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REVIEW ARTICLE

Clinical Uses and Benefits of Ultrasonic Scalers as Compared to Curets: A Review

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ABSTRACT

Complete cementum removal is no longer a requisite. Many studies have demonstrated that hand and power-driven instruments are equally effective in reducing the probing depth, attaining attachment level gains and reducing inflammation by removal of plaque bacteria, calculus, and endotoxin. Power-driven instruments have many advantages over the manual scalers; however, further studies are needed to improve the performance of currently available instruments. These include the development of a more effective tip and ultrasonic generator unit. Long-term randomized controlled studies are also required to examine the efficacy of the newly designed scalers. These studies would help to provide treatment based on exact information regarding the instrument and technology.

Every instrument comes with its own disadvantages and advantages but when proper protocol is followed the instrument can be put to its best use for the comfort of the patient and the operator. The use of Ultrasonic in periodontal surgery definitely has benefits but the choice to use hand instrument or ultrasonic instruments depends solely in the manual skill, expertise and preference of the clinician.

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INTRODUCTION

A myriad of new products have been introduced that have revolution ized periodontal therapy in the past several years. Many of the recognized brand names have survived the test of time, offering the benefit of reducing hand and wrist fatigue as well as tissue trauma. Common in today's hygiene and periodontal armamentarium is the sonic or ultrasonic handpiece. Whether used only occasionally or on a routine basis, most dental professionals are familiar with sonic or ultrasonic technology in some capacity. With the utility of the products that are available today, there is no reason why every operatory should not be equipped with this technology.

The sonic scaler operates at a low frequency of about 3,000 to 8,000 cycles/second (which is how many times the tip comes in contact with the tooth). The sonic scaler is air-driven, and the tip moves in an elliptical motion. The ultrasonic handpiece utilizes either magnetostrictive or piezo-electric technology. Magnetostrictive inserts operate at 25,000 to 30,000 cycles/second and, like the sonic scaler, have an elliptical motion. A low-voltage magnetic signal causes tip movement. Piezo-electric technology operates at 28,000 to 36,000 cycles/second. The tip moves in a back-and-forth motion and works along the side of the tooth, shaving off calculus and debris. Here the handpiece, rather than the instrument tip, is activated.

The use of ultrasonic devices has dramatically improved the practice of supragingival scaling and periodontal debridement. Although ultrasonic technology has been around for decades, improvements in recent years have allowed its use to become mainstream (1-4).

Ultrasonic technology in general, whether

magnetostrictive (long inserts with metal rods that flex) or piezo-electric (small tips that screw onto the handpiece), and sonic scalers to a lesser degree, offer several advantages over hand scaling:

- Less hand and wrist fatigue due to the light touch necessary to merely guide the scaler tip along the tooth surface
- Decreased treatment time, especially with heavy deposits, leaving more time for patient education or procedures such as placement of chemotherapeutic agents (ie, arestin [orapharma], atridox [collagenex pharmaceuticals], or periochip [dexcel pharma]).
- More efficient removal of dental plaque and calculi with ultrasonic instrumentation
- Ultrasonic tip spray promotes elimination of dental plaque
- Ultrasonic instruments rid the radicular surfaces of bacterial endotoxins while preserving the cementum
- Less tissue trauma due to no sharp cutting edges
- Water provides continuous tissue lavage, thereby reducing the need for rinsing during scaling, since the water flow allows for high visibility throughout the procedure; this lavage also increases tissue comfort for the patient during and after the procedure
- Antiseptic solution can be substituted for the water to provide simultaneous irrigation/disinfection of the region being treated
- Excellent for stain removal that may otherwise be tedious to scale by hand
- Gritty, pumice-based polish may no longer be necessary or indicated following scaling with ultrasonic; due to the efficient stain removal during scaling, a milder, minimally invasive paste or polish can be used, preserving the glaze on composite and porcelain restorations; less abrasive polish enhances patient acceptance and lowers post-scaling sensitivity
- less chance of operator injury:
  - Ultrasonic scaler inserts are not sharp—there are no cutting edges
  - Seldom need to place tips in an ultrasonic bath prior to sterilization, eliminating a step in the handling process
  - Rarely need to scrub ultrasonic tips, as is often necessary for conventional hand scalers, further reducing the risk of operator injury
  - Hand instrument sharpening greatly minimized due to minimal usage
- Patients experience a higher level of comfort; the entire procedure is endured more easily.

