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REVIEW ARTICLE

Asepsis and antisepsis in dental surgical procedures

Asepsia y antisepsia en procedimientos quirúrgicos dentales

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ABSTRACT

Introduction: the techniques that comprise asepsis and antisepsis in dentistry, as in other medical specialties, are based on the need to reduce risks before, during and after surgical procedures, increasing the patient's chances of recovery.
Objective: to argue the importance of asepsis and antisepsis in dental surgical procedures.
Methods: a literature review was carried out by researching scientific articles related to the subject. The databases used for this research were: Pubmed, Elsevier and Springer Link, with publication during the period 2002-2022.
Development: Extensive research into methods of asepsis and antisepsis has been essential in the healthcare field to reduce the spread of bacteria, fungi and viruses that cause infections in surgical practices, whose safety protocols have evolved from the use of ointments, essential oils and cauterisation to methods that include the use of ethylene oxide (EO) or iodine solutions as chemical asepsis methods, essential oils and cauterisation to methods that include the use of ethylene oxide (EO) or iodine solutions as chemical methods of asepsis, in addition to the use of aqueous and alcoholic solutions added to compounds such as chlorhexidine, iodophors, quaternary ammonium compounds, hexachlorophene and triclosan.
Conclusions: different methods were determined that are efficient in the dental area, such as the use of active agents in addition to washing with soap, water and alcohol. This research revealed the current problem of nosocomial infections and multi-resistant bacteria, thus ensuring safe dental procedures and reducing complications in the future.

Keywords: Asepsis; Antisepsis; Surgical Procedures; Preoperative Period.

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RESUMEN

Introducción: las técnicas que comprenden la asepsia y antisepsia en odontología como en otras especialidades médicas, se fundamentan en la necesidad de reducir los riesgos antes, durante y después de los procederes operatorios, aumentando las posibilidades de recuperación del paciente.
Objetivo: argumentar la importancia de la asepsia y antisepsia en los procederes quirúrgicos odontológicos.
Métodos: se realizó una revisión bibliográfica a través de la investigación de artículos científicos relacionados con la temática. Las bases de datos utilizadas para esta investigación fueron: Pubmed, Elsevier y Springer Link, con su publicación comprendida durante el período 2002-2022.
Desarrollo: la investigación exhaustiva de métodos de asepsia y antisepsia ha sido esencial en el campo de la salud para reducir la propagación de bacterias, hongos, virus que producen infecciones en las practicas quirúrgicas, cuyos protocolos de seguridad han pasado del uso de pomadas, aceites esenciales y cauterización a métodos que incluyen el uso de óxido de etileno (EO) o soluciones yodadas como métodos químicos de asepsia, además del uso de soluciones acuosas y alcohólicas adicionadas a compuestos como clorhexidina, yodóforos, compuestos de amonio cuaternario, hexaclorofeno y triclosán.
Conclusiones: se determinaron distintos métodos que tienen eficiencia en el área odontológica como el uso de agentes activos además del lavado con jabón, agua y alcohol. Esta investigación dio a conocer la problemática actual en cuanto a infecciones nosocomiales y bacterias multirresistentes, asegurando así procesos odontológicos seguros y disminuir complicaciones en un futuro.

Palabras clave: Asepsia; Antisepsia; Procedimientos Quirúrgicos; Período Preoperatorio.

INTRODUCTION

The terms asepsis and antisepsis are concepts frequently used in clinical and dental settings, referring to the set of techniques for the prevention of contamination with microorganisms on objects used in dental surgical procedures (asepsis), generally through the use of chemical substances, and to the elimination of microorganisms present on the exterior of patients (antisepsis), respectively.[1] Throughout history, cases of death due to infections following dental surgical procedures have been a frequent problem, therefore the reduction of surgical site infections (SSIs) has been a topic of considerable interest since the scientist and surgeon Joseph Lister published in 1867 an article on the practice of disinfection with carbolic acid (phenol).[2]

