Are You STAYING AHEAD of the Ultrasonic Curve?

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by Dani Botbyl, RDH

Dani Botbyl, RDH, is a leading authority in ultrasonic education who for the past 17 years has served as the national clinical educator with Dentsply Sirona Canada. Botbyl has developed and presented evidence-based educational programs specific to ultrasonics to dental hygiene students, pre- and postdoctoral dental students, faculty and practicing clinicians nationally and internationally. She has published numerous articles in industry and peer-reviewed journals. Her current research interests include the educational preparedness of dental hygienists for ultrasonic instrumentation.

Improving the removal and disruption of biofilm using ultrasonic instruments

Course description

This course details how ultrasonic scaling technology can be used for more than the removal of moderate to heavy calculus, and discusses how to implement contemporary ultrasonic practices to remove light calculus and to remove and disrupt biofilm.

Abstract

Today, ultrasonic instrumentation goes far beyond the removal of calculus; when used as part of modern debridement strategies, it can lead to better resolution or reduction of oral inflammation. Despite the benefits of ultrasonic instrumentation, clinicians continue to rely on the technology to remove calculus and are much less focused on using ultrasonics to remove and disrupt biofilm. Research shows that dental hygienists are not maximizing ultrasonic instrumentation in their practices, which limits their ability to help their patients improve their oral and overall health. This article will focus on best practice standards that will help clinicians improve the access or removal of biofilm and light calculus; the preservation of root structure; speed of treatment; and the wear rate of ultrasonic inserts and tips.

Learning objectives

After reading this article, participants should be able to:

1. List four aspects of ultrasonic instrumentation design that affect the removal of deposit and the preservation of tooth structure.
2. Discuss how ultrasonic instrument characteristics—length, diameter, cross section and shape—can improve the removal and disruption of biofilm and light calculus.
3. Define and state the clinical significance of vertical orientation and transverse orientation of ultrasonic instruments.
4. Discuss how instrument selection can be a cost-savings strategy for practices.
5. State the benefit of adapting the back of a curved ultrasonic instrument to furcations and concavities.
6. Discuss how the back and lateral surfaces of a curved ultrasonic instrument can be adapted for successful removal and disruption of biofilm and light calculus.

Introduction

Over the past several decades, ultrasonic technology and the evidence for its use have evolved beyond just the removal of calculus. Today, it provides greater utility subgingivally, including the use of thin, ultrathin, straight and curved ultrasonic instruments for removal and disruption of biofilm.

Essentially, ultrasonic instrumentation can now be categorized into traditional and contemporary approaches (Table 1).[1] Holbrook and Low ignited this more contemporary use of ultrasonics in the 1990s when they examined thin, straight and curved ultrasonic inserts for the negotiation of deep periodontal pockets.[2]

Soon after, Dragoo further explored this concept using left- and right-curved designs, and showed their superiority with better access to deep periodontal pockets.[3] These thin, curved inserts produced more effective removal of calculus *and* plaque, with the least amount of root surface damage when compared with hand instruments and traditional thick ultrasonic inserts.[3] Drisko's benchmark review article on ultrasonic technology for nonsurgical periodontal therapy further confirmed these findings.[4]

The research has also looked more closely at ultrasonic tip movement and there is compelling evidence showing how elements such as noise, water movement and bubbles have effects beyond mechanical removal of biofilm.[5–7] (Obviously, this "therapeutic" Jacuzzi cannot be created by hand instrumentation.) The development of thin, straight and curved ultrasonic instruments, along with "bubble" research, has perpetuated a shift toward ultrasonics as a first choice for periodontal debridement because of its perceived advantages[1,8–12] but most of today's clinicians aren't maximizing the contemporary ultrasonic approach.

Recent research suggests that dental hygiene programs within Canada and the United States are not keeping pace with the scientific evidence and continue to teach students how to use ultrasonics in the traditional manner—with a focus on calculus removal.[1,13,14] It appears that specifically thin and ultrathin straight ultrasonic instruments (USIs) and thin, curved USIs are underutilized or incorrectly used in clinical practice. Despite the benefits of curved USIs, a 2015 Canadian study suggests that approximately 85 percent of recent dental hygiene graduates do not use curved ultrasonic instruments after graduating.[1]

Admittedly, curved designs are less intuitive compared with straight designs, so many clinicians report a lack of knowledge and confidence with their use. This article is intended to help clinicians improve the implementation of USIs beyond the removal of moderate to heavy deposit, with an emphasis on the use of left- and right-curved instruments for enhancing the removal and disruption of biofilm.