PIEZO-ELECTRIC TECHNOLOGY

With piezo-electric technology, achieving ultrasonic mechanical vibration requires the application of an electrical voltage to piezo-electric ceramics. The ultrasonic energy thus generated is transmitted via a transducer contained in the handpiece and is prolonged by an amplifier. The resulting advantages of this mechanism include enhanced power control, greater patient convenience, and high transducer efficiency. The axial transmission mode of mechanical waves allows a more accurate approach to fragile tissues. Furthermore, there is no cumbersome cooling system necessary.

Piezo-electric scalers in particular have some distinct advantages over many other conventional ultrasonic units. In addition to the previously mentioned benefits of ultrasonics in general, piezo-electric technology offers the following:

- Quiet operation
- Less water is necessary during the procedure, adding to patient comfort and operator convenience; less need for management of excessive water accumulation; less water is required because the unit's efficiency is greater than 90%—there is no delivered energy or mechanical friction, hence, little secondary temperature rise; since there is very little temperature rise, the handpiece can be used without water. (However, use of light water spray may be desirable, as this will produce a cavitation or physico-chemical effect.)
- Less vibration
- Small inserts—less cum-bersome to operate, more accurate placement during treatment, increasing patient comfort
- Versatile ultrasonic units have numerous clinical applications due to a comprehensive range of accessories; in addition to inserts for use in scaling and debridement, many other inserts are available for procedures such as periodontics, apical surgery, and prosthodontics; dozens of various inserts are offered that all fit on the same handpiece
- LED curing light is available with some units—much more convenient to assemble and operate than conventional curing lights, saving time, money, and space; the light simply attaches to the unit in place of the piezo-electric handpiece; perfect for sealant curing in the hygiene room as well as for restorative materials
- Lightweight handpiece and hose; easy on the wrist
- Can be used for virtually any class of patient; great for routine prophylactic procedures as well as periodontal scaling and root planing; a wide range of convenient, thin insert designs for all possible scenarios
- Small unit sits on counter; small footprint
- Convenient, color-coded power dial on some units—coordinates with colored rings on inserts; no guessing at the ideal power setting for each insert, as is sometimes the case with other ultrasonic handpieces
- Inserts for piezo-electric units are often interchangeable with other manufacturers
- Easy, convenient barrier protection—intraoral camera sheaths intimately fit many piezo-electric handpieces; barrier protection for the unit itself is provided by simply placing a sheet of plastic wrap loosely over the entire unit; with this in place, the operator can adjust the water and power setting and place the handpiece in its holder without contaminating the unit, which minimizes the use of surface disinfectant, which would add time following the procedure and risk damaging the unit
- Handpiece and inserts are easily removable and autoclavable
- Piezo-electric inserts take up much less space to store than hand scalers and other dental instruments

- The use of state-of-the-art technology helps to strengthen patient relations; communicating with patients and educating them about the advantages of the piezo-electric scaler is a practice builder; patients feel more comfortable throughout the procedure and confident that they are receiving the best possible care.

The piezo-electric scaler is a staple in our hygiene rooms. Hygienists in our office rave about our new piezo-electric scalers and, more importantly, patients are very complimentary about how their mouths feel after their maintenance visits. If you have the desire to move into the world of electric scalers, or are ready to upgrade, give considerable thought to the purchase of a piezo-electric scaler. This technology will stand the test of time. It is the ultimate in ultrasonic scalers.

