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ULTRASONICS

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As the millennium approaches, are curets your only instruments of choice? If so, resolve to expand your armamentarium to reflect current treatment modalities. A deepened understanding of the complex nature of periodontal diseases and technological advancements regarding the diagnosis and treatment of the disease process have influenced the way clinicians approach therapy today. As a result, oral health professionals have changed their view of ultrasonics and their use in the nonsurgical treatment of the disease. The combination of ultrasonic and hand instrumentation provides versatility in patient care and optimal clinical results.

Ultrasonics were first introduced for periodontal procedures in the 1950s and have undergone many changes since then.[1] Simple, compact devices have replaced large, heavy units. The single, bulky universal tip has been replaced by a variety of site-specific, slimmer tips; some of which have been coined "micro-ultrasonics."[2] Dental hygienists today have a choice not only among hand instruments, but among ultrasonic inserts as well.

Root Planing versus Root Debridement

To understand the role of these new inserts, one must review the science that has initiated the changes in the utilization of ultrasonics. Research into the cause of periodontal disease has changed the way in which it is now treated, nonsurgically. Previously, periodontal disease was thought to be caused by mechanical irritants such as calculus. It was also believed that endotoxins from gram-negative bacteria were deeply embedded in the cementum.[3] Therefore, to treat this disease, calculus had to be thoroughly removed from tooth structures and heavy root planing performed to remove endotoxin-contaminated root surfaces. Glassy-smooth roots were thought to be the end-point of scaling and root planing procedures; and hourglass-shaped roots, hypersensitivity for the patient, and occasionally pulpal exposures were the results.[4] Fatigued wrists did not stand in our way.

Today, we know that periodontal disease is caused primarily by pathogens, not calculus.[4] Calculus, due to its plaque-retentive characteristics, is a contributing factor—but certainly not the primary cause. We also know that endotoxins from these bacteria are not as deeply embedded in the cementum as once thought. In fact, they are loosely adherent on the root surface; therefore, heavy root planing may not always be indicated. For that reason, the term "root planing" is slowly being replaced by "root debridement" or "root detoxification."[4] As a result of these findings, the principle objective of periodontal therapy is to eliminate subgingival bacteria to create a more biologically acceptable environment.[5]

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Types of Ultrasonics

Considering this new philosophy of "root debridement," how can ultrasonics help the practitioner and patient achieve a biologically acceptable environment? Understanding the role of ultrasonic instruments requires an understanding of the way they work.

There are currently two types of ultrasonics, magnetostrictive and piezoelectric, both operating with cycles per second ranging from 25,000 to 46,000 (Figures 1 and 2). The magnetostrictive tips are composed of a stack of metal strips or rod of ferromagnetic material capable of being magnetized resulting in an elliptical or figure eight motion of the working end. This type of motion allows the use of all sides (360º) of the working tip. Heat is generated when using magnetostrictive inserts; therefore, water is used as a cooling agent. Piezoelectric tips alternate electrical currents applied to reactive crystals horizontally, resulting in a linear motion. As a result, only the lateral (two) sides of the working tip are activated. Little heat is generated when

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using these tips, minimizing the amount of water necessary.

When deciding whether to use the magnetostrictive or piezoelectric units, the advantages and disadvantages of each should be weighed. Since magnetostrictive tips operate in an elliptical motion, the tip leaves the tooth surface while it is activated, which in essence causes a "banging" motion against the tooth structure. However, all sides of the tip can be utilized. Piezoelectric tips, with their two working sides, operate in a linear motion. This results in the tip never leaving the tooth while activated. While this makes adaptation very critical, it has been shown to result in less surface roughness.[6] Piezoelectric tips are small and separate from the transducers (handpiece), reducing the cost of the tips and making storage easier. Advocates of piezoelectric ultrasonics state that they feel they are not working as hard to remove deposits, and that there is less gingival distension, resulting in greater patient comfort. The newer slender tips now available for magnetostrictive units also achieve these results.

Ultrasonic Tips

Historically ultrasonic tips were designed to remove heavy supragingival calculus. The bulkiness of the tips reduced access to the subgingival environment. Today's tips are thinner and longer, allowing increased access into periodontal pockets. These tips can remove calculus safely and more efficiently, disrupt subgingival plaque, and detoxify the area being treated—all factors proven to be necessary to eliminate disease-causing pathogens!