Table 1: Comparison of traditional and contemporary ultrasonic approaches

TRADITIONAL	CONTEMPORARY
• Thick diameter inserts	• Thin or ultrathin diameter inserts; straight and curved designs
• Subgingival access limited	• Subgingival access is superior
• Moderate to heavy calculus removal	• Light calculus removal; focus on biofilm removal
• Instrument contacts calculus	• Instrument contacts cementum/dentin
• Medium to high power settings typical	• Low-medium power settings typical
• Basic level of knowledge/skill and short "time on task" to achieve competence	• Higher level of knowledge/skill and a longer "time on task" to achieve competence
• Complete debridement requires the use of hand instruments	• Complete debridement possible with ultrasonics
• Client/patient comfort challenging	• Client/patient comfort most usual

QUESTION

Once the moderate to heavy hard deposit has been removed or a maintenance patient presents with no moderate to heavy calculus, what is the best ultrasonic instrumentation strategy?

When treatment-planning best USI options, consider the following, in order:

- deposit type
- gingival condition
- root surface anatomy

For more details, see Fig. 1.

Evaluating the diameter, length, shape and cross section of a USI will help lead clinicians to think critically as they decide which USI is the best option for the debridement task at hand.

Diameter

When moderate-to-heavy calculus is not present, standard- or thick-diameter instruments can leave the game. When the USI active tip will directly touch root surfaces (and not moderate-to-heavy deposit), the best diameter choices are thin or ultrathin. Standard or thick instruments should be considered when the USI active tip is going to directly contact moderate-to-heavy hard deposit. Thin instruments directly touching root surfaces have a greater potential of preserving more root structure.[15]

In the presence of light calculus and biofilm, clinicians are often faced with deciding between thin and ultrathin USI diameters. If an instrument with a thin diameter design can be used, use it! Save ultrathin USIs for situations where thin USIs are too thick, such as: contact points, the CEJ or use in shallow pockets. The consistent unnecessary use of a USI with an ultrathin diameter will result in quicker instrument wear.

Although the removal of moderate-to-heavy calculus is not the focus of this article, it's worthwhile mentioning that the consistent use of thin- or ultrathin-diameter USIs on this category of hard deposit is an inappropriate use of the technology, yielding longer debridement times and quicker wear rates of the USI. Preservation of both the tooth structure and the active tip of an ultrasonic instrument should be objectives in modern periodontal therapy.

A USI active tip that's worn beyond acceptable levels may lead to poor debridement efforts and patient sensitivity. The general rule concludes that a USI should be discarded or recycled once 50 percent of its original active tip has been worn. To ensure safe, effective, efficient performance of USIs, check your instruments routinely using the efficiency indicator cards provided by manufacturers (Fig 2).

Length

Marrying the length of a USI with the depth of the pocket or the apical plaque border (APB) is likely as simple as it sounds. However, the orientation of the USI selected is a more complex concept. For improved subgingival access, including biofilm removal and cavitational activity, consider vertical

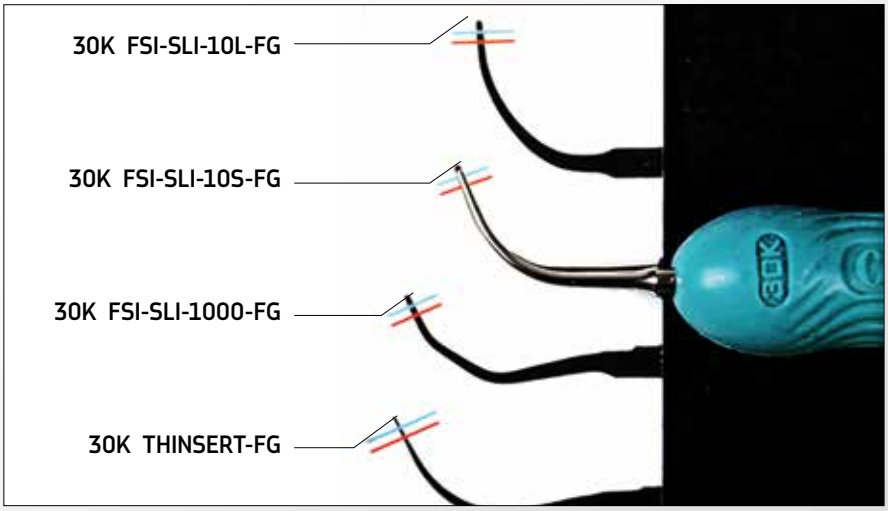
Fig. 1: Considerations for ultrasonic instrument selection