Due to the impact of its findings in reducing the number of patients requiring intensive care, readmission and death, this publication is considered the forerunner of the studies of procedures now known to fall into the categories of asepsis and antisepsis essential in all modern operating theatres, whether used for procedures ranging from appendectomies, cardiac surgery to dental surgery, as SSIs occur in all clinical settings when risk factors related to contamination are not properly controlled at the time of surgery.[3]

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Historically, the first evidence of the use of asepsis and antisepsis techniques dates back to the 16th century when the physician Ambrose Paré used an ointment based on eggs, rose oil and turpentine to treat combat wounds, avoiding the inflammation, pain and fever that patients who were cauterised often suffered.[4] In the 19th century, Ignatius Semmelweis demonstrated that hand washing by doctors before childbirth considerably reduced the mortality rate due to puerperal fevers in patients treated at the Vienna obstetric hospital.[5]

Later, Joseph Lister came to the conclusion that the infections that occurred after surgery were caused by microorganisms, which is why, after testing various chemical substances, he found that phenol was capable of eliminating microorganisms, which is why he proposed cleaning both the hands and the surgical instruments before performing an operation in the operating theatre, thus reducing the rate of post-operative infections to a level never seen before in his time.[6]

Years later, Florence Nightingale proposed that the operating theatre should be a place that should be kept clean, affirming that a healthy environment would allow a better development of the activities during the surgical processes; the work of William Halsted should also be highlighted, who at the end of the 19th century introduced the practice of performing surgery using gloves.[7]

In the case of dental surgery, although the first surgical act is recorded as dental avulsions in the Neolithic period, it was not until 1860, when Simon Hullihen produced a compendium of oral and maxillofacial surgical procedures, including tooth extraction, fracture of the jaws and outlines of orthognathic surgery, that dental procedures were taken as serious operations in the medical community.[8]

In the field of dentistry, since Lister's statements, the range of interventions within the field expanded, two fundamental changes in asepsis and antisepsis occurred, the reduction of mortality in dental procedures to almost zero and the advancement in the knowledge of sterilisation of material, which allowed the first bone grafts to be performed.[8]

Indoor environments in which people spend most of their time are characterised by a specific microbial community, also called the indoor microbiome. [9] Most indoor environments have the characteristic of being connected to the external environment with a free circulation of air, however, some environments are more restricted in terms of the exchange of microorganisms with the environment, to mention but a few: Intensive care units, operating theatres, such environments are areas with limited exchange with the environment, and therefore these can be kept sterile as far as possible.[10]

However, referring to operating theatres and intensive care rooms, despite being closed environments, the area of contamination is not completely delimited due to the entry of health personnel, surgical material and the patient himself, which increases the number of factors of possible contamination.[11]

A nosocomial infection is defined as an infection that occurs during a patient's stay in hospital and which was not present at the time of admission or during the incubation period of the bacteria responsible for the infection. [12]

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Most are caused by environmental microorganisms common in the general population that can cause serious diseases when affecting patients in need of surgical intervention. [13] Nosocomial infection rates are a quality indicator for all hospital evaluations including the dental branch. This literature review aims to argue the concepts related to asepsis and antisepsis in an office or operating room and to offer a protocol with practical recommendations to be implemented in dental procedures performed in health institutions in Ecuador, according to evidence-based recommendations on the use of aseptic and antiseptic solutions with emphasis on the advantages and disadvantages of each of these.

METHODS

A literature review was conducted by researching scientific articles related to the topic and relating clinical concepts to dental interventions in modern dentistry. Articles in English and Spanish were selected on the basis of title, abstract, results and conclusions; among these, those that showed relevant information were chosen. The databases used for this research were: Pubmed, Elsevier and Springer Link, with publication period 2002-2022. The keywords used were: "asepsis", "antisepsis", "sepsis".

Thirty-four articles were collected of which six were discarded because the references of these articles were from non-indexed journals or books not endorsed by a medical publisher.

