EVALUATION OF RESIN TAGS IN SEALANT WITH DIFFERENT ETCHANTS ON MANDIBULAR MOLARS - AN IN VITRO COMPARATIVE STUDY

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ABSTRACT

INTRODUCTION

Dental caries is a microbial disease of the calcified tissues of the teeth, characterized by demineralization of the inorganic substance and destruction of the organic
substance of the tooth. The prevalence of caries is increasing in children due to their lifestyle and their habits.

MATERIALS AND METHOD

Six sound freshly extracted mandibular first molars from individuals who had extractions scheduled were collected. The recovered teeth were cleaned with an ultrasonic scaler of any adhering deposits or debris and preserved in normal saline. The teeth were cleaned, washed, and dried prior to pretreatment of the occlusal surfaces. The teeth were then separated into three equal groups.

RESULTS AND DISCUSSION

The current study's findings also showed that surfaces that had been phosphoric acid pre-etched had considerably better enamel bonding. It was discovered that Group A's mean resin tag length was 18.98 microns. It can be the result of longer tags caused by deeper demineralization and more resin penetration.

CONCLUSION

The results also imply that prior acid etching of the dental enamel may have increased the self-etching sealant's penetration capacity (resin tags). This has practical significance since tooth enamel is the primary component of many restorative techniques, and retention is essential to those operations.

KEYWORDS

Pit & fissure sealant, orthophosphoric acid, resin tag, etchant, SEM

INTRODUCTION

Dental caries is a microbial disease of the calcified tissues of the teeth, characterized by demineralization of the inorganic substance and destruction of the organic
substance of the tooth. Although preventable, it is still considered the most chronic disease with high prevalence affecting many children in several countries including India. The prevalence of caries is increasing in children due to their lifestyle and their habits.(1,2) On the other hand, society is concerned with the standard of medical care and is increasing its demands for proof of the suitability and efficacy of the treatment given. Dental education aims to show that it is beneficial at both training students for practice and at providing care for its patients by measuring treatment efficacy. Examination of patient dental records may offer a practical way to offer proof of the success of our patient care and educational activities. Through classroom and laboratory experiences, students learn how to handle materials and carry out dental treatments with the goal of eventually providing direct patient care. In controlled clinical trials, many of the items and techniques used in clinical practice and taught to dentistry students have been tested.(2) Clinical trials are typically carried out by skilled medical professionals working in the best settings on a select sample of patients in order to properly assess the efficacy of a substance or treatment. A dental student clinic is considerably dissimilar from a controlled clinical trial. While under the supervision of faculty, dental students are novice clinicians who frequently treat patients who may not be good candidates for the operation without the assistance of dental assistants. In light of this, the effectiveness of occlusal sealants as delivered by dental students may differ from the outcomes of a controlled clinical trial. Pit & fissure sealants are a great choice of preventive measure for occlusal caries. Hence they are preferred to be used in children or adults as a preventive or restorative measure for occlusal pit & fissure caries. Only when a sealant is successfully maintained in the fissures can it effectively prevent caries. As a result, retention starts to have a significant impact on how effective the sealant is.(3)

Pit and Fissure Sealant made of resin is held in place by the etched enamel and resin micro mechanically interlocking. The direct outcome of resin penetrating into the porous enamel creating tags is mechanical retention of sealant. Through capillary action, this happens. After polymerizing, the resin monomer interlocks with the enamel surface.Therefore, it may be hypothesized that the amount of microleakage will decrease with the length of the resin tags.(4) The viscosity of the sealant affects the depth of penetration of sealants in addition to surface tension. Low viscosity sealants have a higher chance of quickly flowing, spreading, and penetrating scratched enamel surfaces. Clinicians must overcome a number of obstacles to properly apply conventional Pit and Fissure Sealants, including sensitive manipulation technique, controlling moisture, and laborious process. (5) Premium polymeric restorative materials are preferred, particularly when working with kids who have inconsistent levels of cooperation, tolerance, and patience. Considering all of this, dental manufacturers focused their efforts on providing a material that requires less time to apply, can be applied in fewer steps, and is less technique-sensitive, potentially boosting the material's success. One of these more recent materials is Pit and Fissure Sealant, which self-etches.(6)

