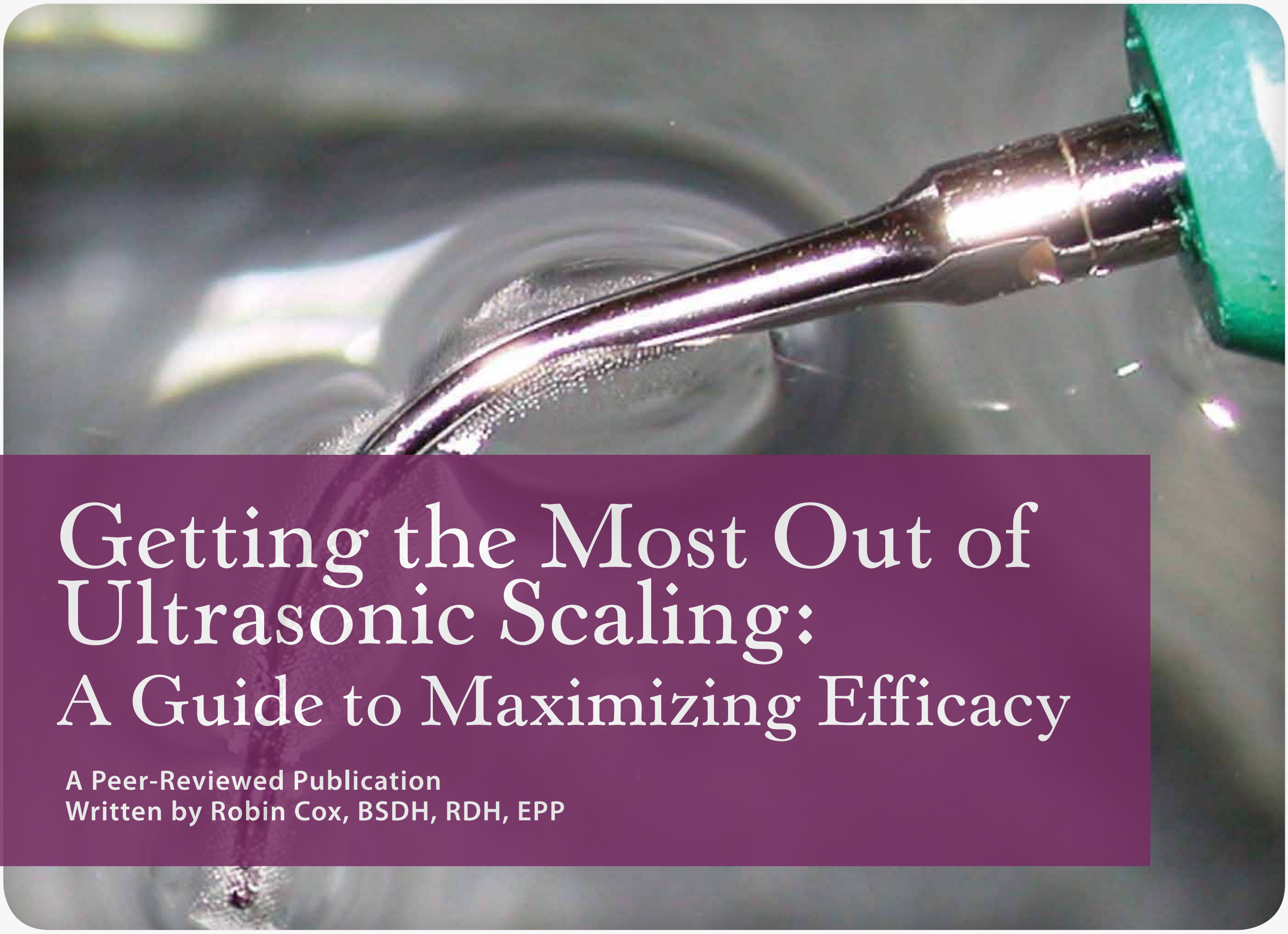

Getting the Most Out of Ultrasonic Scaling:
A Guide to Maximizing Efficacy

A Peer-Reviewed Publication
Written by Robin Cox, BSDH, RDH, EPP

Abstract
Powered instruments have been part of dental hygiene treatment since the late 1950's. Over time new and innovative improvements to the equipment and tip designs have made ultrasonic scaling easier and more effective. Today's patients are in need of the highest level of therapeutic hygiene services available. With the reciprocal link between periodontal disease and several known systemic diseases, dental health care providers need to be knowledgeable about current treatment modalities and the evidence that supports it. This course is designed to aid the clinician in making instrument decisions to improve the quality of hygiene treatment provided to the patient.

Educational Objectives
At the conclusion of this educational activity participants will be able to:
1. List several key benefits of powered instruments over hand instruments
2. Describe the specific use recommendations for the various ultrasonic tip designs.
3. Utilize correct tip to tooth adaptation of ultrasonic instrument tips and inserts
4. Explain the influence and reduced efficacy of worn ultrasonic tips

Author Profile
Robin Cox, BSDH, RDH, EPP, is currently the course director for Periodontal Instrumentation I and II at Oregon Health and Science University, School of Dentistry. Other professional activities include; dental lead for Compassion North Portland and professional lecturer in the Pacific NW focusing on advanced instrumentation. She received her dental hygiene degrees from Oregon Institute of Technology and Eastern Washington University. Past educational experience was gained as lead clinical instructor and course director for several core dental hygiene courses with DeVry University Dental Hygiene program.

Author Disclosure
Robin Cox, BSDH, RDH, EPP has no potential conflicts of interest to disclose.

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Abstract