Researchers also have discovered that the mechanical removal of deposits caused by a vibrating tip is not the only function of an ultrasonic. Lavage associated with using ultrasonics has proven to be beneficial as well for several reasons. Along with constantly flushing debris from areas being treated, water as it contacts the vibrating tip, creates a cavitation of millions of bubbles. As these bubbles contact the tooth surface, they collapse and release bursts of energy which tear apart bacterial cell walls. The effect of this cavitational activity disrupts the subgingival microbial environment.[7] Microstreaming or acoustic mainstreaming, generated by ultrasound in the presence of a fluid environment, also is effective in removing bacterial plaque.[8] Heat automatically generated from magnetostrictive units may also assist in detoxification.[3] As a result, areas of the tooth where the tip does not touch may inadvertently be detoxified as well.[1] For example, if the tip of an insert does not fit into a furcation area, getting it as close as possible may be enough to detoxify the area being treated.

Ultrasonic devices also are unique in that they permit the addition of chemotherapeutic agents (antimicrobials) through the waterline, instead of water. A self-contained unit or a reservoir attached to the dental unit's water supply is required. This added benefit has been shown to enhance pocket depth reduction and gain in clinical attachment beyond what can be achieved by hand instrumentation or ultrasonic debridement alone.[9-11]

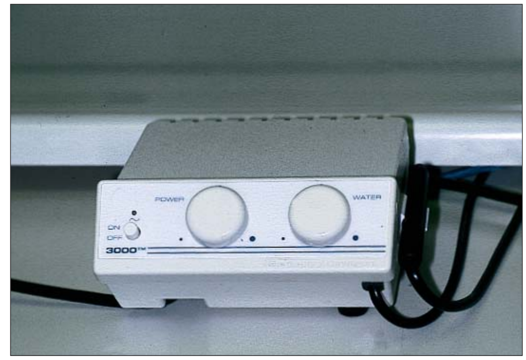

Figure 1.

Figure 2. Example of piezoelectric unit offered by EMS.

Hand versus Power Scaling

Which is more effective, hand scaling or power scaling? Hundreds of studies have been performed comparing the two with varying results. At minimum, the two are equal, but most conclude ultrasonic devices are superior to hand instrumentation in effectiveness.[12-14] Ultrasonic debridement by means other than purely mechanical removal (lavage, cavitation, etc.) offers in itself an advantage over hand instrumentation. Ultrasonic instrumentation, especially when using micro-ultrasonic (thin) tips, has also been shown to be superior when accessing deep, narrow defects and class II and III furcations.[15] Most class II and III furcations are narrower than the working end of a curet, even minicurets. The new, thinner periodontal ultrasonic inserts are ideal for slipping into deep defects and furcation areas, and have been shown to penetrate the pocket approximately one millimeter farther than hand instruments;

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in addition, lavage allows them to penetrate even deeper (Figure 3).[1]

Using ultrasonics is less tiring for the operator, as well as less technically demanding, and the tips do not require sharpening.[16] It has even been shown to be kinder to periodontal tissues.[17] Imagine a piece of calculus at the base of any pocket. An ultrasonic device is effective by simply tapping at the piece of deposit, breaking it away in tiny pieces. A curet, however, must be positioned beneath the deposit to accomplish removal. This can be difficult or even impossible without compromising the gingival tissues. Reduced healing time following debridement with ultrasonics has been attributed to its kindness to the tissues and effects of lavage.[1]

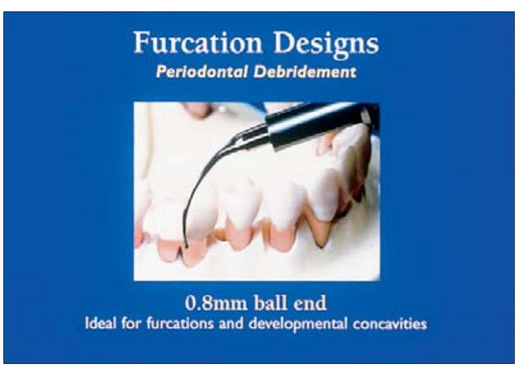

Figure 3.