Inspired by cutting-edge ideas in Minimally Invasive Cosmetic Dentistry and the latest advancements in adhesive technology, Prevest Denpro developed PF SEAL SE, a quicker, simpler, and more gentle sealing solution that does away with the need for phosphoric acid etch and rinse phases completely.(6,7) It is a self-etch pit and fissure sealant with light curing properties that is

enhanced with active nano hydroxyapatite , which can help restore tooth mineralization. There don't seem to be many studies contrasting these materials with traditional sealants, though. Thus, by measuring the depth of resin tag penetration, this study aims to assess the retention of PF SEAL SE (Self Etching Sealant) with and without pre-etching with 37% phosphoric acid.(8)

MATERIALS AND METHOD

Six sound freshly extracted mandibular first molars from individuals who had extractions scheduled were collected. The recovered teeth were cleaned with an ultrasonic scaler of any adhering deposits or debris and preserved in normal saline. The teeth were cleaned, washed, and dried prior to pretreatment of the occlusal surfaces. The teeth were then separated into three equal groups.

Group A - Tricalcium phosphate + citric acid
Group B - Tricalcium phosphate + 37% phosphoric acid
Group C - 37% phosphoric acid

Group A, group B, group C etchants were used on mandibular molars before applying the sealant to each.The teeth's occlusal surfaces were etched with 37% phosphoric acid for 15 seconds before being properly washed with water. After that, the teeth were dried with a light oil-free air stream to obtain the typical frosted chalky white appearance of enamel. A dispensing tip was used to apply PF SEAL SE to the prepared occlusal surfaces. For around 15 seconds, a thin layer of sealant was brushed onto the occlusal surface with moderate pressure. The provided brush was used to remove excess material around the edges. Using a light curing equipment, polymerized for 20 seconds. For around 15 seconds, a thin layer of sealant was brushed onto the occlusal surface with moderate pressure. Excess material was scraped from the margins with the provided brush before being light cured for 20 seconds. Each tooth's root was removed, and the crowns were sectioned bucco-lingually. For each tooth, one part was chosen at random and discarded, while the other half was prepared for scanning electron microscopy. A carbide stone was used to polish the specified parts. After decalcifying the polished parts with 37% PA for 15 seconds to etch away enamel mineral components not covered by sealants, they were cleaned and kept in distilled water.The tooth parts were then completely dried under a heat lamp. The surfaces were coated with pure gold before being placed in a vacuum chamber. The gold spluttered sections were then analyzed using a SEM; SEM Model Quanta 250 FEG (Field Emission Gun) attached to an EDX Unit (Energy Dispersive X-ray Analyses), with an accelerating voltage of 30 K.V., and photos of the sections were acquired. The resin tag lengths were then measured, and the average values from each photograph were calculated.

