REVIEW ARTICLE

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Sonic and ultrasonic scalers in periodontal treatment: a review

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Abstract: Periodontal therapy aims at arresting periodontal infection and maintaining a healthy periodontium. The periodic mechanical removal of subgingival microbial biofilms is essential for controlling inflammatory periodontal disease. Mechanical periodontal therapy consists of scaling, root planing and gingival curettage. The sonic and ultrasonic scalers are valuable tools in the prevention of periodontal disease. The vibration of scaler tips is the main effect to remove the deposits from the dental surface, such as bacterial plaque, calculus and endotoxin. However, constant flushing activity of the lavage used to cool the tips and cavitational activity result in disruption of the weak and unattached subgingival plaque. The aim of the study was to review the safety, efficacy, role and deleterious side-effects of sonic and ultrasonic scalers in mechanical periodontal therapy.

Key words: efficacy; hazard; instrumentation; scaler; sonic; ultrasonic

Introduction

The first step of periodontal treatment is removing bacterial deposits and calculus from the tooth surfaces and obtaining a biologically acceptable root surface while protecting the healthy dental tissues. Basic periodontal treatment aims at eliminating supra- and subgingival plaque and establishing conditions, which will allow effective self-performed plaque control (1). In the past, this aim was primarily realized with handheld instruments (sickle, curettes, chisel, files and hoes) until sonic and ultrasonic scalers were designed for gross scaling and removal of supragingival calculus and stains (2).

Plaque control and patient education is one of the most important stages of periodontal treatment. It is well known that plaque control and patient education should be performed to obtain good surgical access.

Techniques used for scaling, root planning and curettage are hand instrumentation, sonic and ultrasonic instrumentation, laser scaling, demineralization and chemical scaling (3). It is certain that hand instruments and ultrasonic scalers are now used most frequently.

Sonic and ultrasonic scalers

Ultrasonic and sonic scalers are referred to as power-driven scalers. High vibrational energy generated in the oscillation generator is conducted to the scaler tip, causing vibrations with frequencies in the range of 25 000–42 000 Hz. The amplitude ranges from 10 to 100 μm. Microvibration crushes and removes calculus under cooling water (4). Ultrasonic and sonic scalers vary in their efficiency in removing calculus from the tooth surfaces (5, 6). Discomforting stimuli elicited from their use may include pain, vibration, excessive noise, bad taste and high volume of water coolant (7).

Sonic scalers are air-turbine units that operate at low frequencies ranging between 3000 and 8000 cycles per second (Cps). Tip movement and the effect of root surfaces can vary significantly depending on the shape of the tip and type of the sonic scaler. In general, tip movement is orbital (Fig. 1). Sonic scalers provide a simple and inexpensive mechanism (8–11). Sonic scalers have a high intensy noise level because of the release of air pressure needed for movement of the tip of the sonic hand-piece.

Ultrasonic scalers are driven by generators, which convert electrical energy into ultrasonic waves via piezoelectricity or magnetostriction and are designed to facilitate scaling and root planning process (12).

The use of ultrasound in dentistry was proposed by Catuna (1953) for the process of cutting teeth, further work undertaken by Zinner (1955) showed that ultrasound could be used to remove deposits from the teeth. Ultrasonic scaling became an accepted procedure by Syzmid and McColl. It is stated that the instruments were acceptable alternatives to hand scalers in 1960 as they were found to be as effective in the removal of calculus (11).

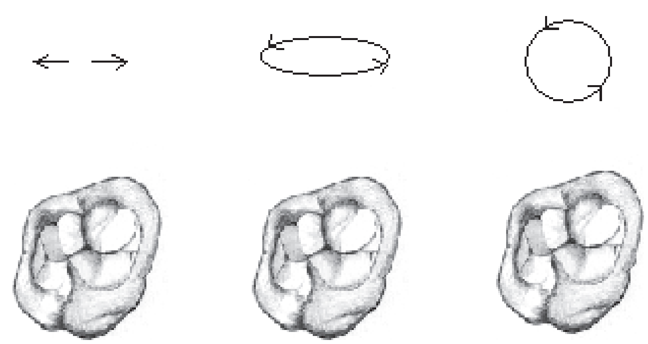

Fig. 1. Tip movement orientation of sonic and ultrasonic scaler.