Figure 4.

However, the disadvantages of ultrasonics include reduced tactile sensitivity; reduced visibility, especially when using indirect vision; the production of contaminated aerosols; and the potential to gouge root surfaces if not used properly.[18] Controversy has been raised regarding the effect of instrumentation on the integrity of the root surface. Again the literature is varied and conflicting. A study by Cross-Poline, et al., compared the effects on root surfaces of a curet, two piezoelectric instruments, and one magnetostrictive instrument. The results showed that the curet produced the smoothest roots, followed by the piezoelectric instruments, with the magnetostrictive instrument producing the least-smooth roots.[6] Other studies reported that manual curets produced a rougher surface than ultrasonics, or that the degree of roughness was essentially equal regardless of which instrument was used.[19-22]

Ultrasonics are beneficial when removing cement, overhangs, heavy deposits, and stain, as well as debriding areas, but there are certain situations in which they are contraindicated (Figure 4). As regards overall health, individuals who have a predisposition to infection (such as after an organ transplant), any known communicable disease transmitted by aerosols (such as tuberculosis), respiratory diseases (such as severe asthma), or an unshielded pacemaker should not receive treatment with an ultrasonic.[18] Controversy is currently arising regarding the use of ultrasonics on women who are pregnant. To date, there are no data to support not using ultrasonics on pregnant women. Prior to performing any treatment, a thorough medical history should always be conducted.

Dental contraindications regarding use of the ultrasonic consist of areas of demineralization, recession, or patient sensitivity. Caution should be exercised when using ultrasonics on restorative materials including composites, amalgams, porcelain, and gold; and they should never be used around titanium implants without a plastic or Teflon-coated tip.[18,23] Discretion is also advised when deciding to use an ultrasonic device on children. Primary and newly erupted permanent teeth have large pulp chambers, in which vibrations and heat from the ultrasonic can cause damage.[18]

Finally, the long-term effect of noise and vibration on the operator has yet to be fully determined. A study by Akesson, et al., reported that dental hygienists and dentists evidenced a slight neuropathy, which may be associated with their exposure to high-frequency vibrations.[24]

Choosing an Ultrasonic Tip

Since research to determine the cause of periodontal disease has been the key force behind designing new ultrasonic tips, which ones are the best to use? The answer depends upon practitioner preference, patient needs, and anatomy of the teeth being instrumented. If a patient presents with very heavy calculus, a heavy tip is indicated. Remember, a heavy instrument is needed to remove heavy deposits, whereas finer tips are necessary for removing finer deposits. General debridement

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inserts featuring a standard diameter tip are most effective for moderate to heavy supragingival deposit removal (Figure 5). However, they may be used on heavier subgingival deposits when access is not a concern. The periodontal debridement or "subgingival" inserts feature thin (approximately 40% thinner than standard diameter tip inserts), probe-size tips for deeper access during nonsurgical periodontal procedures (Figure 6). Keep in mind, as the diameter of the insert decreases, so does the power requirement. Use thin perio tips on low power only. Other tips available include triple bends, beavertails, furcation, and probe-like designs (Figure 7). The choice ultimately depends upon operator preference. For patients classified as American Academy of Periodontology (AAP) Case Type I, with moderate to heavy deposits, a standard diameter tip would be adequate, followed by selective hand instrumentation. Because hand instrumentation leaves a smear layer and ultrasonics do not, some researchers advocate using ultrasonics even after hand instrumentation.[12]

Even patients with gingivitis and heavy plaque can benefit from use of the ultrasonic. It is more efficient in removing plaque, it flushes the debris from the sulcus, and patients have even been known to state that their mouths feel cleaner. Why then waste time "scaling" plaque? If a patient presents with one-to-three-millimeter probe depths, healthy tissues and an absence of or a minimal amount of deposits, selective hand instrumentation may be all that is necessary.

A typical choice for a patient classified as an AAP Case Type II or greater, with moderate to heavy deposits, would consist of a standard diameter insert for general debridement, subgingival inserts for deeper access, followed by furcation inserts if necessary. Since bacterial debridement is the goal, any patient with any AAP classification can benefit from the use of ultrasonics. Knowing which tip to use in a variety of circumstances is the key.