RESULTS

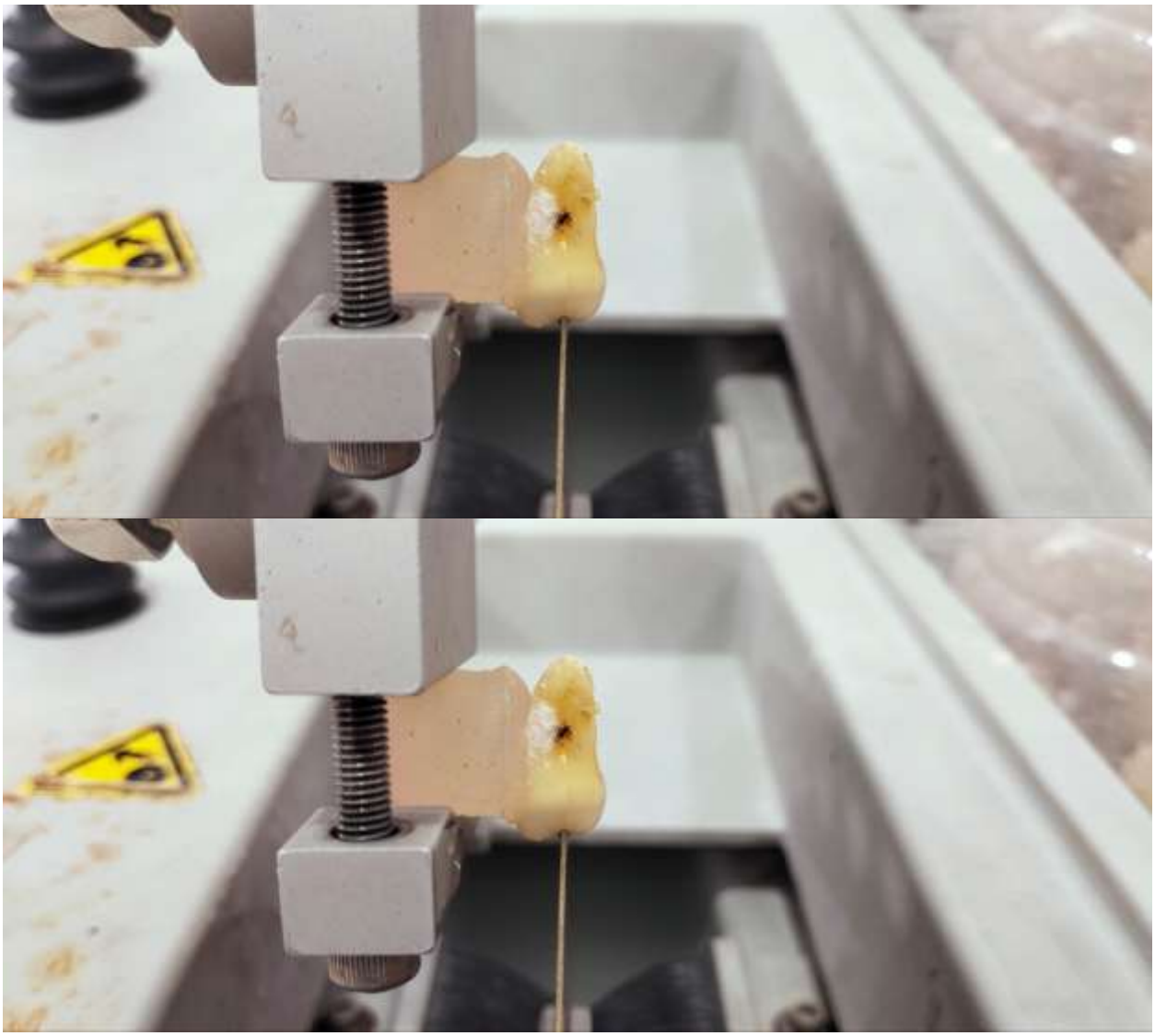


Fig. 1 - Sectioning of teeth samples using Microtome.

Fig. 2 - Sectioned teeth samples.

Fig. 3 - Sectioned teeth samples.

Fig. 4 - Sample subjected to hot air oven drying.