SONIC VS ULTRASONIC

Ultrasonic and sonic scalers appear to attain similar results as hand instruments for removing plaque, calculus, and endotoxin. Ultrasonic scalers used at medium power seem to produce less root surface damage than hand or sonic scalers. Due to instrument width, furcations may be more accessible using ultrasonic or sonic scalers than manual scalers. It is not clear whether root surface roughness is more or less pronounced following power-driven scalers or manual scalers. It is also unclear if root surface roughness affects long-term wound healing. Periodontal scaling and root planing includes thorough calculus removal, but complete cementum removal should not be a goal of periodontal therapy. Studies have established that endotoxin is weakly adsorbed to the root surface, and can be easily removed with light, overlapping strokes with an ultrasonic scaler. A significant disadvantage of power-driven scalers is the production of contaminated aerosols. Because ultrasonics and sonics produce aerosols, additional care is required to achieve and maintain good infection control when incorporating these instrumentation techniques into dental practice. Preliminary evidence suggests that the addition of certain antimicrobials to the lavage during ultrasonic instrumentation may be of minimal clinical benefit. However, more randomized controlled clinical trials need to be conducted over longer periods of time to better understand the long-term benefits of ultrasonic and sonic debridement (5).

Another review was presented by Baehni P et al (1) where he suggested that sonic and ultrasonic scalers should mainly be used during initial therapy and their use is often limited to the supragingival area. Subgingival instrumentation is usually performed with hand curettes. Recent literature shows that clinical and bacteriological results obtained after treatment of periodontal lesions with sonic or ultrasonic scalers are similar to those observed following hand curettage. In addition, recent ultrasonic scalers allow irrigation with sterile or antiseptic solutions. Finally, new inserts are better designed for subgingival instrumentation. Altogether, these observations give a new dimension to these instruments.

POWER-DRIVEN VERSUS MANUAL SCALERS

The literature is clear that periodontal therapies aimed at altering the progression of inflammatory periodontal diseases must include meticulous subgingival mechanical débridement during both the nonsurgical and the surgical phases of treatment as the basis of most anti-infective therapy. In the past, infection control was achieved by the mechanical removal of subgingival deposits of plaque, calculus, and endotoxin with curets, files, and hoes. Historically, it was also generally agreed that aggressive scaling and root planing with hand instruments was necessary to remove tenacious calculus deposits to produce roots as smooth as possible for removal of the endotoxins previously thought to be deeply embedded into the root surfaces. Based on current evidence in the literature, it is now known that endotoxin is a weakly adherent surface phenomenon and that sonic and ultrasonic (power-driven) instruments can be used to accomplish definitive root detoxification and maximal wound healing without overinstrumentation of root and without extensive cementum removal. Power-driven scalers may have unique advantages because of the cavitational activity associated with ultrasonics thought to supplement removal of root surface plaques. In addition, the constant flushing activity of the lavage used to cool the tips results in disruption of the unattached and weakly attached subgingival plaques. The ability to flush the pocket during subgingival instrumentation with water or other chemical irrigating solutions is unique to ultrasonic and sonic scalers and has been shown to enhance pocket depth reduction and gain in clinical attachment beyond that achieved with hand scaling. The added benefit of chemical lavage during ultrasonic instrumentation shows great promise and may enhance the overall effect of nonsurgical anti-infective periodontal therapy. Other major advantages of power-driven scalers may include better access to difficult areas, such as deep narrow defects, root grooves, and furcations, using newly designed microultrasonic tips, which are smaller in diameter and able to penetrate the pocket approximately 1 mm farther than hand instruments. Taken together, it appears that use of ultrasonic or sonic scalers for periodontal débridement will result in improvements in clinical and microbial parameters at a level equal to or superior to hand scalers (6).