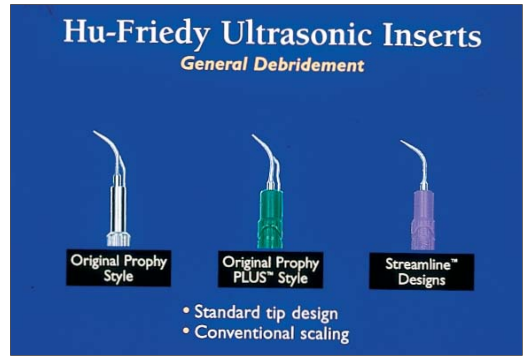

Figure 5.

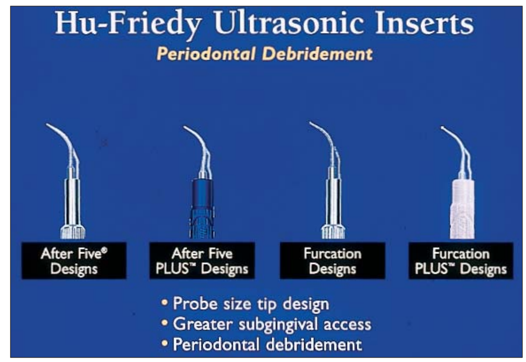

Figure 6.

Figure 7.

Incorporating Ultrasonics into the Prophylaxis Appointment

Today's ultrasonic units are easier than ever to prepare for use and disinfection. Many offices provide one at each operatory for easy access. They are light and compact, minimizing the amount of space required. The inserts are autoclavable for easy sterilization (Figure 8). It is recommended to bleed the line of the handpiece at the beginning of each day by flushing water for at least two minutes (or the manufacturer's recommended guidelines) to clear stagnant water and reduce biofilms in the tubing.[1] After the waterline is flushed (or before, depending upon manufacturer recommendations) the selected tip can be inserted into the handpiece so the power and water can be adjusted for

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maximum efficiency with minimal patient discomfort. This can be achieved by adjusting the power at the lowest position possible, usually not above medium, and adjusting the water until a fine mist or a mist with water droplets is observed (Figure 9). Minimizing the mist from the ultrasonic tip minimizes aerosols outside the mouth. Having the patient rinse with an approved antimicrobial prior to treatment, and using high-speed evacuation also helps to minimize these aerosols.[25,26] The luxury of an assistant for high-speed evacuation during ultrasonic debridement is not typical in most dental offices, so a saliva ejector must be used for evacuation. As with any dental procedure, universal precautions consisting of eyewear and/or face shield, mask, and gloves must be worn.

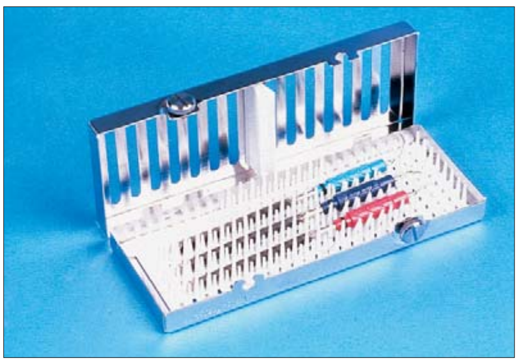

Figure 8.

Figure 9.

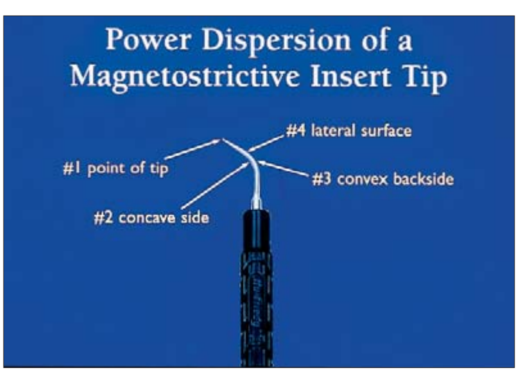

Figure 10.