Powered instruments have been part of dental hygiene treatment since the late 1950's. Over time new and innovative improvements to the equipment and tip designs have made ultrasonic scaling easier and more effective. Today's patients are in need of the highest level of therapeutic hygiene services available. With the reciprocal link between periodontal disease and several known systemic diseases, dental health care providers need to be knowledgeable about current treatment modalities and the evidence that supports it. This course is designed to aid the clinician in making instrument decisions to improve the quality of hygiene treatment provided to the patient.

Ultrasonic scaling possesses certain characteristics that cannot be achieved with hand scaling. These unique properties of ultrasonic scalers make it the preferred method for the majority of non-surgical treatment of periodontal disease, prevention and maintenance. These properties include; mechanical removal of plaque and calculus, conservation of cementum, water lavage, bactericidal effects, improved clinician ergonomics and superior access in furcations and deeper periodontal pockets.[3,4,5]

An insufficient number of in vivo studies have been completed to definitely prove the superiority of ultrasonic scaling over hand scaling. Numerous in vitro studies clearly show the biofilm removal properties are superior with ultrasonic instrumentation.[6.7] Properties such as precise mechanical movement, cavitation,[8] acoustic streaming,[9] acoustic turbulence,[10] conservation of cementum [11] and pocket lavage are the reasons for the superior function of ultrasonic instrumentation. For clinicians who want to deliver the most therapeutic treatment possible, ultrasonic scaling should be at the forefront of treatment modalities.

Looking at each of these properties will demonstrate the benefits over hand scaling and why it is important to be skilled with ultrasonic scaling.

With hand scaling our success is based on effectiveness of mechanical action. The ultrasonic instrument moves at a speed of 25,000 to 50,000 cycles per second (CPS). When applying an ultrasonic instrument to the tooth surface for scaling, the tip of the instrument will complete its pattern of oscillation 25,000 to 42,000 times in a single second, depending on the operation of the generator. A 30kHz insert completes 60,000 strokes per second. [12] The mechanical movement is a precise, longitudinal sweeping motion that cannot be replicated by hand scaling. This extremely fast movement allows the tip to contact the calculus and plaque in a manner that is not comparable to hand scaling.