This type of instruments removes deposits on the tooth surface primarily by the physical action of its oscillating tip. There are two other mechanisms that may aid in the removal of the deposits from the root surface. The first mechanism is the high-energy shock waves produced by the cavitation, occurring within the cooling water supply (13, 14), and the second is the acoustic microstreaming. Patterns that are formed close to the surface of the scaler tip (15). Ultrasound can be produced by magnetostriction or piezoelectricity and ultrasonic units in dentistry are currently available in two basic types; magnetostrictive and piezoelectric. Their mechanism of action is different (10, 14, 16).

Magnetostrictive units operate between 18 000 and 45 000 Cps, using flat metal strips in a stack or a metal rod attached to a scaling tip. When an electrical current is supplied to a wire coil in the hand-piece, a magnetic field is created around the stack or rod transducer causing it to constrict. An alternating current then produces an alternating magnetic field that causes the tip to vibrate. Tip movement is elliptical (Fig. 1) (10).

Piezoelectric units operate in the 25 000–50 000 Cps range and are reactivated by dimensional changes in crystals housed within the hand-piece as electricity passed over the surface of the crystals. The resultant vibration produces tip movement that is primarily linear in direction (Fig. 1) (10, 11).

It is stated that a sonic scaler 'hammers' the tooth surface, irrespective of its alignment to the tooth, whereas a piezoelectric ultrasonic scaler may oscillate parallel to the tooth surface and gently remove calculus if the alignment is correct (17).

Efficacy

Scaling time

Several studies have investigated the time taken to reach the therapeutic endpoint of a clean, smooth root surface. Although hand scalers are the most frequently used, considerable time and skill are required to be able to operate them (18). Another study indicates that the use of the sonic/ultrasonic device for subgingival instrumentation requires somewhat less time than hand instrumentation (19). It is obvious that scaling time with ultrasonic scalers is less than that with hand curettes and the sonic scalers because ultrasonic scalers operate at frequencies 25 to 42 kHz while sonic scalers operate at frequencies of 2 to 6 kHz (14, 20).

Reduction of bacterial plaque in periodontal pocket

Both sonic and ultrasonic scalers, which are recommended for subgingival scaling, have been shown to be effective in removing plaque and calculus from root surfaces *in vivo*, thereby reducing the bacterial load in periodontal pocket. In addition, an antimicrobial effect of ultrasonic treatment against non-periodontopathic bacteria has been demonstrated *in vitro*. A study emphasized that if ultrasonication were also bactericidal against periodontopathogens, ultrasonic scalers would have an advantage over handheld instruments in reducing subgingival plaque bacteria, especially in areas where access is limited (21).

Removal of plaque and calculus

Adequate root preparation in periodontal procedures includes the removal of plaque, calculus, and perhaps diseased cementum and dentin. However there is little consensus on how this could be best achieved. The studies found no difference between power driven-scalers (sonic or ultrasonic) and manual scalers as regards removal of deposits from tooth surfaces if the procedure is done equally (22). But the roughness values after treatment with oscillating sonic and ultrasonic inserts do not differ from each other; there was also no difference in roughness compared to the control surface. But most studies showed that smoother surfaces are obtained with curettes than with an air scaler or ultrasonic instruments (23) and ultrasonic scalers tended to increase roughness (24–27). The roughness of the root surface after scaling procedure is a considerable factor for maintenance, because it has also been reported that bacterial plaque adheres easily to the rough root surfaces after treatment with an ultrasonic scaler (18, 28, 29).

Direct comparison of piezoelectric and magnetostrictive scalers (*in vitro*), regarding calculus removal and tooth surface roughness following instrumentation, has shown that the piezoelectric system was more efficient for calculus removal, but left the instrumented tooth surface rougher (30). These results have been in conflict with results from another study which found that root surfaces instrumented by piezoelectric scalers were smoother than those following instrumentation with magnetostrictive scalers (16, 27, 31). Studies into working parameters and roughness showed that higher instrument power setting resulted in higher mean and maximum surface roughness at both low and high lateral forces. The surface roughness increased from low to high power settings using the angulated working tip, but decreased for the straight tip (31, 32).