The working mechanism and the correct use of ultrasonic devices is discussed in another review. Comparative efficiency of ultrasonic and hand instrumentation is evaluated for the removal of subgingival plaque and calculus, for the effect on root surfaces and for the ability in removing endotoxins. Possible side effects of the ultrasonic vibrations on the tooth structures and periodontal tissues, the incidence of bacteremias and the spreading of oral infections via aerosols are stated. Particular attention is given to the clinical results of both instrumentation technics and the necessity of root planing. One can conclude, that ultrasonics present an alternative and/or a supply for hand instruments, provided that a selective and careful use is taken into account (7).

A systematic review of efficacy of machine-

driven and manual subgingival debridement in the treatment of chronic periodontitis.The purpose of this systematic review was to determine the efficacy of machine-driven compared with manual subgingival debridement in the treatment of periodontitis.A literature search for controlled clinical trials with at least 6 months' follow-up comparing machine-driven instruments with hand instruments for the treatment of chronic periodontitis was performed up to April 2001. Screening of titles and abstracts as well as data extraction was conducted independently by two reviewers (J.T. and T.F.F.). As primary outcome variable, the prevention of tooth loss was used; secondary outcome variables were the prevention of disease progression, the resolution of anatomical defects and the resolution of gingival inflammation. Efficiency was assessed by mean time needed to treat one tooth.From a total of 419 abstracts, 27 articles were included for the review. The weighted kappa score for agreement between the two reviewers was 0.77, 95% CI: 0.65-0.89, indicating substantial agreement. No study reported on the selected primary outcome variables. Using clinical attachment gain, probing pocket depth reduction or bleeding on probing reduction as outcome variables, there appeared to be no differences between ultrasonic/sonic and manual debridement. No major differences in the frequency or severity of adverse effects were found. However no meta-analysis could be performed on any of the previously mentioned parameters. Ultrasonic/sonic debridement was found to take significantly less time, i.e. 36.6%, than debridement using hand instruments (P = 0.0002, 95% CI of the standardized effect estimate: 0.39-1.37, heterogeneity P = 0.77).With respect to clinical outcome measures, the available data do not indicate a difference between ultrasonic/sonic and manual debridement in the treatment of chronic periodontitis for single-rooted teeth; however, the evidence for this is not very strong. In addition, ultrasonic/sonic subgingival debridement requires less time than hand instrumentation. Further research is needed to assess the efficacy of machine-driven debridement on multirooted teeth and clinical outcome variables having tangible benefit to the patients should be addressed(8).

PATIENT BENEFITS: WHY ULTRASONICS?

The evidence is clear. Today's clinician knows how ultrasonic scaling advances patient care. Since the landmark Drisko review article of 1993, non-surgical periodontal therapy has advanced beyond basic calculus removal. Ultrasonic therapy in periodontics now focuses on the etiology of periodontal disease by disruption of bacterial biofilms and stimulation of the host immune response (9).

In the American Association of Periodontology position paper on ultrasonic scalers (2000), the following statements were made (10):

- In general, the evidence suggests that the disruption and removal of subgingival biofilms (plaque) can be accomplished with powerdriven scalers at a level comparable to manual scalers.
- The lavage effect produced by the water coolant used with power-driven scalers provides a constant flushing activity during instrumentation that appears to have some therapeutic effects (11).
- Ultrasonics are clearly superior in the treatment of Class II and Class III furcations when used by experienced dental professionals. Based on these observations and published studies, sonics and ultrasonics may be the instrument of choice for scaling and root planning furcations.

The bottom line: an ultrasonic scaler is one of the single most important instruments you have for improving the periodontal hygiene and health of your patients.

CLINICAL BENEFITS

As a dental health care professional, you're concerned for your patients' health and comfort. Providing them the best care is foremost on your mind. The Cavitron Plus and Jet Plus systems provide a high level of clinical efficacy. Our dynamic auto-tune technology allows you to switch inserts as often and efficiently as you do your hand instruments. The handpiece attachment enables unsurpassed oral access and tooth adaptability enabling you to effectively utilize curved inserts for superior debridement in deep pockets and furcations.