DEVELOPMENT

Preoperative preparation of the patient and surgical elements

Due to the importance of properly performing asepsis and antisepsis techniques in surgery, the World Health Organisation (WHO) promotes the strategy "Safe Surgery Saves Lives", which focuses on describing recommendations to minimise the possibility of SSI, referring to the resolution of problems with risk factors involved, and prioritising those with the greatest impact on the postoperative morbidity rate.[13]

Within the criteria mentioned by the World Health Organisation (WHO),[13] the Surgical Care Improvement Project recommends the monitoring of at least six essential outcome indicators and processes to reduce SSIs: Pre-surgical antibiotic prophylaxis (administration, selection of antibiotics, establishment of their dosage and duration period), Glucose control (verification of possible diabetes and coagulation problems), Depilation of the operative area (if necessary for the area to be operated on) and Operative Normothermia (assistance in maintaining the patient's body temperature during the operation) postulates described in table 1.[14]

On the other hand, within the techniques that make up antisepsis, one of the points that has gained relevance in the prevention of SSI is the pre-surgical preparation of the patient's surface to be worked on as one of the factors in which it is possible to intervene and reduce the risk. [15]

In recent years, extensive reviews have been devoted not only to the comparison of disinfectant solutions and their application technique, but also to the importance of rinsing with antiseptic substances, the use of sterile surgical drapes and the preparation of the extraoral area, with the aim of reducing the risk of SSI by preventing the presence of microorganisms for as long as possible and causing the least irritation during surgical interventions. [16]

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Table 1. Risk factors associated with the development of surgical site infections (SSIs)

Patient-related	**Procedure-related**
Age	Duration of surgical scrub
Alcoholism	Skin antisepsis
Diabetes Mellitus type II	Skin preparation
Hypoalbuminaemia	Duration of operation
Immunosuppression	Antimicrobial prophylaxis
Nutritional status	Operating room or office ventilation
Remote site infection	Lack of adequate sterilisation of surgical instruments
Culture of microorganisms (especially S. aureus)	Surgical draining
Length of preparation stay	Surgical technique Deficient haemostasis Space of action Trauma performed

The most relevant aspects of proper preparations following the appropriate postulates of asepsis and antisepsis are described in a practical manner below, in order to establish and relate the techniques presented to the appropriate context.

Methods of application of antisepsis techniques

Research conducted in 2015 and led by the Cochrane Wounds Group, presented a comparison of 14 trials related to reducing the rate of SSIs in a study involving 3317 participants, assigning them to follow basic hygiene protocols in preoperative procedures, to contrast the use of soap and water versus the use of alcohol and hydrogen peroxide, as well as a study of 500 participants comparing alcohol-only hand disinfection versus the common use of soap and water. Risk differences of moderate quality rates of 0,77 to 1,23 were obtained for the soap and water versus alcohol and peroxide comparison, and very low quality rates of 0,23 to 1,34 for the alcohol-only versus soap and water comparison.[17]

The use of additional active ingredients versus soap and water and the use of alcohol was also compared with samples of 4387 and 100 participants respectively, obtaining low quality risk differences in both cases.[17] The use of additional active ingredients versus soap and water and the use of alcohol was also compared with samples from 4387 and 100 participants respectively, obtaining low quality risk differences in both cases. [17] This was done in order to compare the efficiency of the samples with active ingredients and soap and water, where it is evident that the use of additional components to the soap and water wash greatly increases the efficiency of antisepsis, the opposite being the case with the application of alcohol, soap and water.

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Water-based solutions

A water-based scrub contains the active ingredients used in traditional hand washing. The most common solutions contain chlorhexidine gluconate or povidone iodine (table 2). Exfoliation involves wetting the hands and forearms with water, applying the aqueous exfoliation solution systematically by hand or with a sponge, rinsing with running water and repeating the process.[17]

Alcohol-based solutions

Alcohol-based solutions are used to make 'alcohol wipes'. A health professional applies the solution to dry hands, then rubs them systematically before allowing the solution to evaporate. Alcohol wipes do not require water. Some alcohol-based solutions contain additional preservatives and additives.[18]