Access to subgingival area

Adequate access for debridement is more difficult as probing pocket depths increase. It was reported that complete removal of subgingival plaque and calculus is unlikely to be successful when pockets exceed 4 mm using hand instruments because it is doubtful whether hand scalers can reach the root surfaces, and it is understood that they cannot completely remove the cause of the problem (16). Studies indicated that non-surgical access to the base of the pocket for calculus removal was suitable for sonic and ultrasonic instruments when compared with hand instruments (33). But of course at difficult areas, for adequate access (probing pocket depth ≥5 mm) curettes are more effective with flap surgery than the ultrasonics. However, the effectiveness of the ultrasonic instruments is decreased in deep pockets because deep pockets restrict the movement orientation of the tip (2, 10). Recently a new type ultrasonic insert called Slimline has been designed to facilitate greater pocket penetration and debridement in deep pockets. Design features include a narrower diameter of tine and tip, and an angulation of the tip approximating to that of hand curettes. But studies demonstrate that both types of ultrasonic insert examined (conventional insert and Slimline) were able to penetrate and to debride the apical plaque border regardless of pocket depth (34, 35).

Access to furcations

Recent studies confirm the need for different instrumentation approaches. Hand instruments alone are not always adequate to remove root accretions with or without flap surgery in furcal areas.

There are kinds of study indicating that scaling and root planning are equally effective in Class I furcations either with handheld instruments or sonic/ultrasonic instruments, whereas ultrasonics are clearly superior in the treatment of Class II and III furcations. To facilitate furcal instrumentation, many of the new ultrasonic and sonic tips are 0.55 mm or lesser diameters.

Results of an *in vitro* study revealed that the curettes were significantly more efficient than the ultrasonic inserts in removing paint from both root trunks and furcation entrances (36). Recently, globule-ended scaler tips have been used by clinicians to obtain a more effective, successful mechanical treatment, and it is suggested that these types of ultrasonic tips are more effective than the standard tips and the hand curettes in furcations (2, 10, 37, 38).

Other studies investigated to obtain more effective furcal debridement have demonstrated that diamond-coated sonic scaler inserts can debride root surfaces in the furcation to a greater extent than can the usual instruments such as conventional sonic instruments or Gracey curettes (39, 40). And another study result concluded that as against to handheld instruments, the diamond-coated sonic scaler inserts markedly reduce the time required for root surface instrumentation of molars with furcation involvement during flap surgery, and that clinical wound healing is dependent on the instrument type used (39). In addition, the diamond-coated instruments will produce a rougher surface than the plain inserts or the hand curettes (41).

Safety

During scaling and root planning procedures with ultrasonic instruments, wrong application of the tip to the tooth surface or unintentional overinstrumentation of calculus-free subgingival root areas may cause surface alterations including scratches, gouges and nicks on the tooth (42). These damages increase exponentially as the ultrasonic power is increased from medium to high. It is also revealed that instrument contact time, angulations and design of the tip, tip to tooth angle, power level of the unit, sharpness of the working edge, instrument pressure are important on the degree of root damage (43–45).

Several studies experienced influence of tip angulations, lateral force and instrument power setting on root substance removal. It is suggested that lateral force had a greater impact on scaler tip angulations and power setting, and tip angulations had the greatest effect on defect depth followed by lateral forces and power setting. It is also suggested that higher lateral forces and higher tip angulations resulted in greater defect depth at any power setting, and defect volume and defect depth are related the type of the ultrasonic units used.

There is a linear increase in defect volume as tip angulations increase, in magnetostrictive ultrasonic scalers. So the defect volume is the highest at the 90° tip angulations. But it is stated that in piezoelectric ultrasonic scalers, defect volume is the highest at 45° angulations.

In magnetostrictive units, lateral force and scaler tip angulations had a similar impact on defect depth, and their effects being greater than the effects of the power setting.

In piezoelectric units, tip angulations is the most important effect on defect depth. Instrumentation at 0° tip angulations did not result in severe root damage regardless of the other working parameters.

Mostly piezoelectric ultrasonic scalers are needed to be used with very high lateral forces and at high power setting for effective subgingival debridement in initial periodontal treatment, but they lose an important advantage over handheld instruments.

Thus to prevent severe root damage in mechanical periodontal treatment, piezoelectric units should be used at 0.5 N, low or medium power setting and at close to 0° angulations (43, 44, 46).