Fig. 5 - Scanning Electron Microscope

Fig. 6 - Tricalcium phosphate + 37% phosphoric acid

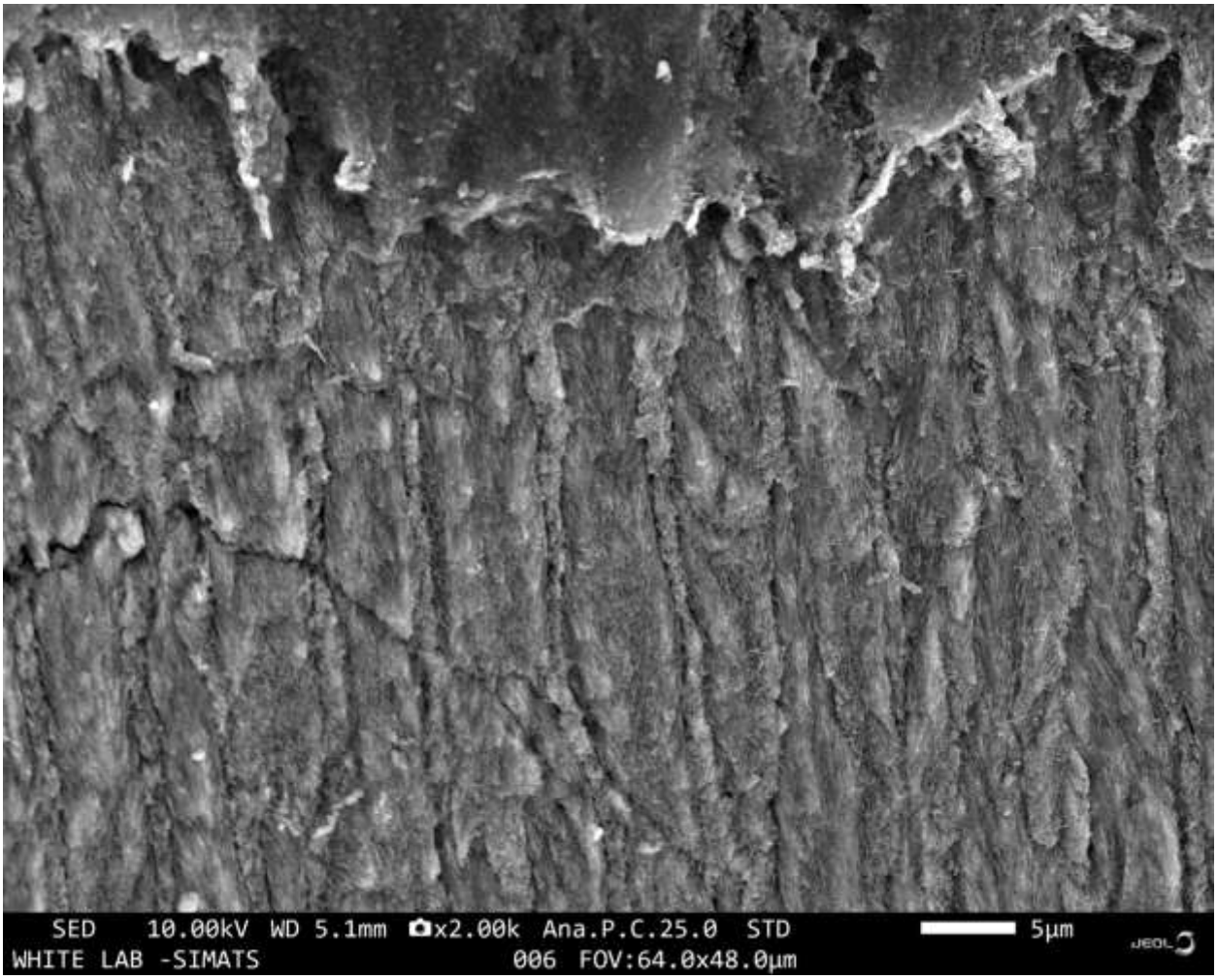