As a clinician you're also concerned with repetitive motion disorders, and how they can impact your career. Hand scaling is typical of the type of repetitive motion that experts agree may lead to painful carpal-tunnel syndrome. Our ultrasonic units replace the stress of hand scaling with a low-amplitude high-frequency energy that's capable of powering off even the most tenacious calculus with a "feather touch."

PRACTICE BENEFITS

The newer set of ultrasonic instruments offer several advanced features to improve the ergonomics for the clinician. Good ergonomics in a dental practice are critical to ensuring a healthy team and bottom line. The new ergonomically-contoured 360° foot control as well as the swivel cable attachment on the handpiece reduce the potential for work induced injuries.

Unique time-saving features help keep your office working efficiently. The 30kHz is a proven operating frequency for preventive care ultrasonic scalers. The autoclavable Steri-Mate handpiece and purge mode expedite patient set-ups while offering a high level of water quality and protection from cross-contamination.

USE OF ULTRASONIC SCALERS DURING PERIODONTAL SURGERY

Originally hand instruments were used for debridement of supragingival and subgingival plaque and calculus. During the second half of the last century, electric and air operated instruments were introduced, which proved to be of great value to the operator for obtaining optimal treatment results. These mechanical scalers are now available in sonic and ultrasonic versions. The vibrations of the sonic tip that are transmitted to the tooth surface are responsible for the clearing effect. The term ultrasonic describes a range of acoustic vibrations with a frequency above 20,000 vibra-

tions per second. Most of these instruments work according to the magnetostrictive or piezoelectric principle.

In many studies the effectiveness of professional debridement is related to the ability to remove plaque, calculus and endotoxins and to the degree of smoothness of the treated tooth surfaces. After reviewing the various studies, the limitations of every analysis method should be taken into account. Additionally, the type of instrument, the tooth type, the anatomy of root, the initial pocket depth, the patient's cooperation and in particular the manual skills. This hampers the comparability of the results between the studies.

Advantages of Ultrasonics in periodontal surgery:

- Sonic and ultrasonic instrumentation has the potential to make scaling and root planning less demanding.
- More time efficient.(3.9 minutes for ultrasonic, 5.9 minutes for manual scaling)
- More ergonomically friendly.
- Modified tip designs allow for improved access in many areas, including furcations.
- New, slimmer, designs operate effectively at lower power setting thus improving patient comfort.
- Absence of need to sharpen the tips of power driven instruments.
- Better visibility due to lavage and constant flushing mediated by acoustic micro-streaming.
- Easy to distinguish blood clots from granulation tissue and loosens granulation tissue.
- Reduced root surface alterations and dentin removal.
- In 1984 Hunter and Kepic et al in 1990 showed that ultrasonic instruments are not significantly different in removing calculus with or without flap access. Both studies showed ultrasonic instruments to have slightly less residual calculus than hand scaled specimens when examined microscopically (12).
- Recent studies have found ultrasonic instruments more effective in removing endotoxins adhering to the root surfaces (13,14).
- Cavitation and acoustic microstreaming phenomenon associated with ultrasonic are thought to have an adjunctive effect on plaque and endotoxin removal. (15,16).
- Light strokes using ultrasonic instruments rather than intentional cementum removal results in fibroblast reattachment to previously diseased roots.
- Wound healing studies have confirmed that attachment gain and reduction of gingival inflammation and pocket depths can be achieved by thoroughly removing, subgingival deposits with meticulous light overlapping,stokes with an ultrasonic scaler.
- Cavitational activity supplements removal of root surface plaques. Constant flushing activity of lavage to cool tips results in disruption of unattached and weakly attached subgingival plaques and granulation tissue.
- Constant irrigation resulting in flushing the pocket during instrumentation with water or other chemical irrigating solutions, is unique to ultrasonic scaler and have been shown to enhance pocket reduction to gain in clinical attachment level beyond that achieved by hand scaling.
- Better access to difficult areas, such as deep narrow defects, root grooves and furcations, using newly designed micro ultrasonic tips,smaller in diameter and able to penetrate 1mm father than hand instruments.
- Ultrasonic instrument are an unambiguous choice in scaling and root planning of mobile teeth.
- Root planning with hand scalers predispose to many linear injuries and the entire root surface is covered with a smear layer.
- Study by Guentech et al 2006 in Modified Widman Flap procedure when compared with manual instrumentation resulted in less recession following treatment and less trauma to soft tissue during therapy.
- Ultrasonic instrumentation is definitely more patient friendly with less discomfort and pain.