Cavitation is a word that we are familiar with when talking about ultrasonic instruments. As a review, cavitation is a physiological property associated with ultrasonic waves. In the fluid medium, pressure waves cause the formation and implosion of atomized gas bubbles creating shock waves.[7] This physical reaction creates energy and heat at the reaction site, in turn causing fracture of deposits and cell disruption, particularly to the gram negative bacteria.[13]

The other two unique physiological properties are acoustic microstreaming and acoustic turbulence. Imagine the forceful flow of water over the vibrating tip of the ultrasonic scaler. The water that passes over the oscillating tip generates a current of water around the probe, inside the periodontal pocket. This current, although small, has enough force to dislodge bacterial plaque and its associated colonies.[14,7] Acoustic turbulence is the swirling effect produced by the current created from acoustic microstreaming. This swirling of fluid in the confined space of the periodontal pockets aids in the disruption of the plaque biofilm. (Figure 1)

In order to reap the maximum benefits of ultrasonic scaling, one must become highly skilled in the use of the instrument and all of the inserts or tips associated for thorough debridement. One of the claimed benefits with the use of powered instruments is that it takes less time to complete the procedure.[15] This statement may mislead the clinician into spending insufficient time with their ultrasonic devices. Part of the skill in using this method, is spending adequate time in the treatment area.

Figure 1. Visual image of acoustic turbulence (water current created by oscillating tip).

With hand scaling, it has been said that to thoroughly scale a multi-rooted tooth, 10 minutes per tooth is needed.[16,17] In one study that set out to compare ultrasonic technologies, twenty minutes per quadrant was an insufficient amount of time to thoroughly scale using either magnetostrictive or piezoelectric technology. The following statement referred to ultrasonic scaling; "This study suggests that more than 20 minutes of instrumentation per quadrant is required for adequate removal of light–moderate subgingival calculus."[18]

Based on this information, maybe our thoughts of taking less time to scale aren't as accurate as previously thought. Certainly the time we spend using an ultrasonic scaler is less than hand scaling, more ergonomic and less stressful on our bodies, but spending a sufficient amount of time scaling is essential. It's difficult to say exactly how much time is needed for any one particular treatment. The use of proper technique with a variety of tips can achieve definitive debridement. [19, 16]

The beneficial properties of ultrasonic scaling are essentially dependent on operator application. There is a wide variety of inserts and tips to use for comprehensive scaling. However, most clinicians limit themselves to the use of one or two favorites. When using ultrasonic scalers the clinician should use the same instrument decision tree as one does for hand scaling. Just like hand scalers, inserts and tips are designed for specific purposes and accessibility.

The clinician is faced with the decision of which instruments to use based on type and location of calculus, health or disease status of the patient and root anatomy.[3] This information will direct the clinician to use the proper instrument to complete the job with the least difficulty and most efficiency. The focus will be on reviewing the recommended use of inserts for magnetostrictive devices. However, the basic principles for selection are similar for both magnetostrictive and piezoelectric devices.

There are two design considerations with tip selection. First, there is the tip shape; straight or curved. Then there is a choice of diameter; standard, slim and ultra slim. The combination of any of these designs will dictate how it is supposed to be utilized. The following descriptions are based on manufacturer's recommendations and research for tip application.

Standard diameter tips are designed for power or for moderate and heavy calculus removal. Because they are meant to be used at high power settings, they are not recommended for subgingival scaling in narrow pockets and areas of difficult access. Utilizing these tips in such areas, especially at high power, increase risk of tooth structure damage.[11]

Standard diameter tips are considered straight tips. They are available with a single, double and triple bend in the shank. There is also a large flat option called the Beavertail. Each one is designed for specific access and application.