Alterations on the restorations

Ultrasonic scalers may sustain chips, scratches or loss of material on the restorations. When ultrasonic scalers are applied on the amalgam surfaces they will alter the topography of the restoration surface. However, brightness of surface occurs because of removal of the superficial layer of the amalgam and they may occur as scratches on the surface (10).

It is indicated that porcelain and composite restorations can be significantly damaged by sonic or ultrasonic instrumentation.

A study that aimed to assess the effect of ultrasonic vibration on the surface integrity of a resin composite inlay has indicated that both parallel and perpendicular orientations produced an indentation with a scattering of composite debris (47).

Effect on implants

The peri-implant area seems to be more susceptible than the periodontium to bacteria (48), indicating that early plaque removal is essential in patients with dental implants (49). The common problem in removing plaque from implants is related to possibly breaking the stabilization of the implant and damaging the implant surface. In particular, conventional sonic and ultrasonic scalers with metal tips cause considerable changes to implant surfaces (50–52). Therefore, use of plastic curettes, graphite or nylon-type instruments, rubber polishing cups, brushes with abrasive paste, or air-powder abrasive systems has been recommended (53, 54). Recently, an ultrasonic scaler has been developed that generates ultrasonic vibration at a frequency of 25 kHz that is converted into horizontal vibration by a resonating ring. The tip movement is only parallel to the root surface and thus the instrument causes only minimal damage to the implant surface. But it is still controversial whether this type of units is more reliable than the conventional ultrasonic scalers (55). Further studies are required into this subject.

Effect on demineralized surfaces

Active periodontal therapy aims to provide for healthy oral hygiene. But sometimes it may result in a number of undesirable iatrogenic undesired side-effects. Mechanical debridement of the root surface inevitably results in the loss of some cementum and dentine (56–60). When ultrasonic scalers are applied on demineralized surfaces such as initial caries lesion or hypoplasic enamel they may cause cavitations on the tooth surface for reasons of tip angulations, substance of the tip (for example diamond-coated tips), power setting and application time. Thus the patient may complain dentinal hypersensitivity, especially on the cervical areas (10, 61, 62).

Dentinal hypersensitivity is a complication that may appear as a patient complaint after the removal of plaque and calculus from the tooth surface. Dentin is normally covered by enamel in the crown region and periodontal tissues in the root area. Under these circumstances, dentin is protected from wear. But if dentin is exposed by loss of enamel or periodontal tissues (such as enamel erosion, gingival recession, loss of cementum…) a large number of dentinal tubules will thus be exposed leading to direct avenues to the pulp for bacteria and bacterial elements present in the oral environment (63, 64). As a result, the patient may experience increased sensitivity of exposed root surfaces to thermal, tactile, evaporative and osmotic stimuli. This pain condition has been termed dentinal hypersensitivity in the literature (18, 65, 66).

Hazards and side-effects related to the use of ultrasonic scalers

There are a few hazardous effects associated with the use of ultrasound on patients routinely in the health field. In dentistry, the use of ultrasonic scalers may cause potential hazards on patients or clinicians. These are related to thermal alterations on the pulp or gingival tissues, blood and air contamination associated with aerosols, sensorial complaint because of vibration, electromagnetic interference depending on magnetic field, tooth or restoration surface damages because of wrong application of the inserts.

Thermal effects

Pulpal thermal injury

Temperature rises in the tooth can cause damage to the pulp and dentine, and so during dental procedures heating of the pulp should be avoided as temperature increases can lead to vascular injury and tissue necrosis and result in irreversible pulpitis.

Heating associated with the use of ultrasonic scaler may be due to frictional heating due to contact between the scaler and the tooth, direct temperature application by the irrigation fluid, acoustic energy absorption of ultrasound transmitted into the tooth.

Thermal pulp assessed in monkeys showed that 15% of teeth did not recover from a 6°C pulp temperature rise. An increase above 11°C was shown to destroy invariably the pulp and a 17°C increase produced pulp death (11). However, a recent work suggests that an increase of 11.2°C produces no damage to the pulp tissues (67).

Thermal injury on periodontal tissues

Early workers demonstrated that ultrasonic scaling caused no injury to the periodontal membrane (68), alveolar bone or the gingiva, but further histological examination of tissues immediately after ultrasonic scaling showed superficial tissue coagulation.

In conclusion, studies which investigated the extent of damage caused by the direct application of heat to the tooth all conclude that heat generation is minimized by using low/medium power settings and light contact, and sonic and ultrasonic scaling should not be considered without irrigation and the flow rate should be at least 20–30 ml min^{-1} in the application region (10, 69, 70).

