Systematic Review of Zirconium Dioxide Restoration Decontamination Methods after Contact with Saliva During Try-In

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Abstract

Prosthodontic restorations made of zirconium dioxide are popular. An important step in prosthetics is the cementing of a zirconium dioxide crown on the tooth. For high-quality adhesion, the inner surface must be cleaned of saliva and blood contamination.

The aim of the study is systematic review on the impact of the method on the quality of cleaning of zirconium dioxide restorations after contamination with saliva.

Electronic search of articles was carried out using search engines and databases Google Scholar, Pub Med. Articles are included, the content of which relates to the topic of methods of purification of zirconium dioxide after contamination with saliva. The publication date criterion has been selected since 2013.

69 articles were reviewed during the review process. After analyzing the literature according to the inclusion criteria, the total number was 50 publications.

There are many methods of cleaning zirconium dioxide from saliva contamination. There are commercial products on the dental market that show good results. Additional research methods are needed to determine the most effective method of contamination from saliva contamination.

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Introduction

Ceramic dental restorations are becoming increasingly popular due to their aesthetic appearance and biocompatibility. [1] Recently, the use of zirconium ceramic restorations has also increased due to their high transparency, reduced laboratory costs for the manufacture of ceramics and ease of milling zirconium. [2]

In the practice of an orthopedist, the preservation of the result of prosthetics for many years is important. Reliable adhesion of zirconium ceramics was obtained by mechanical retention and chemical adhesion of cement with ceramics. [3,4]

During the clinical procedure for fitting restorations in contact with adjacent teeth or in cases of occlusion, it is impossible to avoid contamination of the inner surface of the restorations with saliva and blood. Saliva contamination leads to a decrease in the adhesion of cement with zirconium dioxide. [5]

It is necessary to determine the most effective protocol for the purification of zirconium dioxide, because there are many different methods.

The purpose of the study: systematic evaluation of scientific data on the impact of the chosen method on the quality of purification of zirconium dioxide after contamination with saliva.

Materials and methods

Electronic search of articles was carried out using search engines and databases Google Scholar, Pub Med. Articles are included, the content of which relates to the topic of methods of purification of zirconium dioxide after contamination with saliva. The publication date criterion has been selected since 2013.

Search terms included "zirconium dioxide", "permanent crown fixation", "contamination", "saliva".

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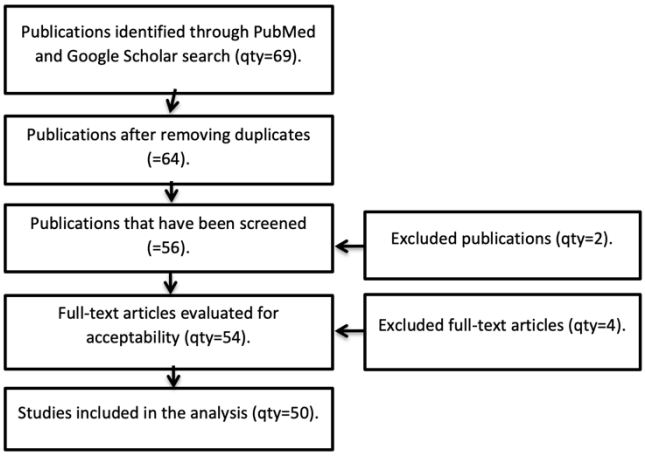

Table 1. Article selection process.

The studies were filtered and selected in several stages. Firstly, they were evaluated by name. Secondly, individual documents at the first stage were additionally evaluated by reading abstracts and full-text articles. The difference in choice was resolved by discussion.

The selection of publications was also carried out according to the following inclusion criteria – the date of publication of the article was not earlier than 2013, the topics of purification of zirconium dioxide after contamination with saliva appeared.

The first exclusion criterion was the selection of publications dated earlier than 2013. Further, the consideration did not include works whose title and summary did not meet at least one of the submitted inclusion criteria. At the last stage, the content of the full-text versions of the selected articles was studied.

In the course of working through all the selected information, the possibility of a systematic error was considered. The Cochrane Collaboration system was used to determine the risk of the possibility of a systematic error during the study of the selected information. [6]

The levels of systematic error were systematized as follows: low risk if all criteria were met; moderate risk when only one criterion was missing; high risk if two or more criteria were missing; and unclear risk if there were too few details to decide on a certain risk assessment.