The tips with one and two bends are very similar and are especially useful in all areas of the mouth, supragingival and subgingival to the cervical third of the root (≤4mm). These can be used at high power settings making them very effective for initial debridement of moderate to heavy calculus. In addition, these single or double bend tips are very good for accessing deeper pockets in single rooted teeth or line angles where tissue distention is not a factor. The back side of the tip (magnetostrictive only) adapts very well to the concavities of these areas and along line angles. The shank is rounded with a tapered end. There is no significant difference in access or use between these two. (Figures 2 and 3)

The standard diameter triple bend is a commonly used for heavy calculus removal. It differs in design as it has a diamond pattern in cross section. (Figure 4) When an insert has "bladed" edges, the power distribution is stronger at the apex of the edge. The triple bend has improved line angle and interproximal adaptation. The beveled edge is extremely efficient at removing moderate to heavy calculus in these areas. This tip is also effective on the buccal and lingual aspects. It is important to examine the design of this particular insert, as it does have some limitations. Because of the bends, this instrument will not adapt well in pockets >4mm and will cause significant damage to root and tooth structure if the point comes in direct contact at

Figure 2. #10 tip, single bend, standard diameter.

Figure 3. #100 tip, double bend, standard diameter.

Figure 4. #1000 tip triple bend, standard diameter; beveled edges are areas of high energy.

90°. This insert is indicated for patients with a lot of calculus but not many deep pockets.

The pie server shaped Beavertail is a work horse for heavy calculus bridges. This tip is meant to be used with the point or edges directed on the ledge of calculus. Care needs to be taken when using this tip as it is not intended to come in contact with tooth structure. It works on extremely high amplitude and will indeed cause damage if applied to the tooth. Clinicians should have one available in their arsenal for special cases. (Figure 5)

Figure 5. Beavertail tip, used for heavy calculus bridges. The working area is the point of the instrument.

Slim diameter tips are generally available in the same tip designs as the standard diameter tips. The diameter of the tip is 30% smaller than the standard tip. This slimmer design can access deeper pockets and furcation areas and are especially suited for root anatomy.[20,21,3] In addition to the designs earlier mentioned, there is also a curved design available in the slim inserts. These curved instruments are intended for posterior root adaptation and have much better contact with convexities and concavities than do the straight tips.

Slim tips have excellent adaptability and superior access over standard diameter tips and hand instruments. They need to be used in a manner that will maximize its effect while maintaining tissue and tooth integrity.

The slim tips are meant to be used at low to medium power settings. At these settings the slim tip will effectively remove bacterial plaque [9,20] as well as light to moderate calculus. In addition, the slim tips are less invasive of the root surface than other tips, retaining more dental cementum during scaling. [11,3] However, the advantages of the slim design are only afforded if the tip is used properly and within the manufacturer's recommendations. If one is using these slim tips to remove heavier calculus at high power settings, root structure may be compromised and clinical attachment loss may occur.[15,20] In addition a high power setting can cause damage to the insert itself, resulting in ineffective oscillation.

When using slim tips, the mindset of using a single insert for the entire mouth needs to be rethought when scaling subgingivally. The straight, slim inserts are designed more or less like a probe. Because they are straight they adapt well to single rooted teeth, (Figures 6 and 7) but not so well to posterior teeth. When treatment involves pockets greater than 4mm, especially if there is furcation involvement, the clinician should utilize both curved and straight tips.

Figure 6. SLIM STRAIGHT

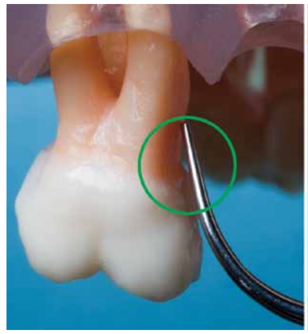
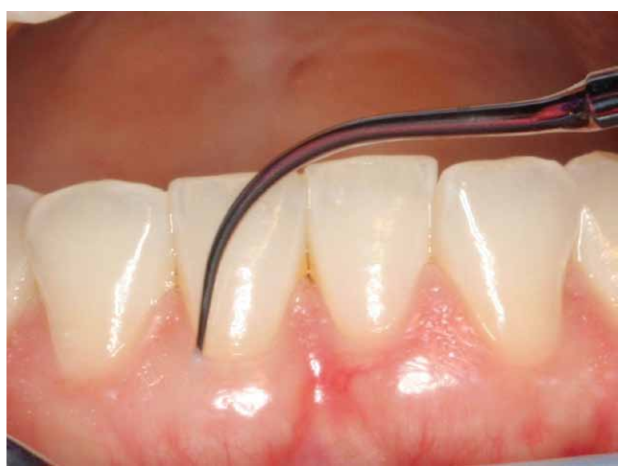