At this point it, the power necessary for debridement procedures needs to be addressed, as well as why this is crucial for adjusting the power and water settings. Remember that ultrasonics work through both the mechanical action of the tip and the multiple effects of lavage. Increasing the power of an ultrasonic device increases the longitudinal oscillation, which maximizes the "chipping" or mechanical action of the insert. But increasing the power also increases aerosol formation, which results in reduced water cooling and cavitational effect, and can increase patient sensitivity. Cavitational activity alone can adequately detoxify subgingival plaque—the true enemy in periodontal disease. So if we are increasing the power, we are decreasing the detoxification capabilities.[27] Therefore, medium power settings are recommended for moderate to heavy debris removal, and lower power settings are recommended for light debris removal and deplaquing procedures. Chapple, et al., in a comparative study, determined that there was no difference in effectiveness of ultrasonics whether they were operated at full or half power. Therefore, to maximize patient comfort and to minimize aerosols, the power setting should rarely be placed above the medium setting.[12]

Along with power, operator technique when using an ultrasonic is crucial to effective debridement with minimal tissue trauma. A light pen grasp and fulcrum (either intraoral or extraoral) are used, since a light touch is all that is necessary, even for heavy calculus removal. Let the ultrasonic do the job it is designed to do! Excessive force is not necessary, and even prevents efficient removal of deposits. Increasing the pressure decreases the mechanical vibrations, which minimizes the "chipping" action and ultimately the effectiveness of the device. Applying the lightest amount of lateral pressure possible while still maintaining control of the instrument and proper adaptation of the tip is all that is necessary for deposit removal.

In the case of magnetostrictive ultrasonics, power is dispersed through several areas on the tip (Figure 10). The point of the insert tip is the most powerful surface. The concave surface (inner surface) is the second most powerful area, followed by the convex (back) surface. The least amount of energy is generated on the sides of the insert. By adapting the various surfaces of the insert (concave, convex, and lateral) to the tooth, the clinician can regulate energy dispersion and control patient sensitivity. To avoid root damage clinicians should use inserts on low power with light lateral pressure and tip angulation close to zero degrees.[28] The point of the insert should never be applied to the tooth at a 90º angle, which can result in gouging and root surface damage. Knowing which sides are the most powerful enables efficient deposit removal and maximizes patient comfort.

Two basic motions are used when using an ultrasonic device.[1] Woodall describes these as first, a "gentle tapping" or "chipping" motion against deposits to break them up. Remember, the lighter the pressure, the more effective the "tapping." The second motion is a "sweeping" motion to remove bacteria and detoxify the areas being treated. This is accomplished by continuous, back-and-forth, multidirectional overlapping strokes covering every millimeter of the tooth. Releasing the foot pedal periodically allows for aspiration of water and debris (Figure 11).

A common misconception leads some practitioners to use the tip like a curet, walking the first two-to-three millimeters around the gingival line. If probe depths are only two to three mil-