Fig.7 - Control

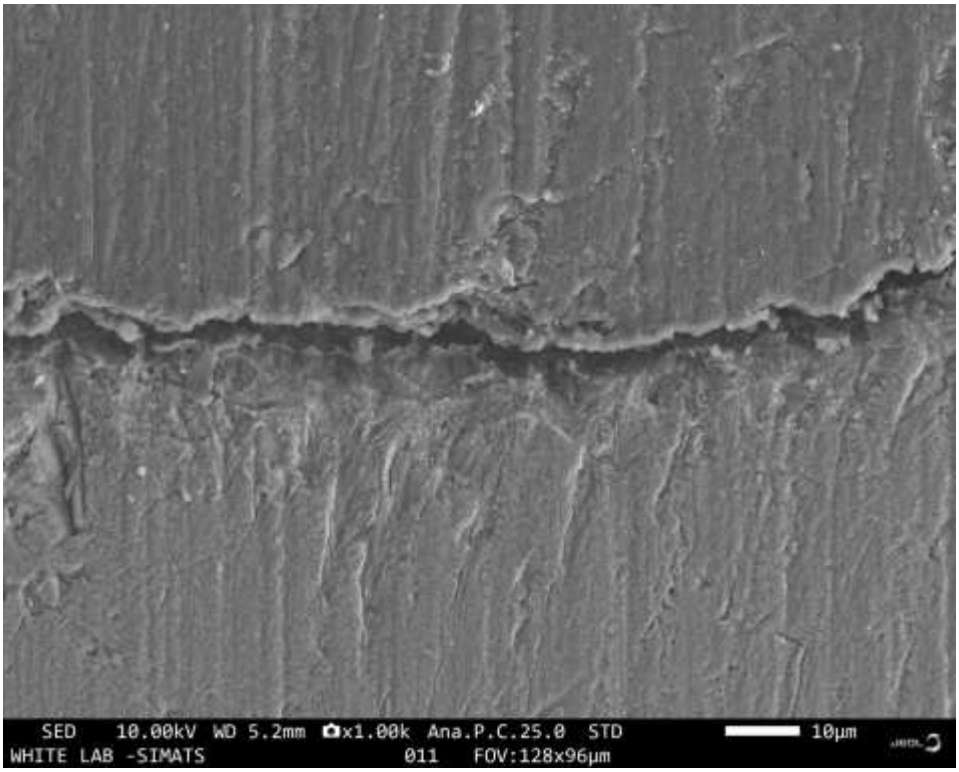
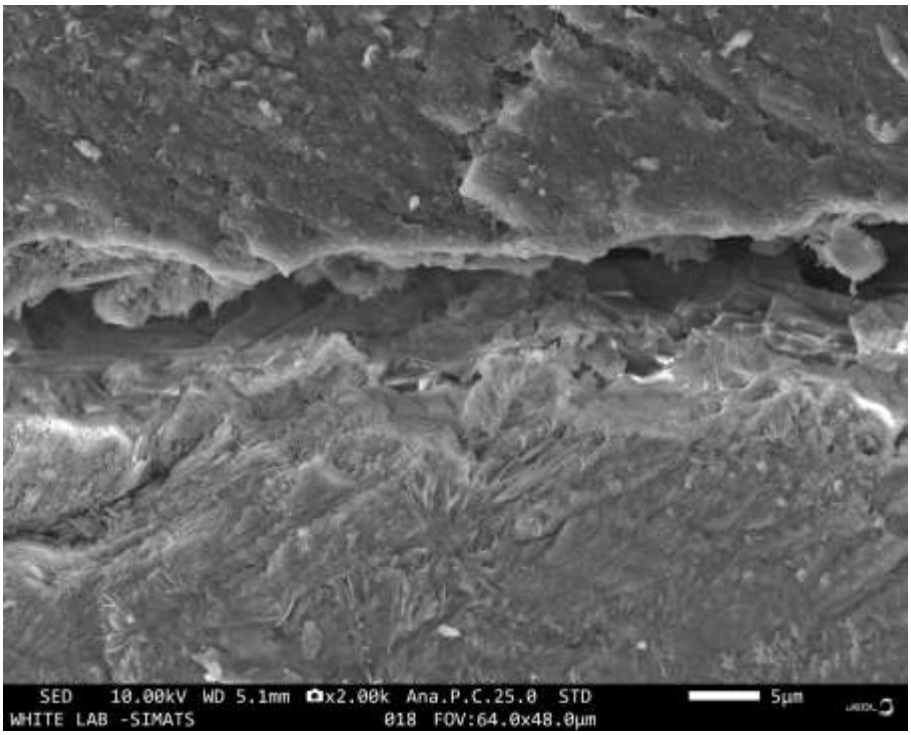