Deposit Type
- Moderate–Heavy Calculus
- Light Calculus
- Biofilm

Gingival Condition
- Tight/Firm
- Loose/Flabby
- Thick
- Thin

Root Anatomy
- Flat
- Contoured/Concave

Fig. 2: Ultrasonic wear indicator guide



orientation,[5] while transverse orientation is used primarily for supragingival debridement and to access contact points or deposit coronal to the CEJ (Figs. 3a–c).

Cross section

Another USI characteristic that needs to be examined closely is the appearance of the active tip in cross section. USIs are typically designed as either circular/cylindrical or rectangular/square (Figs. 4a–b). The rounded corners are the areas where the two edges meet and these offer a more concentrated area of energy that should be considered when the demand to remove hard deposit beyond light levels exists.

USIs with round cross sections have been shown to preserve more root structure;[15,16] therefore, when the focus of debridement is on biofilm or light calculus and the USI active tip may be in contact with cementum or dentin, choosing USIs with a slim diameter and a round cross section has advantages.

Shape

Lastly, and perhaps one of the most important considerations of contemporary ultrasonic implementation, is instrument shape, also referred to as tip geometry. An ultrasonic instrument may be straight or curved (semispiral). When comparing the active tip area of straight and curved USIs, it is vital to distinguish that a straight USI has a straight active tip, while a curved USI has an active tip with a curve or an arc (Figs. 5a–c).

When a debridement case does not present with moderate-to-heavy calculus (or any level of hard deposit), or when the moderate-heavy calculus removal phase has been completed and only light calculus and biofilm remain, a greater degree of contact is needed between the USI active tip and the tooth/root surface.[17] Furthermore, it is in the best interest of the reduction or elimination of inflammation for clinicians to go beyond visualizing the active tip merely *contacting* the tooth/root surface; to maximize biofilm removal and disruption, the clinician needs to visualize and command the active tip to *conform* to the surface being instrumented.

Examples of ultrasonic instrument orientation

Fig. 3a: Vertical orientation with a curved instrument.

Fig. 3b: Transverse orientation with a curved instrument.

Fig. 3c: Transverse orientation with a straight instrument.

Ultrasonic instrument cross sections

Fig. 4a: Round/cylindrical cross section with no rounded corners.

Fig. 4b: Square/rectangular cross section with rounded corners.

Figs. 5a–c: A comparison of ultrasonic instrument active tip areas. Note the convex surface of the curved instrument defined by the purple circle in Fig. 5c.

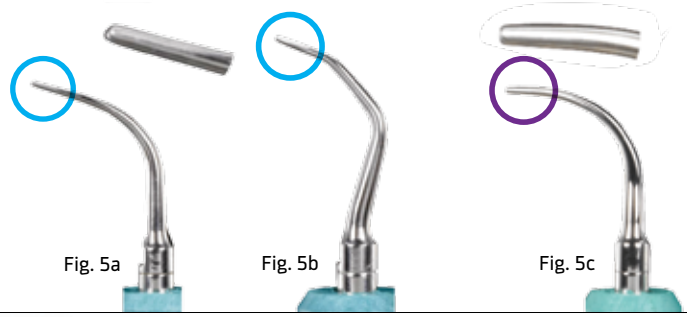


Fig. 5a Fig. 5b Fig. 5c

The arc on a curved USI is on the back surface of the instrument, and it should be noted that the lateral surface of a USI may not be the surface that best conforms to the anatomy of the site being debrided. In other words, the lateral surface of a curved or straight USI active tip may not have the same advantage as the back surface of a curved USI.