Figure 7. SLIM CURVED

In figure 6 you can see that the straight tip does not adapt to the root and is improperly positioned onto the root. In figure 7 notice how the curved insert adapts well in the concave surface of the mesial root.

New on the market is an ultrathin insert. (Figure 8) The ultrathin insert is 47% thinner than its comparable slim insert which allows for access in very narrow pockets and increases tactile sensitivity. It also has an increased back bend angle of 9° making it easier to adapt to root anatomy and access deeper pockets. While the slim tips are fragile at high powers, this new design was developed to withstand higher power settings, although it is designed to be used at low to mid-power settings. This insert is highly recommended for periodontal maintenance patients, for access and pocket management.

Figure 8. Thin insert. 47% thinner and 9° back bend angle for access.



Other important keys to ultrasonic technique are adaptation of the tip to tooth, instrument stroke, grasp and lateral pressure. Small adjustments to each of these categories can increase your scaling effectiveness significantly. The following recommendations are based on the technology of the ultrasonic instrument function.

When learning the use of an ultrasonic scaler the instructor probably said, "adapt the terminal 2-3mm of the tip to the surface being scaled." This statement is significant, based on the pattern of ultrasonic vibrations. Along the ultrasonic wave there are areas or points where no vibration occurs. These areas are referred to as nodal points. Depending on the tip design these nodal points occur between 2.2 mm and 4.4 mm from the point of the insert.[8] When adapting for scaling, if the terminal 2-3 mm is not in contact with the treatment area a nodal point may be reached rendering the instrument ineffective. (Figure 9)

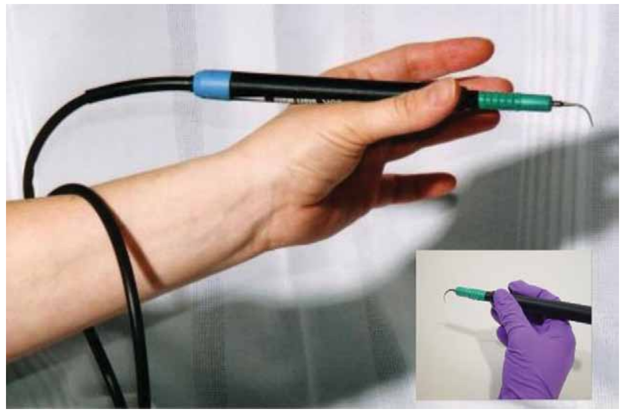
Figure 9. Nodal points-points of no movement along insert.

When using the terminal 2-3 mm of the tip, it can be difficult to cover the entire surface area that needs to be scaled. The instrument should be used with repeated, short, overlapping, brush-like strokes with very light lateral pressure. This motion allows for more complete coverage of the surface area being scaled. This stroke is recommended for deplaquing and removal of calculus and root surface toxins. The instrument will perform in all directions of the stroke and is intended to remove debris from top to bottom. Vertical, horizontal and oblique strokes are used to cover all surfaces of the treatment area.[3]

The point of the instrument should never be placed directly on tooth structure at a 90° angle. This is the area of highest power and will cause tooth damage. With moderate and heavy calculus the point can be used directly on the calculus in a repeated tapping motion to dislodge large pieces of calculus. When accessing a periodontal pocket, one should take care that the tip of the working end is not heavily contacting the clinical attachment. Although it has been shown that the attachment is penetrated by the ultrasonic tip, careful technique will minimize this, preventing significant damage affecting the healing of the pocket.[11]