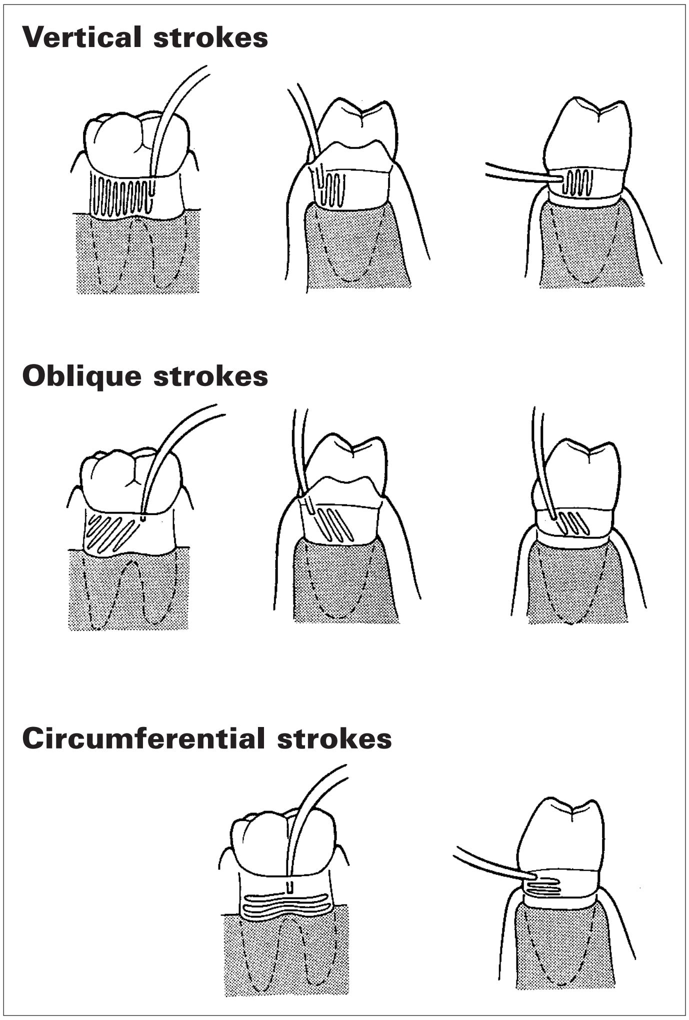

Figure 11. Example of strokes when using an ultrasonic.

limeters, and the purpose of using the ultrasonic is to remove debris that is present, this may be adequate. Ultrasonic tips are now shaped more like probes—use them like you would use a probe! Insert the tip vertically, parallel to the long axis of the tooth, as deep as the probe depth recorded (Figure 12). Walk the tip into the proximal surfaces, keeping the tip adapted to the tooth, keeping in mind the anatomy of the tooth. To ensure patient comfort, keep the tip moving at all times when in contact with the tooth. The maximum effect of the ultrasonic will be achieved if used in this manner.

Operator seating positions are typically the same as for hand instrumentation. The operator can be somewhat creative about seating positions, since a firm fulcrum and lateral pressure are contraindicated when using ultrasonics. Direct vision is preferred when using an ultrasonic, since indirect vision is compromised due to the mist of the irrigant interfering with the mouth mirror. Saturating the mouth mirror with water alleviates this problem somewhat, though it has to be repeated frequently. It is also very helpful if a dry two-by-two gauze square is used to hold the upper and lower lips when working in the maxillary and mandibular anterior regions of the mouth. This makes retracting the lip easier for the practitioner, and minimizes the spray of water on the patient.

Figure 12.

Ultrasonic tips do not last forever and should periodically be evaluated for wear (Figure 13). As the tip of the insert wears, scaling efficiency decreases. A good rule of thumb to follow is one millimeter of tip wear results in approximately 25% loss of efficiency. Two millimeters of wear results in approximately 50% loss of efficiency, and, at this point, should be replaced. Many ultrasonic tip inserts are accompanied by wear guides.

Conclusion

After clinical assessment and treatment planning, an armamentarium should be selected tailored to the individual needs of the patient. Ultrasonic instrumentation is proven effective and efficient in treating periodontal disease. When used properly, ultrasonics are kind to the soft tissues, require less healing time, and are less tiring for the operator. The combined use of ultrasonic and hand instrumentation is suggested to meet your patient's needs and to achieve the intended clinical results.

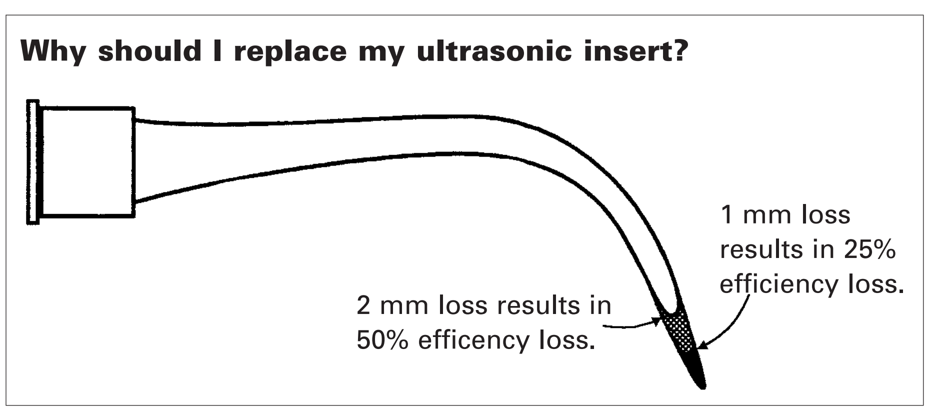

Figure 13.

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