DISADVANTAGES OF ULTRASONIC

- It may produce thermal damage to tissues(pulp and dentin)
- Ultrasonic scaler is applied lightly to the tooth surface to remove plaque and calculus which may alter the topography of tooth surface. Whether the surface finish produced after ultrasonic use is biologically acceptable for reattachment of the periodontal tissues is still in discussion.
- Studies by Rischer and Eastm in 1992 point that cavitation may cause trauma to blood vessels and accelerate the blood coagulation system thus resulting in unwanted blood clots in the system.
- Vibrations of a wire at an ultrasonic frequency will potentially damage erythrocytes, leucocytes and platelets. It was shown that hemolysis of heparinised blood occurred with a wire vibrating at 20 KHz and the level of platelet damage was dependent on the wire diameter.
- Ultrasound produce acoustic microstreaming fields around the scaling tip .These shear forces produced are powerful enough to damage the platelets.
- Neurologic disturbances of hand caused by vibrations, hearing loss and interferences with cardiac pacemakers (17).
- "White Finger" is produced by large amplitudes produced by pneumatics.
- Aerosol produced by the in vivo use of an ultrasonic scaler on periodontally involved teeth was contaminated with blood and that contamination occurred regardless of inflammation.
- This Aerosol production contaminated with blood are of concern lately. Huntley et al found a greater amount of aerosol contamination on the sleeves and chest of scrub jackets with sonic and ultrasonic scalers than with hand scalers (18).
- Miller et al found atrial and ventricular pacing was inhibited by electromagnetic interference produced by a magnetostrictive ultrasonic scaler (19).
- Studies by Osteocagide FJ and Long BA 1997 found that gracey curette were more effective in debribing root trunks,furcation entrance and furcation areas of mandibular molars.
- Ultrasonic instrumentation is accom-

plished with light touch and light pressure. However light stokes with a blunt vibrating end may impair tactile sensitivity and constant water spray hampers visibility.

- The usage of ultrasonics is contraindicated in patients with respiratory diseases.
- Metal ultrasonic instruments are contraindicated in titanium implant patients which can be etched.

CONSENSUS

The ill effects /disadvantages of an ultrasonic instrument could be overcome by proper use of the device during surgery.

- To eliminate the problem of heating effects,ultrasonic scalers should not be used if the irrigate water flow below 20ml/min.
- Cavitation can cause damage to platelet which have the potential to cause pulp death, although in vivo experiments have shown no significant danger of thrombosis.
- Prolonged operation of an ultrasonic scaler may cause disruption of blood and nerve supplies to the operator fingers, although the work is unconfirmed.
- In order to reduce the hazards of aerosols, the equipment should be used in conjuction with a pre-procedural antiseptic mouth rinse and a high volume evacuator and any high risk infective patient should be treated by hand instruments.
- The ultrasonic scaler may produce temporary hearing shifts in the patient and clinician, although there is no evidence of permanent damage.
- Magneto-strictive ultrasonic scalers should not be used by clinician or patient with a pacemaker.

SUMMARY AND CONCLUSION

It is clear from the literature that scaling and root planing play a pivotal role in the elimination ofcausative factors of periodontal disease throughout periodontal therapy, including the nonsurgical, surgical and maintenance phases. In the past, it had been generally agreed that excessive root surface removal by hand instruments was necessary to remove the tenacious calculus deposits. However, research over the past years has shown that definitive root surface detoxification can be achieved without excessive cementum removal or aggressive instrumentation.