Summing up the risk of bias for each study, most studies were classified as unclear risk. A number of studies have been found to have a low risk of bias. There were several limitations in the current review, including studies written only in English, which could lead to publication bias. In each study there were different degrees of heterogeneity in the materials and methods of research.

Results

69 articles were reviewed, 49 of which were on the PubMed database, 20 - Google Scholar. Having made the selection according to the exclusion criteria, the total number of works was 50. The selected articles analyzed current data on the methods of purification of zirconium dioxide after contamination with saliva.

Discussion

There are various methods of cleaning the inner surface of the zirconium dioxide restoration after contamination with saliva or blood before permanent fixation.

The main component of saliva is water (99%)[7] Glycoproteins, enzymes, immunoglobulins, mucins, nitrogenous products, various electrolytes are also present [8]. Zirconium dioxide has a polarity and affects the adsorption of saliva proteins.[9] Saliva proteins are attached to zirconium dioxide by non-covalent bonds.[10] The protein layer formed after contact with saliva cannot be removed by washing with water.[11]

Zirconium is an amphoteric metal oxide that exhibits both anion-exchange and cation-exchange properties depending on pH and buffer composition.[12] Enamel is also amphoteric due to the fact that mainly phosphate groups and calcium atoms are exposed on its surface, and, consequently, both acidic and basic components bind to this mineral. [13]

Zirconium dioxide and enamel surfaces have similar properties in terms of protein adsorption.[14]

Chemical cleaning can be performed using alkaline, acidic or neutral solvents or emulsions.[15] Acid purification is mainly based on the removal of organic residues that are easily dissolved in acid.[16] This can be achieved using hydrofluoric acid or orthophosphoric acid. [17]

Sodium hypochlorite (NaOCl) was used in dentin as a deproteinizing solution. NaOCl is a well-known non-specific proteolytic solution capable of removing organic material, as well as magnesium and carbonate ions.[18]

A commercially available product (Ivoclar Vivadent, Schaan, Leichtenstein) has been

marketed for the removal of pollutants.[19]

Ivoclean is advertised as an alkaline extraoral universal ceramic cleaner. [20] Ivoclean has been reported as an effective way to clean ceramic surfaces. [21]

Ivoclean consists of highly concentrated zirconium oxide particles that form a concentration gradient that creates an increased affinity for phosphate compared to a ceramic surface. [22] The increased affinity in the solution removes organic impurities from the surface of zirconium dioxide, which can then be washed off with water.[23]

The manufacturer claims that rinsing with water and air drying after applying the solution effectively removes saliva contamination from the surface of restorations, including zirconium dioxide.[24] Initial evaluations of this cleaning solution have shown its effectiveness. [25]

ZirClean is also an alkaline cleaner for zirconium dioxide structures and other ceramics after fitting.[26,27] Its alkalinity is due to potassium hydroxide, which interrupts the ionic bond formed between the contaminant and zirconium dioxide.[28,29,30]

Unlike Ivoclean and ZirClean, Katana cleaner is acidic (pH 4.5), which allows either extraoral or intraoral application.[31,32,33] The manufacturer advertises the product as a universal cleaner capable of removing impurities from a wide range of dental materials and tooth structure. [34,35,36] The MDP salt acts as an active ingredient in which the hydrophobic methacrylate ends of the MDP molecule are attached to organic pollutants, which weakens the adhesion to the surface being restored. [37,38,39] Hydrophilic phosphate heads are surrounded by impurities that allow them to be washed off with water.[40,41,42] Organic solutions are often recommended to remove saliva contamination from the inner surface of restorations before cementation.[43,44,45] It has been reported that sandblasting effectively removes impurities from saliva and restores the strength of the joint to the control values obtained without saliva contamination.[46,47, 48]

A cleaning agent known as AD Gel (ADG) (Kuraray Noritake Dental, Tainai, Japan) is also used to treat the surface of dentin, since it is believed that it improves the adhesion of the polymer composite to dentin by dissolving the collagen layer after the acid etching stage.[49,50]

Air-borne particle abrasion produced the highest shear bond strength (21 MPa) of all tested cleaning methods, suggesting the most complete surface restoral. Although mechanical surface abrasion has been reported to be the most effective way of decontaminating a ceramic surface, it remains a controversial method nonetheless.

Conclusions

There are many methods for cleaning zirconium dioxide from saliva contamination. There are commercial products on the dental market that show good results. Additional research methods are needed to determine the most effective method of contamination from saliva contamination.

Declaration of Interest

The authors report no conflict of interest.

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