The grasp of the ultrasonic instrument is very important for both ergonomics and efficacy. (Figure 10) The instrument should be balanced in your hand to reduce the need for a tight finger grasp to hold the instrument in place. Pinching the end of the instrument or the handle can result in efficacy reduction of the device itself and will inhibit the natural movement of the ultrasonic tip. To make sure you have the correct grasp and placement, balance the handle between your thumb and index finger in a position where little or no assistance is required. At that point, bring thumb and index finger together and grasp only tightly enough to keep it in place. During scaling, the grasp should always be very light so that maximum efficiency is achieved. Having a light grasp ensures that you are maintaining light lateral pressure, which is also required for effective debridement and stroke. The tighter the grasp, the stronger the lateral pressure will be.

Figure 10. Balance and grasp.



Several manufacturers have developed inserts with larger grips for better ergonomics. Larger grips lessen muscle load and pinch force. [22] Other features include natural finger rests and ribbed design so that the user maintains a light grasp and pinch while being able to keep it stable in a wet environment. Newer inserts are also lightweight and comfortable and tactile sensitivity is minimally compromised. (Figure 11)

Figure 11. Ergonomic grip for ultrasonic scaling.

All ultrasonic machines and instruments need to be maintained to manufacturer's recommendations to achieve long life. Water filters, O-rings and line flushing are essential regular maintenance tasks to ensure safety and proper operation of these devices. In addition, the tips for piezoelectric and inserts for magnetostrictive need to be monitored regularly.

Monitoring the wear of the insert or tip should be done frequently. When a tip wears, the non-vibrating nodal point comes closer to the point of the instrument. This will result in the scaling area being reduced. A single millimeter of wear reduces efficacy by 25% and a loss of 2 mms reduces it by 50%. [23] In addition, when a tip is worn the clinician must use excessive pressure which causes discomfort for both the patient and the clinician. Manufacturers supply wear guides to help assess need for replacement. The clinician should have one available and monitor wear carefully for replacement as needed.

To extend the life of magnetostrictive inserts always fill the handpiece with water prior to placing the insert inside.

Lubricate the O-ring with water before gently placing the insert into the handpiece. Use proper grasp, pressure and stroke during scaling procedures to avoid excessive tip wear. Evaluate the stack of the insert. Bent, spread or broken laminates in the stack cause loss of power and can also damage the handpiece, and should be discarded. Always follow manufacturer's instructions for cleaning and maintenance.

Another consideration is mismatching manufacturer inserts or tips and generator or machine. It has been shown that interchanging manufacturer inserts and generator units can change the system's performance.[14] Manufacturer's inserts or tips are designed to perform with their own generator. By utilizing the same manufacturer, you will be optimizing the oscillation performance of the instrument you are using.

In conclusion, the use of powered instruments provides therapeutic value over hand scaling alone. The properties associated with ultrasonic scaling make this treatment modality a must if the clinician wants to provide optimal therapy. To achieve the maximum benefits of ultrasonic instruments, proper technique is required. Improper grasp, pressure, adaptation and stroke can alter the efficacy of the instrument and possibly cause tooth structure damage. For thorough debridement, an adequate amount of time must be spent using these devices.

A wide variety of instrument tips are available. Definitive debridement can only be achieved if access and adaptation is achieved. Each tip is designed for specific conditions and access. Selecting the correct ultrasonic instrument should be based on location and type of calculus as well as patient health and disease status. Whether using piezoelectric or magnetostrictive units, larger diameter tips are indicated for higher power settings and heavier calculus removal. Slim and ultra-slim tips are used on low to mid-power settings, for light to moderate calculus in difficult to access areas. It is recommended that for thorough debridement, an assortment of ultrasonic tips be used during each procedure.

Reduced effectiveness of the ultrasonic scaler will occur with improper maintenance and operation. Utilizing worn tips, bent or broken laminates or improper use and care, as well as interchanging manufacturer tips and generators all affect optimal performance.

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