, 2005). To acquire electrons to achieve greater stability, this oxidizing capacity is given thanks to hypochlorous acid (HOCl), product of its hydrolysis, which is also responsible for the disinfectant action (Jungbluth et al., 2011)

The relative amount of hypochlorite ion and HOCl present in solutions depends on temperature, influencing pH fluctuation under storage conditions. Chlorine in the form of gas is unstable due to its volatility, it also has a harmful and irritating odor for the respiratory tract, eyes and mucous membranes. By lowering the pH below 4 and 5, the relative amount of hypochlorous acid (HOCl) decreases and chlorine gas (Cl) Jungbluth et al. (2011) dissolved in water increases. The presence of light influences the degradation of sodium hypochlorite (NaClO). In the study by Ubeda et al, sodium hypochlorite was exposed to different levels of luminosity; for eight months, resulting in a loss of 68.5% of its effectiveness in the presence of light; 39.3% with ambient brightness and 8.3% in the absence of light (Apaueclda Fernandes, 1991).

The shelf life of sodium hypochlorite depends on many variables, including pH, which is considerably decreased in the most dilute sodium hypochlorite samples, because they decrease the amount of sodium hydroxide salts, resulting in less stability of the solution, therefore shorter shelf life (Clarkson et al., 2001).
Commercially available NaOCl products are 1-15% aqueous solutions with an alkaline pH (around 11) and often contain 0.01-0.75% sodium hydroxide salts and other basic salts or buffers to increase their stability, especially 1% solutions contain more of these salts. More dilute solutions typically have a longer shelf life, but it is likely that the higher sodium hydroxide content in undiluted samples may give more stability by counteracting the pH drop.

Another factor that influences the stability of sodium hypochlorite is exposure to carbon dioxide present in the air, when exposed it shows a loss of the available chlorine molecule, in a study it was obtained that a sample of sodium hypochlorite without protective cap lost 59.2% and with lid 20.35% stability. This research aims to determine the criteria of dental students from eighth to tenth semester in terms of knowledge about the handling and storage of sodium hypochlorite prior to the start of their pre-professional practices.

2. Materials And Methods

Type of research

According to your approach

The research focus of this article is mixed: qualitative-quantitative, the qualitative aspect is included in a specific way because it determines the level of knowledge about the management and storage of sodium hypochlorite of students from eighth to tenth semester of the dentistry career of the Uniandes University.

According to the purpose

According to its purpose is an applied research because through the study concepts and recommendations are established and strengthened, for the storage of sodium hypochlorite.

According to its scope

The descriptive scope in the research was carried out through a survey, using Google Forms, software responsible for the administration of surveys and analysis of results. The questionnaire was designed by gathering all the variables that affect the pH of sodium hypochlorite, to be extrapolated to seven closed polytomic questions describing the storage conditions of sodium hypochlorite.

The sample was taken at convenience, based mainly on criteria of knowledge in the chair of endodontics and use of sodium hypochlorite in preprofessional practices. All eighth, ninth and tenth semester students of the Dentistry career of the Autonomous University of the Andes were included. To whom the link of the survey was sent digitally, through their course representatives.

3. Results and Discussion

From the data collection of the Google Forms software, 117 responses were obtained from students from eighth to tenth semester of the dentistry career.

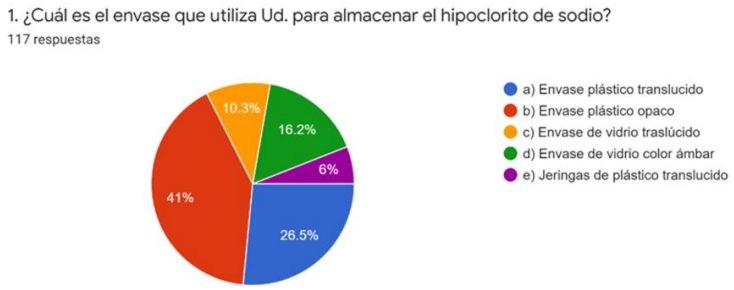
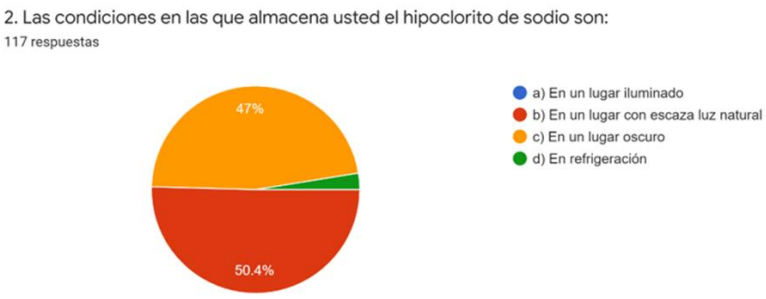