Currently, not all manufacturers of ultrasonic equipment recommend the use of the face, back and lateral surfaces of USIs. Historically, magnetostrictive technology such as Cavitron has offered clinicians the option of using all surfaces, while piezoelectric technology is more known for advising clinicians to specifically adapt only the lateral surfaces to maximize it. Clinicians would be wise to check the directions for use provided by the manufacturer of the equipment they are using. If a manufacturer instructs not to adapt the back surface of a USI during the treatment procedure, the clinician should contemplate the limited debridement possibilities of that specific technology or product, and perform technique accordingly.

PICTORIAL

CURVED ULTRASONIC INSTRUMENTS

Maximizing the benefits of any ultrasonic instrument is multifactorial. Instrument adaptation is certainly not the only key to success, but it is an important one. In the presence of biofilm or light calculus, it's important to not only contact the tooth or root with an instrument but also to strive to select an instrument that will conform to the tooth or root; our objective is to remove or disrupt as much etiology as possible.

Selecting the orientation of a curved instrument

To maximize subgingival access, the most upright *vertical* orientation is often needed (Fig. 6a); vertical orientation positioned more obliquely will not access the same depth (Fig. 6b). Note the differences in instrument point location to the yellow line of Figs. 6a and 6b. Transverse orientation (Fig. 6c) is used to access supragingival deposit and is especially effective to reach under contact points.

Vertical orientation: Selecting the correct curved instrument

The best insert choice for Q1 posterior buccal is a left-curved instrument. Note the incorrect orientation when using the right-curved instrument in this area. In vertical orientation, the point of the curved-right instrument (Fig. 7a) contacts the tooth surface. Continued subgingival penetration on the buccal surface of this tooth with this instrument would only lead to increased point-to-root contact.

An overwhelming advantage of curved ultrasonic instruments is the ability of the back convex surface of the active tip to conform to any concave tooth/root surface. Therefore, when deciding between a curved-right and -left insert, choosing the instrument whereby the back can adapt to the tooth/root surface (Fig. 7c) will improve access. In some areas, such as the distals of many posterior teeth, the back cannot physically be adapted. With these cases the lateral is the surface of choice (Fig. 7b).

Sequencing of a curved instrument

Subgingival access on buccal surface of maxillary right molar is best done with a curved-left insert. Using vertical orientation, place the curved-left instrument at the DB line angle (Fig. 8a). Work distally as far into the distal subgingival space as needed, based on the depth of pocket (Fig. 8b). With a goal of reaching the halfway point across the interproximal space, maintain as much of an upright vertical position (vertical orientation) as possible. Compromising the vertical orientation will compromise access.

Once debridement is complete in the subgingival distal space, work or position back toward the DB line angle (Fig. 8c), pass this line angle now instrumenting the direct buccal surface (Fig. 8d, p. 116). At the MB line

Disclosure:
The author declares that in the past 12 months she has had a financial interest, arrangement or affiliation within the field of dentistry or health care with Dentsply Sirona Canada.

angle (Fig. 8e), while maintaining vertical orientation, start to direct the ultrasonic instrument into the mesial subgingival space (Fig. 8f). Note: Ideal access of interproximal areas may require a slight oblique instrument position (Fig. 8g) but this change from vertical orientation should not be used until well past line angles. Failure to do so increases risk for poor access below the gingival margin interproximally.

Accessing a furctation using a curved instrument

The buccal furcation of the upper right maxillary molar is best done with a curved -left instrument. Unless the technology being used restricts clinicians to using the lateral surfaces only, there is an advantage to leading or contacting the tooth or root with the convex back when possible, because it conforms to the concave anatomy of the tooth or root. Depending on classification of furcation, tooth position and client-operator position, many combinations of the back and lateral surfaces may be options.

This series of images shows the back (Fig. 9a) and the lateral side (Fig. 9b) of the curved instrument leading into the dome of the furcation. During treatment, the clinician should keep the active 2–3 millimeters of the tip adapted and use a combination of suitable stroke types to debride as much of the dome that is exposed (Fig. 9c). Once the dome has been fully accessed, shift to the mesial surface of the distal root, adapting either the back or lateral surface of the curved instrument (Fig. 9d). The final required step is placement of the lateral surface of the curved insert on the distal surface of mesial root (Fig. 9e).