Cavitation

Cavitation is the formation of a pocket of vapor in a liquid. It is created by highly intensive ultrasonic waves. Cavitational activity encompasses all of the linear and non-linear oscillatory motions of gas and/or vapor-filled bubbles in an acoustic field.

Transient cavitation describes the violent oscillations of air bubbles in a liquid following ultrasonic exposure and their subsequent implosion, which generates shock waves throughout the liquid medium (37, 71).

It is estimated that cavitational activity occurs around the oscillating tip and is an important contributory factor in the clinical efficacy of the ultrasonic scaler. Although its possible contribution to the removal of deposits from teeth has not been evaluated, it may be hypothesized that plaque and calculus removal is primarily mechanical, with cavitational activity causing fracture of the attached deposits through the resultant shock waves (72–74). In addition to the contribution effects, there are some side-effects to the cavitational activity.

It is suggested that cavitational activity due to a vibrating wire at an ultrasonic frequency may probably damage erythrocytes, leucocytes and platelets. Blood platelets are susceptible to damage by the hydrodynamic shear stresses. When cavitation occurs in blood or plasma containing platelets, those platelets close to the cavitation sites are either disrupted or induced to undergo the release reaction. The resulting aggregates would adhere to a vessel wall or occlude small blood vessels and so participate in thrombus formation and if thrombus formation is within the microvasculature of the pulp, pulp death could occur (11, 75).

The *in vitro* studies have shown that human platelets are highly susceptible to the acoustic cavitational fields generated by ultrasonic scalers at the power levels commonly employed in the clinic. Consequently, if enough of this energy enters the tooth, it could cause thrombosis due to the platelet aggregation, which may result in the death of the pulp. However, the *in vivo* investigations have suggested no significant danger of thrombosis due to the cavitational activity. However, the unusual geometry of the tooth coupled with the slower flow rates of the blood within the pulp cavity suggests that pulpal thrombosis during or after ultrasonic scaling is still a possibility (11, 75).

Vibration white finger phenomenon

White finger disease is a disorder that affects the blood vessels in the fingers, toes, ears, and nose. So this condition is also known as acrocyanosis. Its characteristic attacks result from a constriction of these blood vessels. Vibration white finger is quite often found in people whose occupation involves their hands being exposed to vibration, and is typically seen in pneumatic drill operators. White finger is caused by repeated and frequent use of hand held vibrating tools (76), for example, ultrasonic hand pieces, power drills, chainsaws, pneumatic drills, etc. (77, 78). It may also be caused by holding or working with machine that vibrates. It is not clear how vibration causes the condition. It is probably due to slight but repeated injury to the small nerves and blood vessels in the fingers. Over time, these may gradually lose some of their functions and cause symptoms. It has been estimated that up to 1 in 10 people who work regularly with vibrating tools may develop this phenomenon.

The fine blood vessels in the fingers go into spasm in this annoying condition, causing a color change in the skin and also a change in the feeling of the fingers. This can occur either when the hands get cold or quite spontaneously for no apparent reason. The skin of the fingers usually goes pale first, then bluish, and finally a dull red, as the circulation returns. The fingers may burn or tingle rather than being painful.

If the above problem happens without any history of exposure to vibration, it is called Raynaud's disease (77, 79, 80). In Raynaud's Syndrome, blood vessels in the fingers are damaged and do not work normally. Poor circulation of blood can damage soft tissues in the hand. Primary Raynaud's syndrome is defined as idiopathic intermittent vasospastic attacks of the acra- mainly of the hands- triggered by cold or emotions (81). In contrast to secondary Raynaud's syndrome, where the attacks are due to an underlying disease, there are no organic changes to be found causing primary Raynaud's syndrome (82, 83).

At first only the finger tips are affected. In severe cases, the whole finger becomes 'white' and all the fingers are affected. Very severe cases can result in finger loss. The thumb is usually not affected. Not much can be done to reverse the condition, so it is best treated by prevention. Symptoms are loss of feeling and control in fingers, tingling, then numbness, skin turns pale and cold, pain and sometimes redness when blood flow returns to fingers, and 'attacks' can be brought on by cold or hard work that can last for minutes or hours (77).