Figure (1).
Source: Padilla-López 2022



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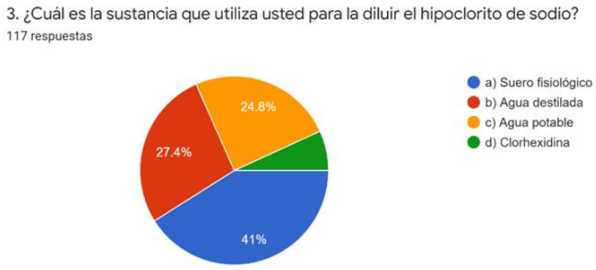

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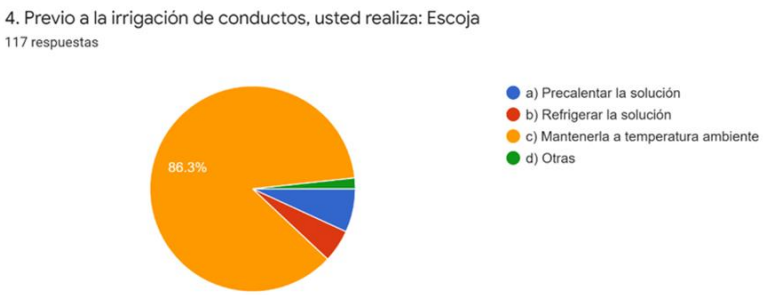

Figure (4).
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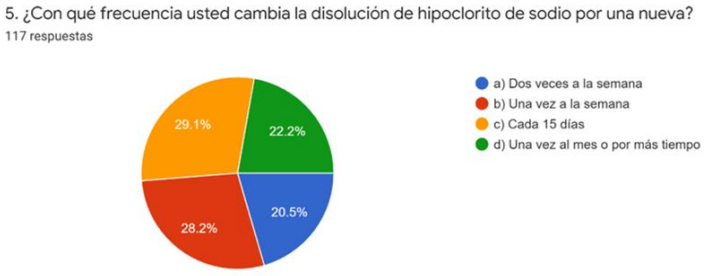

Figure (5)
Source: Padilla-López 2022

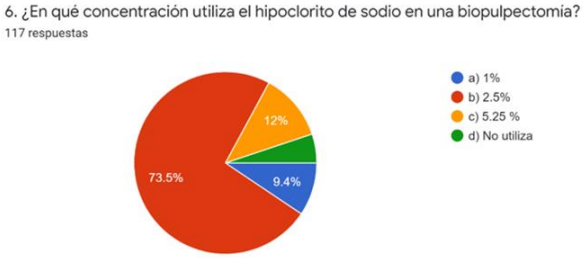

Figure (6).
Source: Padilla-López 2022

Figure (7)
Source: Padilla-López 2022

In question 1, 41% of respondents store sodium hypochlorite in an opaque plastic container, while 26.5% of students use translucent plastic containers, impairing the stability of the available chlorine molecule; followed by 16.2% in amber glass containers and 10.3% in translucent glass containers. Figure 1

50.4% of the responses received consider that sodium hypochlorite needs to be handled in an environment with scarce natural light while 47% state that a dark place is ideal for storage, only 2.6% keep sodium hypochlorite refrigerated, where light and heat are avoided at the same time, decreasing the degree of evaporation, as long as the freezing point is not reached. Figure 2. 41% of respondents dilute the solution with the use of physiological serum; 27.4% with distilled water and 24.8% with drinking water. All options are scientifically accepted. While a minority of 6.8% dilute with chlorhexidine it is not considered a viable option for precipitate formation. Figure 3

86.3% consider that the ambient temperature sodium hypochlorite is ideal for use in the irrigation protocol as specified in question 4, 6.8% preheat sodium hypochlorite, 5.1% keep in refrigeration before irrigating the ducts, Figure 4. In question 5 there are different criteria of the students regarding the change and renewal of solution, where after 15 days it is done by 29.1% of respondents; while 28.2% do it weekly, 20.5% twice a week. 22.2% change the sodium hypochlorite solution once a month or leave it for longer, which if not stored in a suitable environment (cool and with little light) would reduce the chlorine available under acceptable levels. Figure 5

One of the fundamental pillars of irrigation and instrumentation is the previous diagnosis where to perform biopulpectomies 73.5% use sodium hypochlorite at 2.5%, 12% at a concentration of 5.25%; 9.4% consider that 1% is an adequate condition for the aforementioned therapy. Figure 6. In necropulpectomies, 50.4% use 5.25% sodium hypochlorite followed by 42.7% to 2.5% while 5.1% use 1% sodium hypochlorite Figure 7.