Fig. 8 - Tricalcium phosphate + citric acid



DISCUSSION

The physical blockage of the pits and fissures is responsible for the cariostatic qualities of sealants. This stops new bacteria from colonizing the pits and fissures and stops any bacteria that may still be present there from getting access to fermentable carbohydrates. Effective sealants must have the following qualities: low sorption and solubility, resistance to wear, minimal tissue irritation, cariostatic action, sufficient working time, quick cure, good and extended adhesion to enamel, and viscosity permitting penetration into deep and small fissures.(5)

Mandibular molars removed from the study owing to root caries were devoid of caries on the occlusal surfaces, discolouration, and enamel microfractures. Premolar occlusal surfaces were cleaned with pumice prophylaxis before being etched. Blackwood demonstrated that the traditional pumice prophylaxis caused the least amount of microleakage when compared to enameloplasty, air abrasion, and pumice prophylaxis.(9)

Since the SEM can provide extremely high-resolution images of a sample surface and disclose features approximately less than 1 to 5 nm in size, it was utilized to measure the length of resin tags.(10) SEM micrographs have a significant depth of field and a distinctive three-dimensional appearance that is helpful in comprehending the surface structure of a sample because of the extremely narrow electron beam. In this investigation, SEM looks at the resin tag penetration depth, which aids in determining how well the adhesives adhere. (1)Ferrari et al. state that in SEM, low magnifications (×1000) reveal the uniformity of the enamel etch pattern as well as the density

and true depth of the resin tags, while high magnifications (×3500) reveal the morphological traits of the resin tags penetrating the enamel, despite the fact that assessments of the depth of etching have largely been subjective.(2)

SE sealants represent a potentially significant advancement in adhesive dentistry, particularly in terms of fewer steps required for application and the potential for chemical interaction with collagen fibers coated in hydroxyapatite. Nonetheless, bonding to enamel is still important and is a contentious topic covered by a number of writers.(2,9)

This study assessed how resin tag length to undamaged enamel was affected by an optional 37% phosphoric acid etching. Research showed that etching is necessary in order to establish sufficient adhesion to undamaged enamel using self-etching systems alone.

Mild self-etching methods can produce adequate bond strengths and sufficient micro-mechanical interlocking despite their shallower resin tag creation and less severe etching pattern. (9)This could be the result of the residual hydroxyapatite that was left attached to the collagen, which could act as a receptor for further chemical adhesion, as well as the simultaneous demineralization and resin monomer penetration. In the current investigation, no resin tag development was seen in Group B samples, where the samples were directly applied with self-etching sealant; instead, all of the samples had enormous gaps in the resin-tooth interface. That is, the enamel surface was not able to make a bond with the self-etching sealant. (11)The polymerization contraction that takes place in the direction of the light source may potentially be the cause of the gap creation. With moderate self-etching systems, it has been noted that the shorter etching pattern and decreased micromechanical retention are concerning, particularly when bonding to unprepared enamel and possibly compromising the strength of the resin enamel interface.(12) Research has also demonstrated that self-etching systems with bonding to the ground produce bond strengths comparable to those of uncooked enamel. Manufacturers frequently advise a first phosphoric acid etching process before applying mild self-etching systems to strengthen the adhesion to enamel because the evidence on the topic is still debatable. (13) Consistent with the findings of earlier research demonstrating the advantages of phosphoric acid enamel etching.

The current study's findings also showed that surfaces that had been phosphoric acid pre-etched had considerably better enamel bonding. It was discovered that Group A's mean resin tag length was 18.98 microns. It can be the result of longer tags caused by deeper demineralization and more resin penetration.(14) Higher bond strength values are obtained by pre-etching with phosphoric acid, which eliminates the outermost enamel and produces micro imperfections with an adhesive surface.(15)

CONCLUSION

According to the current study's findings, PF SEAL SE is a substance that does not effectively attach or penetrate the tooth surface. Applying the material in accordance with the manufacturer's directions will result in more microleakage and a higher likelihood of restoration failure. The

results also imply that prior acid etching of the dental enamel may have increased the self-etching sealant's penetration capacity (resin tags). This has practical significance since tooth enamel is the primary component of many restorative techniques, and retention is essential to those operations. Consequently, better retention may arise from the use of prior acid etching or the removal of prismatic enamel layers by grinding or beveling the cavity borders.

