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The Effect of Dental Ultrasonic Scaler on Dental Restorations

Deema Kamal M Shukri[1*], Dala Jumah Alturaif[2], Laila Mohammed Alanazi[3], Alwaleed Talal Alanazi[4], Riyadh Ahmed Almalki[5], Dawi Hamed S Alrashidy[6], Abdullah Mohammed Gusti[7], Hassan Waleed S Khan[8], Nadia Aqeel Alanazi[9], Hani A. Al Qataberi[10]

1General Dentist, Private clinic
2General Dentist, Private clinic
3General Dentist, Private clinic
4General Dentist, Saudi Ministry of Health
5Dental intern, Taif University
6Genral Dentist, Saudi Ministry of Health, General dentist Saudi Ministry of Health
7General Dentist, Saudi Ministry of Defense
8General Dentist, Ministry of health
9General Dentist, Ministry of health
10Periodontist, Oral and Maxillofacial Surgery Department, Vision Colleges, Jeddah, Saudi Arabia

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***Corresponding author:** Deema Kamal M Shukri
General Dentist, Saudi Ministry of Health

Abstract

The ultrasonic scalers are today becoming the most chosen form of dental polishing and cleaning. With the various researchers and lab tests done on them, it is steered clear of any side effects or invasive methodologies that might harm the patient in any manner. It works both on the soft and hard oral tissues have become the most widely used cleaning instruments among dental practitioners. Ultrasonic scalers use its vibrating power to eradicate different forms of dental plague and foreign components from the teeth. Through various on-field experiments and lab tests, it was made sure that these ultrasonic scalers work much better than any other primitive method for the same task. And that's the major reason why it is so much in demand, ultrasonic scaling has become widely used for professional tooth cleaning. The aim of the systematic review is to assess the role of ultrasonic scaling on dental restoration. A computerized literature search was performed in following database including: Pubmed, the Cochrane Library, Google Scholar and Scopus databases from 1st January 2000 till January 2022. Studies determining the impact of ultrasonic scaling on dental restorations including randomized controlled trials, prospective and retrospective studies, and cross-sectional studies were included. After an initial search a total of 570 articles were identified. Then, 44 studies which were full-text articles were critically reviewed by independently for eligibility. Finally, 10 studies which met all the inclusion criteria were included in the review. The findings showed that out of all of the elements used, we can observe that the glass ionomers have had the chances of greater impacts. Further studies should assess the method of polishing for the removal of discolorations from ceramic restorations after ultrasonic scaling procedures and the possible side effects of polishing.

Keywords: Ultrasonic scaler, dental restoration, scaling, composite, ceramic, glass ionomer cement.

INTRODUCTION

The surgical procedure used to remove any foreign particles or plaque from our teeth and gums includes a variety of processes like use of ultrasonic waves, polishing the teeth surface with air-powder polishes, and many other such systems [1]. The common problems of stains or the yellowness of our teeth can be managed through procedures like polishing which is immensely effective. It can close tiny gaps between our teeth and also work on making a more beautiful smile [2]. To conduct procedures like polishing various systems have been used. All these systems have similar end results but what majorly differs is the amount of time each one takes [3]. It is observed that the system of ultrasonic scaler takes less time that other methods and is also supported for being the favourite method of most dentists because of its

simple use [4]. It works just fine as the other systems and reduces the yellowness and stains on the teeth [5]. This system called the ultrasonic scaling system has been a latest invention in the dental world and is now considered an additional to the other previously used conventional systems. This method is much preferred nowadays because of 3 major reasons:

- These are very simple to use and easy to execute.
- They cause minimum damage to the teeth structure of the patient and also cause the least pain.
- They work the best for cleaning the yellowness of the teeth [6].

The ultrasonic scalers are today becoming the most chosen form of dental polishing and cleaning. With the various researchers and lab tests done on them, it is steered clear of any side effects or invasive methodologies that might harm the patient in any manner. It works both on the soft and hard oral tissues have become the most widely used cleaning instruments among dental practitioners [7, 8]. Sadly, there is one drawback of this system as it loses its competition to piezoelectric scalers. They later have proven better in the removal of tartar or hardened plague and also working on sticky film bacteria that causes the gum on the tooth to go loose. This is majorly the result of unhealthy oral habits [8, 9]. Along with that, more information about the ultrasonic procedure suggests not to go for it if dentists believe that we need some sort of refurbishments for our teeth. As this system has also had negative feedbacks about increasing teeth surface roughness after polishing [4, 5]. But blaming only the system for its nature is not the absolutely right thing to do. Other factors should also be considered before forming a belief that ultrasonic waves do not give satisfactory results. The other factors might include:

- The bonding or adherent system the dentist uses.
- The location of the teeth.
- The closeness of the affected part to the root of the teeth.
- Severity of the periodontal status [10].