Table 2. Chemical methods of antisepsis

Antiseptic agents	Compound	Description
Alcohol	Ethanol, isopropanol and n-propanol	Compared to other common antiseptics, alcohol is associated with the highest and fastest reduction of microbial counts. faster reduction of microbial counts
Iodine and iodophors	They are composed of elemental iodine, iodide or triiodide, and a high molecular weight carrier polymer.	Iodophors rapidly reduce transient and colonising bacteria, but have little or no residual effect.
Clorhexidine	Chlorhexidine Chlorhexidine gluconate	It is not sporicidal. Its immediate antimicrobial activity is slower than that of alcohols due to its binding to the outermost layer of the skin. Chlorhexidine gluconate is effective in the presence of blood and other protein-rich biological materials.
Quaternary ammonium compounds	Alkyl benzalkonium chlorides, benzethonium chloride, cetrimide, and cetylpyridium chloride	They are mainly bacteriostatic and fungistatic, although they are microbicidal against some organisms at high concentrations. They are more active against gram-positive bacteria than against gram-negative bacilli.
Hexachlorophene	Halophenol	Slow-acting antiseptic that forms a bacteriostatic film on the skin, effective against gram-positive bacteria. Restricted use in newborns
Triclosán	2,4,4'-trichloro-2'-hydroxy diphenyl ether	Incorporated with detergents (0.4% to 1%) and alcohols (0.2% to 0.5%) it can be used for hygienic and surgical hand antisepsis, preoperative skin or oral cavity disinfection. Inhibits staphylococci, coliforms, enterobacteria and a wide variety of gram-negative oral and skin flora.

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In oral and maxillofacial surgery, the most commonly used antiseptic compounds are ethyl alcohol, chlorhexidine and iodine compounds such as iodopolyvinylpyrrolidone, the last two being used on mucous membranes, the reason why ethanol is not used on mucous membranes is because it can irritate them, so its use is only topical.[18]

Methods of application of aseptic techniques

Asepsis techniques have been standard practice in dental care for several years as previously mentioned, as they help prevent the transfer of environmental germs present on objects or surfaces to an open wound and other susceptible areas in a patient's stomatognathic system.[19] A person is vulnerable to infection as soon as a wound occurs, regardless of whether it occurs as a result of an accidental injury or a surgical incision.[20] Aseptic technique of disinfecting the surgical site through the application of various routes of killing microorganisms helps prevent healthcare-associated infections.[13]

Chemical compounds most commonly used as surface disinfection methods

Of the chemical compounds most commonly used for complete asepsis, two categories can be distinguished: Gases and Liquid chemical solutions.

Table 3. Chemical methods of asepsis

Type of method	Compound	Function
Gases	Ethylene oxide (EO))	Especially used to sterilise heart-lung machines, respirators, sutures, dental equipment, books and clothing.
Gases	Formaldehyde	- For preserving anatomical specimens - Destroy anthrax spores in hair and wool.
Chemical solution	Chlorine solutions	- To disinfect floors, sinks. - Disinfect faeces and urine. - Purify drinking water. - Eliminate odours.
Chemical solution	Phenol (Carbolic acid) (Lysol)	- Ceiling and furniture. - Rinse for blankets and bedding
Chemical solution	Iodine (Betadine)	- Preoperative skin preparation - Disinfection of thermometers utensils, rubber bands

The safest and most modern processes of surgical asepsis are based on certain guidelines: Ensuring that health care workers, the environment and equipment are sterile for a considerable time prior to surgery.[21] Thus, surgical asepsis involves four fundamental strategies, which include:

1. Use of barriers: sterile gloves, masks, gowns and caps.
2. Preparation of materials, instruments and patient, instruments should be sterilised by moist heat.

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3. Contact guidelines: Sterile items remain sterile only when touched by other sterile items.
4. Environmental controls: Sterile drapes and trays for equipment and patient.