REFERENCES

1. Baehni P, Thilo B, Chapuis B, Pernet D. Effects of ultrasonic and sonic scalers on dental plaque microflora in vitro and in vivo. *J Clin Periodontol* 1992;**19**:455–59.
2. Beuchat M, Busslinger A, Schmidlin PR, Michel B, Lehmann B, Lutz F. Clinical comparison of the effectiveness of novel sonic instruments and curettes for periodontal debridement after 2 months. *J Clin Periodontol* 2001;**28**:1145–50.
3. Breininger DR, O'Leary TJ, Blumenshine RV. Comparative effectiveness of ultrasonic and hand scaling for the removal of subgingival plaque and calculus. *J Periodontol* 1987;**58**:9–18.
4. Busslinger A, Lampe K, Beuchat M, Lehmann B. A comparative in vitro study of a magnetostrictive and a piezoelectric ultrasonic scaling instrument. *J Clin Periodontol* 2001;**28**:642–49.
5. Drisko CL, Cochran DL, Blieden T, Bouwsma OJ, Cohen RE, Damoulis P, *et al.* Somerman MJ, Iacono V, Genco RJ. Position paper: sonic and ultrasonic scalers in periodontics. Research, Science and Therapy Committee of the American Academy of Periodontology. *J Periodontol* 2007;**78**(8):1476.
6. Drisko CH. *Dent Clin North Am* 1998;**42**(2):229-44.
7. Gantes BG, Nilveus R, Lie T, Leknes KN. The effect of hygiene instruments on dentin surfaces: scanning electron microscopic observations. *J Periodontol* 1992;**63**:151–57.
8. Tunkel J, Heinecke A, Flemmig TF. *J Clin Periodontol* 2002;**29**(3):72-81.
9. Drisko CL. Scaling and root planing without overinstrumentation: hand versus power-driven scalers. *Curr Opin Periodontol* 1993;78-88.
10. Position paper: Sonic and ultrasonic scalers in periodontics. Research, Science and Therapy Committee of the American Academy of Periodontology. *J Periodontol* 2000;**71**(11):1792-801.
11. For clean and sterile water recommendations consult: Centers for Disease Control and Prevention. Guidelines for Infection Control in Dental Health-Care Settings - 2003. *MMWR* 2003;**52**(No. RR-17):28:34.
12. Kepic TJ, O'Leary TJ, Kafrawy AH. Total calculus removal: an attainable objective? *J Periodontol* 1990;**61**:16–20.
13. Checchi L, Pelliccioni GA. Hand versus ultrasonic instrumentation in the removal of endotoxins from root surfaces in vitro. *J Periodontol* 1988;**59**:398–402.
14. Chiew SY, Wilson M, Davies EH, Kieser JB. Assessment of ultrasonic debridement of calculus-associated periodontally- involved root surfaces by the limulus amoebocyte lysate assay. An in vitro study. *J Clin Periodontol* 1991; **18**:240–44.
15. Moore J, Wilson M, Kieser JB. The distribution of bacterial lipopolysaccharide (endotoxin) in relation to periodontally involved root surfaces. *J Clin Periodontol* 1986;13:748–51.
16. Walmsley AD, Laird WR, Williams AR. Dental plaque removal by cavitational activity during ultrasonic scaling. *J Clin Periodontol* 1988;**15**:539–43.
17. Moller, et al 1976, Coles and Hoare 1985,Trenter SC, Walmsley AD: Ultrasonic dental scaler:Associated hazards. *J Clin Periodontol* 2003;**30**:95-101.
18. Huntley DE, Campbell J. Bacterial contamination of scrub jackets during dental hygiene procedure. J Dent Hygiene 1998;72:19.
19. Miller CS, Leonelli FM, Latham E. Selective interference with pacemaker activity by electrical dental services. Oral surgery Oral Medicine Oral Radiology Endodontic 1998;85:33.