If the severity of the issue is too high or if the affected area of the teeth is too close to the root of the teeth, using ultrasonic sounds can result in bigger, life-staying issues like sensitivity, permanent discoloration, or adverse change in the shape of the teeth. It is highly important for the patient to note all these factors before choosing to go for any sort of treatment.

Even with its numerous benefits and capacities, the ultrasonic system also has a few negative sides. These include:

- The ultrasonic vibrations may cause wear and tear of the hard tissues of the teeth.
- It can roughen the already problematic surface of the teeth [2].
- Tooth gaps may increase creating pain and problems in the set of the teeth [13].
- Accumulation of hardened plague may increase.
- May cause severe gum problems and gum loosening.
- There are chances of teeth fall-out because of the loosening of the gum [11].
- The teeth set might start looking worse [14].

Dental materials are used to fill teeth gaps, unevenness and cavities. While there are different sizes of particles used in these composites, it is common sense to say that larger the particles, more the roughness it causes. With smaller particles, also known as nano composites, the roughness levels are reduced accordingly [15]. Nano composites are reputed majorly for their:

- ⊕ Amazing cleaning abilities.
- ⊕ Makes the teeth set look natural and white [16]
- ⊕ Less pain to the patient.
- ⊕ Particles ranging from 5.0- 120 nanometres.
- ⊕ Makes the surface look glossy.
- ⊕ Retains the smooth surface of the teeth for longer times [16].
- ⊕ Fills the teeth space without leaving any micro-cavities [17].

The only negative feature of this procedure is that it might cause degradation or can stain teeth after about 6 months after completion. So whatever procedure is used, it is necessary to make sure that we maintain good oral hygiene in order to sustain its effect for longer periods of time [2]. Ultrasonic scalers use its vibrating power to eradicate different forms of dental plague and foreign components from the teeth. Through various on-field experiments and lab tests, it was made sure that these ultrasonic scalers work much better than any other primitive method for the same task. And that's the major reason why it is so much in demand [18], ultrasonic scaling has become widely used for professional tooth cleaning. Another negative claim held upon this method is its possibility to defunctionalize prosthetics used for oral care. Dentists use prosthetic methodologies to improve the dental structure, restore different missing parts or cavities of our teeth. These prosthetics are generally made of stainless metal or fibres. Now, if these sonic waves are longitudinally used on teeth, there is a high chance of it causing toxic reactions with the prosthetics, eventually affecting the health. Zirconia, which is a ceramic element also, used in diamonds, is one of the elements used as teeth prosthetics. Ultrasonic vibrations can have a comparatively worse impact on dental restorations [18].

Therefore, the aim of the study is to determine the impact of ultrasonic vibrations on the structural integrity of dental restorations. This will help to provide an effective understanding regarding the procedures for future research.

Aim and Objectives

The aim of the systematic review is:

- To assess the role of ultrasonic scaling on dental restoration.
- To understand the influence on the surface roughness of the dental restoration

METHODS

The present review was prepared according to the Preferred Reporting Items for Systematic Reviews and Meta- Analyses statement [PRISMA Checklist 2009]

Literature Search

A computerized literature search was performed in following database including: Pubmed, the Cochrane Library, Google Scholar and Scopus databases from 1st January 2000 till January 2022. The keywords used to determine the relevant articles included: ((((dental restoration) AND (ultrasonic scaling)) AND (scale)) AND (restoration)) AND (effect)

Eligibility Criteria

Inclusion and Exclusion Criteria

The full-text articles of the relevant studies were obtained and reviewed by the reviewer independently to ensure that the studies met the inclusion criteria. The inclusion criteria were as follows:

- Studies determining the impact of ultrasonic scaling on dental restorations.
- Randomized controlled trials, prospective and retrospective studies, and cross-sectional studies.
- Full-text research studies that determined the surface roughness on the dental restoration.
- In-vitro studies and in-vivo studies.
- Studies published in English language only.

The exclusion criteria were as follows:

- Review articles, commentaries, abstracts and summary.
- Studies that included other prevention modalities for periodontal maintenance except ultrasonic scaling.
- Studies published in languages other than English languages in order to prevent translator bias.

Study Selection

References for textbook and selected articles were screened to identify any relevant studies. The author was independently involved in the process of this study and extracted the necessary information. All available titles and abstracts were identified and scanned and their relevance to the study was determined. When information from the title and abstract was unclear in determining the paper's relevance, full-text articles were thoroughly investigated by the reviewer. Additionally, papers that had cited these articles were identified through Science Citation Index (http://www.isinet.com) to identify potentially relevant subsequent primary research.