In dentistry, large amplitudes produced by pneumatic drills will cause this phenomenon. The vibration that is passed from the drill through to the hand causes disruption in the blood flow to the fingers. It may still have the potential to produce this phenomenon although this vibrational amplitude associated with dental scalers is small (11).

In a clinical trial, tests were conducted that compared 10 dental technicians who had worked for more than 7 years and 10 men not exposed to occupational vibration (84). Male dental technicians frequently used grinding equipment, which produced vibrations of up to 40 kHz. It was found that response time to stimuli on fingers was higher in technicians, implying nerve or receptor dysfunction. Damage to myelinated and unmyelinated fibres in the fingers of technicians was also revealed.

The other investigations about this manner indicated that long-term exposure to ultrasonic scalers had a high frequency of neurological symptoms that was especially prevalent in their dominant hand. In most studies, it was found that the vibrations could produce a reduction in strength and tactile sensitivity and performance due to the disruption of blood and nerve supplies to the fingers.

Currently it is still unclear as to whether the hand piece especially ultrasonic hand pieces causes 'white finger' in dental personal and further research studies are needed (11).

Blood and air contamination depend on aerosol

The ultrasonic scalers must be used with a large amount of coolant to keep the scaler tip and handle from becoming too hot. The coolant water spraying against the tip of the scaler greatly increases the aerosol volume (85, 86).

The term aerosol as defined by Micik *et al.* (87) includes particles of 50 μm or less, while spatter includes particles greater than 50 μm. Dental aerosols have been defined by Cooley as suspensions of extremely fine airborne particles that are liquid, solid or combinations of both and that are 50 μm or less in diameter (88).

Aerosols are produced during ultrasonic scaling. These aerosols which may transmit pathogenic microorganisms could be hazardous to health because studies have shown that bacteria and blood are routinely present in aerosols produced by ultrasonic scalers and aerosols can be suspended in the air. In dental clinics where ultrasonic scalers are being used, there is an increased amount of airborne bacteria, which increases the potential for the spread of infection between patients and between patient and operator.

Investigations into this manner suggested that bacterial diseases such as tuberculosis, staphylococcus infections and the presence of other pathologic organisms could decrease air quality in the dental offices and could be transmitted to the operator and the patients in the clinic (85, 89, 90) and the smaller particles of an aerosol have the potential to penetrate and lodge in the smaller passages of the lungs and are thought to carry the greatest potential for transmitting infections (89,91).

Reducing the contamination risk depends on aerosol

Use of an antiseptic mouth rinse prior to procedure

Mouth rinses prior to treatment can help control infectious agents in aerosols (11, 92) and can reduce the colony forming units up to 94% in comparison with a non-rinsed control. A clinical study has confirmed that the use of an antiseptic mouthrinse 40 min prior to procedure can significantly reduce the bacteria in the aerosol produced during ultrasonic scaling (93). Many studies have confirmed use of clorhexidine irrigants during ultrasonic scaling but outcomes that it was not effective on produce of aerosols have been shown (11).

Use of a high volume evacuator during the scaling procedure

The studies that investigated the use of a high volume evacuator sheath with the ultrasonic scaler hand piece indicated that use of this kind of device could minimize aerosol contamination up to 93% during ultrasonic scaling.

However, methods to minimize the formation of aerosols during ultrasonic scaling are limited; there are some procedures to reduce of contamination risk (89, 90).

Use of an ultrasonic scaler insert designed to have cooling water exit through the tip of the scaler somewhat 'focusing' the spray

An ultrasonic insert which has been recently introduced that focuses the spray produced may reduce aerosol contamination during ultrasonic scaling. It may be assumed that there is less aerosol produced and thus less contamination by focusing the water spray. But studies indicate that the amount of aerosol contamination produced by traditional style of ultrasonic insert and thereby the newer focused coolant water insert is similar (85).

Use of a rubber dam

During many dental procedures, the use of a rubber dam will eliminate virtually all contamination arising from saliva or blood. If a rubber dam can be used, the only remaining source for airborne contamination is from the tooth that is undergoing treatment. This will be limited to airborne tooth material and any organisms contained within the tooth itself. In certain restorative procedures such as subgingival restorations and the final steps of crown preparation, it often is impossible to use a rubber dam. The use of a rubber dam also is not feasible for periodontal and hygiene procedures such as root planing, periodontal surgery and routine prophylaxis. This is of particular concern owing to the fact that periodontal procedures are always performed in the presence of blood and instruments such as the ultrasonic scaler, which have been shown to create the greatest amount of aerosol contamination are used (89).