REFERENCES

1. Perdigão J. Restoration of Root Canal-Treated Teeth: An Adhesive Dentistry Perspective. Springer; 2015. 255 p.
2. Eliades G, Watts DC, Eliades T. Dental Hard Tissues and Bonding: Interfacial Phenomena and Related Properties. Springer Science & Business Media; 2005. 198 p.
3. Bekes K. Pit and Fissure Sealants. Springer; 2018. 179 p.
4. British Standards Institution. Methods of Test for Phosphoric Acid (orthophosphoric Acid) for Industrial Use. 1978. 12 p.
5. dos Santos KT, Sundfeld RH, Garbin CAS, de Alexandre RS, Sundefeld MLMM, Ceolim BN. Length of resin tags in pit-and-fissure sealants: all-in-one self-etching adhesive vs phosphoric acid etching. Compend Contin Educ Dent. 2008 Apr;29(3):186–92.
6. Smyslov RY, Emel'yanov AI, Ezdakova KV, Korzhova SA, Gorshkova YE, Khripunov AK, et al. Composite Hydrogels Based on Bacterial Cellulose and Poly-1-vinyl-1,2,4-triazole/Phosphoric Acid: Supramolecular Structure as Studied by Small Angle Scattering. Biomimetics [Internet]. 2023 Nov 2;8(7). Available from: http://dx.doi.org/10.3390/biomimetics8070520
7. Sebastian V. Adsorptive detoxification of Cd and Pb from wastewater using MWCNTs functionalized with -di-(2-ethyl hexyl phosphoric acid) and bis-(2,4,4-trimethyl pentyl) phosphonic acid. Environ Sci Pollut Res Int [Internet]. 2023 Nov 18; Available from: http://dx.doi.org/10.1007/s11356-023-30808-x
8. Development of Processes and Equipment for Production of Phosphoric Acid. 1948. 164 p.
9. Gelio MB, Zaniboni JF, Monteiro J, Besegato JF, Pereira JR, Buchaim RL, et al. Medium-term evaluation of the bond strength and dentin penetration of self-adhesive resin cements to root dentin. Aust Dent J [Internet]. 2023 Oct 27; Available from: http://dx.doi.org/10.1111/adj.12988

10. Tzelepi Z. Development of Self-adhesive, Remineralising and Antibacterial Composites and the Effect of These Properties on the Bond Strength, Monomer Conversion and Resin Tag Formation in Human Dentine. 2018.

11. Keith Hunter J. Biomechanical Preparation of Finely Curved Canals of Mandibular Molars: A Thesis Submitted in Partial Fulfillment ... Endodontics .. 1981. 156 p.

12. Alsanah AS, Alqahtani FA, Alshehri DM, Alqahtani AM, AbuMelha AS. Prevalence of Middle Mesial Canal in Mandibular Molars of a Saudi Subpopulation: A Prospective Cone-Beam Computed Tomography Study. Cureus. 2023 Oct;15(10):e47554.

13. Showers PF. The Cross-sectional Anatomy of the Mesial Root of Mandibular Molars Before and After Instrumentation: A Thesis Submitted in Partial Fulfillment ... Master of Science in Endodontics .. 1992. 190 p.

14. British Standards Institute Staff. Methods of Test for Phosphoric Acid (Orthophosphoric Acid) for Industrial Use. Methods of Test for Phosphoric Acid (Orthophosphoric Acid) for Industrial Use. Determination of Sulphate Content. 1989. 4 p.

15. British Standards Institute Staff. Methods of Test for Phosphoric Acid (Orthophosphoric Acid) for Industrial Use. Determination of Soluble Sulphate Content (Potentiometric Method). 1990. 12 p.