Data Extraction and Quality Assessment

Studies that fulfilled the inclusion criteria were processed for data extraction. The main aim of the systematic review is to determine the role of ultrasonic scaling on the dental restoration. Therefore, the studies were investigated for data extraction. The following information was gathered to understand the role of scaling: author, year, aim, results, summary and conclusion.

RESULTS

Search and Study Selection

The process of retrieving and screening the studies which were included for in this systematic review. After an initial search a total of 570 articles were identified. After screening the titles and abstracts, only 210 were found to be relevant. The remaining studies were excluded as some of them were duplicated, irrelevant and others did not justify the inclusion criteria. Then, 44 studies which were full-text articles were critically reviewed by independently for eligibility. Finally, 10 studies which met all the inclusion criteria were included in the review.

Characteristics of Studies Included in the Review

The included studies were assessed on several factors as mentioned in Table 1. The following parameters were included: the author and year, objectives, aim, results, summary and conclusion.

Table 1: The results of the study conducted

Author, year	Aim of the experiment	Findings	Conclusion	Reference
Erdilek, 2015	The effects of various levels and variants of ultrasonic waves were tested on different elements. These included some like: nano-hybrid, polyacid composites, regular glass, ionomer cements. After testing the effect of the waves on various surfaces with diverse levels of smoothness, it was seen that on each of these elements, these waves worked with the same effectiveness thus making it clear that whatever the type of roughness offered in the tooth structure, these waves would function highly in each such variety.	Although both sonic and USS exacerbated the tribological properties of all gingiva material, USS corrugated the substrates of all control samples far beyond SS. As a consequence, USS might have had a serious effect on molar biomaterials, particularly conventional ionomers.	According to this experiment, the originator highly recommends the ultrasonic treatment and ends his clause on the positive note on this.	19
Shenoi *et al.*, 2014	Role of ultrasonic scaling and its impact on the roughness of tooth-colored restoration. This includes Filtek Z 250 XT, GC 2, GC LC, and GC 9	Surface roughness during pre-instrumentation and post-instrumentation was the greatest with GC 2, and lowest with the Filtek Z 250 XT.	GC 2 LC restoration was affected with the ultrasonic scaling the most, while the least susceptible restoration was Filtek Z 250 XT	20
Babina *et al.*, 2021	To understand and analyze the effects of ultrasounds and polishing treatments on the rough the enamel. The major components used are: Premise, Herculite Ultra, and Harmonize.	Substrate degradation to composite materials varied depending on the substance. Ultrasonic scaling had no substantial effect on the premise surface. Surface morphology of frameworks that help and repair margins was increased more by air-powder buffing with both powders than by supersonic scales.	Thoracic tooth hygiene should be approached with prudence. In the case of restorations, laser scalability and air-powder buffing should be avoided if feasible.	21
Filho, 2008	After ultrasonic instrumentation, the tensile fracture toughness of crowns bonded with inorganic mineral cement to natural teeth changed	The tensile bond strength was significantly reduced after 15 minutes of heating and cooling and ultrasonic instrumentation (p.05).	Recommendations such as using ultrasonic instruments sparingly, particularly in the case of molars with metallic restorations.	22
Eid, 2013	On four distinct types of regularly used laminate ceramic restorations for class V cavities, the impact of ultrasonic scaling on machining parameters and quantitative bacterial count.	In compared to other varieties, silicone caulk and segmentation divides buyers composites had significantly smoother surfaces and a lower bacterial count, demonstrating that microbial stickiness is directly related to substrate ruggedness.	The interfaces of compound ceramic restorations are affected by the application of ultrasonic scalers.	23
Sharon, 2021	Temporary cement remains are commonly removed from tooth structure using an ultrasonic down sampling. The ultrasonic scaler's impact on the sturdiness of the foundation end of the race is a key problem.	Following ultrasonic scaling, the average change at the finish line area was 71.5 24.6 m. Enamel and chamfer finish lines had higher modifications than tantalum and scalpel blade.	The roughness value of the majority of materials was found to be more than 0.2 µm.	24
Lai, 2007	the effects of sonic and ultrasonic scaling on the surface roughness of five different types of restorative materials commonly used in cervical lesions	had disastrous effects on the surface roughness of all test materials.	The roughness value of the majority of materials was found to be more than 0.2 µm.	4
Lee *et al.*, 2019	to analyze the potential of ultrasonic waves on translucent surfaces such as ones made of ceramics. Some the elements used were: Lava Ultimate, Vita Enamic and others.	This case showed critical differences as it showed ways in which the translucent elements lost their properties.	The findings can aid restorative dentists in the selection of appropriate materials and motivate periodontists for performing scaling procedures with due consideration of restorations in esthetically demanding areas.	25
Nakazawa K, 2018	to access the impact of ultrasonic scaling along with low-temperature degradation on Zirconia.		At the end of the test, the results showed that even though the ultrasonic waves do not impact the upper strata or enamel formed with	26