In this article, he analyzes the criteria of students from eighth to tenth semester of the dentistry career of the Autonomous Regional University of the Andes "UNIANDES", in the academic period May – September 2022, on their knowledge about the storage of the Gold-standard of endodontic irrigation, as well as the concentrations of preference and the cases in which each of them would be used. 26.5% of students use translucent plastic containers as well as 10.3% in glass containers with the same characteristics for the storage of sodium hypochlorite, where the available chlorine molecule is affected by being photosensitive; One of the classic studies of the endodontic literature mentions that factors such as storage container, temperature, and time impair the stability of the solution, in the aforementioned study a 12-month follow-up of the different concentrations was carried out, showing a decrease in the properties after the established time, it should be noted that in the study the constant variable was the protection to photosensitivity, Using plastic and glass containers that do not allow

the passage of light, therefore emphasis should be placed on the correct handling of the storage conditions of the students (del Carpio et al., 2015; Pipikin & Tqrk, 1995).

97.4% of respondents say that ambient light can be harmful to sodium hypochlorite since they consider that dark or low light places are ideal to keep it, this result has discrepancy with what was obtained in the characteristics of the container, since it is shown that if there is concern on the part of the respondents when storing the irrigant but not in what type of container it should be used.2.6% keeps sodium hypochlorite refrigerated, where light and heat are avoided, and the available chlorine molecule remains stable, in the study of Nandakumar et, it was shown that the use of cryotherapy with the refrigerated irrigant to 4 (Nandakumar & Hasim, 2020) ° controls post-endodontic pain in daily clinical practice, which benefits the treatment. The temperature at which the irrigant is stored also has an important role for the stability of the available chlorine molecule, concentration and Ph, in the study by Pipkin et al, it was shown that after 200 days of storage the 5% sodium hypochlorite solution showed greater decomposition in terms of its composition stored at an ambient temperature of 24° compared to the solution stored at 4° (Pipkin & Tqrk, 1995).

In the present study it was reported that 73.5% of students use sodium hypochlorite (2.5%), 12% to (5.25%); 9.4% consider that (1%) is an adequate condition for pulp therapy, in the study by Verma et al, it is established that there is no statistically significant difference between using any of the concentrations, For post-treatment periapical tissue recovery, the efficacy of tissue and organic matter dissolution depends on several factors, but mainly on concentration, temperature, flow, ultrasonic activation. Sodium hypochlorite with low concentrations may be more effective if the aforementioned variables are added. Stojicic et al, in their study, compared the effectiveness of different concentrations (Verma et al., 2019; Wright et al., 2019) of sodium hypochlorite (1%,2%,4%,5.8%) to dissolve pulp tissue, in their methodology the determination of lost mass after immersing the samples in the different concentrations was included, it was shown that with the complementation of ultrasonic activation the dissolution effectiveness of the lowest concentrations is enhanced, becoming comparable with the highest (Stojicic et al., 2021).

Root resorption is common in cases of pulp necrosis together with the resorption of the apical bone, in these cases the apical constriction is lost, so it is very likely that the apical foramina are permeable, for this reason, there must be an exhaustive irrigation protocol, but controlled to avoid a possible accident with sodium hypochlorite. . There is much discrepancy in the literature about the ideal concentration for endodontic irrigation, respondents use higher concentrations (%5.25) in necropulpectomies in 50.4% while 42.7% to 2.5%, the choice of concentration is multifactorial and depends entirely on the clinician. There are studies in which it is determined that the flow of the irrigant through the needle is also very important, the flow pattern of the open needles is greater than those with a closed design, which results in a greater turnover of the irrigating solution, but it is possible that there is greater apical pressure and therefore an extrusion of irrigant towards the periradicular tissues. (Berman et al., 2021; Claudino et al., 2022; Boutsioukis et al., 2009) One of the variables reported in the studies is the pH of the irrigant, which can be enhanced to obtain a better dissolution of organic tissue, the present research raises the question that is based on whether storage conditions can alter this variable (Christensen, 2008).

4. Conclusion

36.8% of students from eighth to tenth semester of the dentistry career of the Autonomous Regional University of the Andes "UNIANDES", do not store sodium hypochlorite correctly, since in the survey it was obtained that containers are used that do not protect the irrigant from ambient light. 97.4% of respondents have knowledge about the environmental condition of storage and temperature. There is discrepancy regarding the concentration that should be used for the instrumentation of pulps with a diagnosis of necrosis since 50.4% use higher concentrations (%5.25) while 42.7% use the irrigant at 2.5%. Research should be complemented by experimental studies where it can be demonstrated that storage conditions may impair the composition and stability of sodium hypochlorite.

Conflict of interest:
The authors declare no conflict of interest.

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