Future methods contemplate the possibility of using high-spectrum radiation, which implies the use of Cobalt-60 gamma radiation due to its high penetrating power, in order to avoid contamination in surgery.[22] Meanwhile, the use of UV radiation is currently favoured as a method of asepsis, however, this is a form of surface radiation and its penetration capacity is poor, so for the moment it is used to sterilise surfaces, grafts and surgical material (scalpels). Given the precedent, it is hoped that radiation sterilisation can soon be safely extended with the development of new technologies in the field of application in health areas.[23]

Asepsis and antisepsis prior to oral surgery

According to Lindero I. in the Guía de Atención en Cirugía Oral Básica de la Universidad Nacional de Colombia, [24] it is recommended to maintain an appropriate oral environment:

- A detartration should be performed prior to the surgical intervention.
- Order the patient to rinse with antiseptics such as 0.2% chlorhexidine for about 20 to 30 seconds.
- Disinfect the oral peripheral area and the area to be treated using gauze soaked in Povidone Iodine based solution.
- Always use sterile surgical drapes to prevent cross-contamination.
- Manage biosafety measures.

According to historical facts, surgical procedures and their complications have been solved, with the advancement of dentistry that has evolved over time, however, cases of nosocomial infections with direct post-operative repercussions on the patient's recovery from surgery are still prevalent today. Therefore, extensive research into methods of asepsis and antisepsis has been essential in the health field to reduce the spread of bacteria, fungi and viruses that cause infections in surgical practices, whose safety protocols have evolved from the use of ointments, essential oils and cauterisation to methods of asepsis and antisepsis, essential oils and cauterisation to methods that include the use of ethylene oxide (EO) or iodine solutions as chemical methods of asepsis, in addition to the use of aqueous and alcoholic solutions added to compounds such as chlorhexidine, iodophors, quaternary ammonium compounds, hexachlorophene and triclosan, for use as antiseptics. The appropriate use of these components allows greater benefits to be obtained in the hygiene practices of surgeons, as mentioned in the study presented by Tanner et al,[15] where a higher rate of disinfection is observed when using alcohol and hydrogen peroxide compared to soap and water, mentioning the benefits of alcoholic solutions as they are quick-drying compared to aqueous solutions that require an appropriate technique to dry the surgeon's hands prior to the use of gloves.

In addition, operating theatres are mentioned as vulnerable environments for the patient, due to their excessive use and the flow of patients in certain specific cases, given that they require adequate aseptic conditions that allow for the reduction of possible contamination factors.

Chemical compounds include gases and chemical solutions that help to eliminate and reduce contaminants in the environment and on the skin, for example ethylene oxide. While, in physical asepsis, there are processes that help to reduce the contamination load involved in surgery, such as the use of gloves, sterile caps, air filters, sterilisation of tools by heat, environmental control such as clean trays, sterile cloths. In addition, in a more advanced area, disinfection by gamma and UV radiation is used, which completely destroys the microorganisms involved, generating total disinfection.[25]

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In dentistry, where the surgical site is generally in contact with food that may contain pathogens, special care must be taken to be meticulous when preparing the surgical site to avoid infections or contamination that may lead to postoperative problems.[25] Therefore, within the dental field, oral infections are the most frequent in the case of viruses or bacteria in the oral cavity, where the most common are: aerobic and anaerobic, gram-positive and gram-negative bacteria. Among these, the genera Lactobacillus, Actinobacillus, Staphylococcus or Streptococcus stand out.

For this reason, asepsis with chemical compounds is the most commonly used method for working in these environments, thus protecting the working area and reducing the risk of infection. Furthermore, the importance of asepsis and antisepsis techniques in the oral and maxillofacial surgery environment must be reaffirmed and emphasised due to the danger faced by both the patient and the practitioner of contracting infectious diseases, not forgetting COVID-19 at the present time.[25]

CONCLUSIONS

The current problem related to nosocomial infections is of worldwide relevance, and their treatment is becoming increasingly complicated with the appearance of multi-resistant bacteria, so that ensuring sterile conditions in surgical procedures is the most appropriate option to avoid serious complications in the future. Asepsis and antisepsis methods are fundamental, and it is important for all healthcare personnel performing or attending a surgical procedure to know which methods are applicable on live and inert surfaces, as well as the recommended application time. Surgical preparation for oral surgery is indispensable, performing equipment asepsis with solutions such as ethylene oxide, formaldehyde, as well as antisepsis of the patient and professionals with chlorhexidine, alcohol, triclosan, among others. With these measures, the operative and post-operative phases will be carried out without complications.

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