Author, year	Aim of the experiment	Findings	Conclusion	Reference
			Zirconia, it might not be similarly beneficial to tackle the virus as well.	
Elmagd, 2019	Lithium disilicate glass ceramics are used in this operation with the same purpose of checking its prominence to sonic waves.	The preservation of dilithium silicon resins is affected by ultrasonic scaling using a piezoelectric ultrasound down sampling for one minute under standard settings (the angle here between tip and linoleum substrate surface was 15°, at maximum energy. and acceptable cooling with distilled water).	It was majorly affected by the waves. Also sustained as unusable and definitely not a substitute.	27

DISCUSSION

Scaling is a common oral treatment technique, and thermoelectric instruments have become popular for cleaning alveolar and central tooth regions [8]. On enamel biomaterials, however, these procedures may generate rough regions like as scuffs, and fractures [4]. Ultrasonic scalers used throughout the cervical margin, in particular, can readily damage restorative surfaces and margins, causing tooth enamel hypersensitivity and consequent oral and dental complications. Plaque, calcification, and microbial toxic metabolites are removed from the dental and uncovered tooth structure by ultrasonic scaling. Endodontists advise sonic scaling every 6-12 months [28], however different molar implants have a longer lifetime. Plaque and sediments accumulate excessively in the anterior areas of the teeth, uncovering the restorations to gingival treatment [11]. Ripple effects of these scrubbing treatments include an increase in the overall harshness of tooth fibrous tissue and wound dressings. Exterior discrepancies significantly raise available surface area by 3 to 4 times, having provided an area of interest for pathogens to adhere and expand, leading to a faster hardened dental plaque and so more. Clarified that bacterial adherence is approximately equal to surface quality of the implants [11, 29].

Tensile modulus was not diminished by ultrasound equipment for less than 10 mins; however, it was reduced dramatically after 20 minutes. The obtained consistent patterns, nevertheless the scientists used shorter instrumentation durations in absolute terms since such samples seemed to be much lesser [30]. Thermal cycling has also been associated to deterioration in compressive interfacial adhesion in specimens [31]. However, it appears that the majority of iterations used are indeed a major consideration [31]. The discrepancy in the characteristic of temperature dependence between dental, cement, and metallic base generates discrete motions of these components, which leads to breakdown of both the overlapping components and, as a result, a loss in compressive interfacial adhesion.

The substrates of laminate biomaterials are affected by the application of ultrasound. With terms of enamel in mind, it is always advocated that frequent dental scraping be done with great caution, and that polishing the scaled surfaces can help to overcome the changes in roughness, minimizing additional cavities, upper strata discoloration, hardening of the plague, and consequent gum aggravation [23]. There is nothing to hide when saying that all these lab experiments had revealed a lot about how each of these composite's work. Out of all of the elements used, we can observe that the glass ionomers have had the chances of greater impacts [4]. They have major chances of increasing-rough texture, definitely more than any other element, so far tested. There are 2 basic reasons these could be blamed upon. They are:

- It's heterogeneous nature
- The fact that it is also biphasic.
- The compound has poly-salts which are usually removed before using them and hence what remains is the particles majorly of glass, which do not react as expected [24, 25].

Now comparing this performance to the other elements, it is seen that their performance is comparatively better. These elements which have one or two similar elements to ionomers, did not seem to react like it. The level of roughness was quite low, thus making these elements more suitable to sonic waves. The modified ones were far better off than the conventional ones in every aspect. Thus, it can be claimed that the modified glass ionomers function better in this respect [32]. The in vitro design is the major limitation of this study. The effects of saliva, accumulated mastication, and aging of the ceramic materials may influence the results in actual clinical conditions. Additional clinical studies are needed to confirm the results of this study. In addition, further studies should assess the method of polishing for the removal of discolorations from ceramic restorations after ultrasonic scaling procedures and the possible side effects of polishing.

CONCLUSION

The conclusion to this discussion should be more on a relative note. We believe that usage of ultrasonic waves cannot be stopped or discarded. When people today with more obese hygiene habits, are in need of such rescue methods, dentists are left with only one option. They need to take resort to some different

kind of composites for teeth filling and other such procedures. Using these same composites will make this argument even tougher and so, research must be done on the same. When our oral beauty and hygiene becomes a priority, we should keep no stone unturned to make this a better experience for the users all together.

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