In conclusion, the findings support the use of aerosol reduction devices such as high-volume evacuator whenever an ultrasonic scaler is used to avoid pathogenic bacterial between both patients and clinicians (36).

Effect on auditory system

Disagreeable or undesired sounds are described as noises. Noise can cause interference with speech and communication, pain and injury, and temporary or permanent loss of hearing.

Normally human auditory system has sense sound level between 20–20 000 Hz. The sound level that exceeds this frequency is called ultrasonic sound. In dental units, equipment such as ultrasonic scalers, high-speed air turbine drills, high-volume evacuators, and amalgamators mostly produce high intensity noise that may be a potential hazard to the auditory system of the persons exposed to the ultrasound.

Acoustic lesions can be described as acute and chronic

Acute

It is caused by a very high sound level such as gunfire. It is painful at first and it may be irreversible.

Chronic

It is caused by prolonged exposure to a lower sound level irritant such as ultrasonic devices, pneumatic drills. It is not painful at first but it is irreversible because cochlea hair cells are incapable of regeneration (94).

The ultrasonic damage can affect the operator through airborne noise and for the patient damage can occur through the transmission of ultrasound through tooth contact to the inner air via the skull bones during scaling of the molar teeth. So investigations suggested that noise from ultrasonic scalers is greater for the patient than for the operator (11).

Following ultrasonic scaling, tinnitus may occur. It is an early sign of hearing loss and can be defined as the perception of noise in one or both ears, or in the head, which has no external source of sound or vibration(95). Investigators reported that some of the subjects exposed to ultrasound experienced temporary shifts in hearing threshold, tinnitus or numbness following ultrasonic scaling. However, these symptoms were not significant when compared to the normal population (67, 96).

Noise induced hearing loss may be undetected for years as it is estimated that individuals may lose about 28% of hearing before becoming aware of the problem. Before this stage, only audiometric tests can confirm that early hearing loss has begun (94).

High intensity noise can also affect physiological system. Exposure to noise can cause an increase in blood pressure, quickened pulse, and constriction of blood vessels. It has been found that hand reflex time to stimuli lengthened after human subjects had been exposed to noise, and precision movements of hands and arms were also affected.

Finally the ultrasonic scaler has been shown to cause no permanent harm to hearing through airborne noise. Transmission of ultrasound through the bone may potentially damage the inner air, although this has not been demonstrated. So, it is still unclear if a potential hazard to hearing exists for the patient, and if this is an increased problem for patients exposed ultrasonic scaling (11).

Effect on cardiac pacemakers

In hospital units electrocautery and defibrillation, magnetic resonance imaging, lithotripsy, transcutaneous nerve stimulation, and other magnetostrictive ultrasonic scalers and ultrasonic bath cleaners are the equipments that produce environmental magnetic field (97).

Electrical dental devices such as vitality pulp testers, electronic apex locators, and ultrasonic instruments may interfere with the function of cardiac pacemakers (98, 99) and may produce deleterious effects in medically fragile patients with cardiac pacemakers (99–101).

Recent works have indicated that interference can be caused if the pacemaker pacing lead comes within 37.5 cm of the scaler[6] and the safe distance from a patient with an implanted cardiac pacemaker is considered to be 50 cm or more (102). Although the dental environment is a source of light to moderate electromagnetic interference, there is only a small risk that the operation of pacemakers may be affected (103). Therefore exposure to magnetostrictive ultrasonic scalers should be avoided due to the potential deleterious effects the ultrasonic instruments may produce in patients or operators with cardiac pacemakers. However, any hazardous effects of the piezoelectric ultrasonic scalers have not been detected until now (11).

Conclusion

The sonic and ultrasonic instruments have a common usage field because of their facilitator effects in mechanical periodontal treatment. However, sometimes a wrong practice seeming simple to us may cause tooth damage or loss of it, if attention is not paid to possible deleterious effects of the instrument used, and there maybe some reversible or irreversible pathologies not only in the patient but also in the operator. So the sonic and ultrasonic instruments should always be used having in mind their possible deleterious side-effects.

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