Conclusion

Modern debridement strategies have advanced beyond using ultrasonics only for the removal of calculus, and it is not enough to know our ultrasonic instruments by color. Clinicians must possess a solid understanding of USI design characteristics and strive to achieve confidence with curved -left/right ultrasonic instruments if they want to maximize ultrasonic technology for the disruption and removal of subgingival biofilm, conservation of the tooth structure, resolution of inflammation and efficiency. The effects of long-term, chronic inflammation stretch far beyond the oral cavity, and our patients can only benefit from the best technology has to offer when it is combined with the best clinical technique. ■

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1. The curved-left and -right ultrasonic inserts are designed and best suited to: (a) Adapt to convex root anatomy; (b) adapt to concave root anatomy; (c) remove biofilm and light hard deposit; (d) remove moderate-to-heavy hard deposit.

A. Only (a), (c) and (d) are correct.
B. Only (a) and (d) are correct.
C. Only (b) (c) and (d) are correct.
D. Only (b) and (c) are correct.

2. Correct adaptation is when the working end of an insert is positioned to conform to the morphology of the tooth surface. When correctly adapted, the entire length of the insert will be in contact with the root surface.

A. Both statements are true.
B. Both statements are false.
C. The first statement is true and the second statement is false.
D. The first statement is false and the second statement is true.

3. True or false? A curved-right ultrasonic instrument is best used on the patient's right side and a curved-left ultrasonic instrument is best used on the patient's left side.

A. True.
B. False.

4. Key characteristics that should be considered when selecting the most appropriate ultrasonic instrument for debridement are:

A. Length and diameter.
B. Length and shape.
C. Length, diameter and cross-section.
D. Length, diameter, cross-section and shape.

5. Where possible, adaptation of the back surface of a curved magnetostrictive ultrasonic instrument allows the clinician to achieve which periodontal debridement objective(s)? (a) To conform the convex surface of the instrument into concave surface of tooth/root structure. (b) Less risk of adaptation of the point of the ultrasonic instruments into the tooth/root surface. (c) Ideal access of the distal surface of mandibular and maxillary molars.

A. Only (a).
B. Only (a) and (b).
C. Only (b) and (c).
D. All of the above.

6. Which group of characteristics best describes contemporary ultrasonic instrumentation?

A. Thick instrument diameters, moderate-to-heavy calculus removal, instrument contacts cementum or dentin.
B. Thin or ultrathin diameters, focus on biofilm, instrument contacts cementum or dentin.
C. Thin or ultrathin diameters, focus on biofilm, debridement to completion not possible without the use of manual instruments.
D. Thick, thin or ultrathin diameters, focus on biofilm, instrument contacts cementum or dentin.

7. Which statement best describes how a clinician should determine which surface of a piezoelectric ultrasonic instrument is best to use to contact tooth, root, calculus or biofilm?

A. Assume the point, back, face and lateral surfaces are active.
B. Assume the lateral surfaces and point are active.
C. This will depend on how many millimeters of the instrument have worn.
D. Check the manufacturer's directions for use.

8. From the list below, choose the statement that is incorrect.

A. An ultrasonic instrument worn beyond the manufacturer's suggested level removes calculus just as quickly as an ultrasonic instrument that is not worn beyond the manufacturer's suggested level.
B. An ultrasonic instrument worn beyond acceptable levels can contribute to patient sensitivity.
C. Using a thin ultrasonic instrument on moderate-to-heavy calculus consistently can lead to quicker instrument wear/replacement.
D. Manufacturers recommend that once 75 percent of the original active tip of an ultrasonic instrument is worn, it should be replaced.

9. Choose the statement which best suggests the debridement rationale for the removal of light calculus and biofilm.

A. Straight thin or ultrathin instruments are always best suited for debridement of anterior teeth.
B. Straight thin or ultrathin instruments are always best suited for debridement of anterior teeth, and curved thin instruments are better suited for posterior teeth.
C. Straight slim instruments are the best choice for pockets 4mm or less on anterior teeth.
D. Regardless of the location (anterior or posterior) or the depth of the debridement site, root anatomy should guide the instrument selection process.

10. Conservation of the tooth/root surface is an objective of periodontal debridement. Manual instruments and ultrasonic instruments are equal in their ability to preserve root structure.

A. Both statements are true.
B. Both statements are false.
C. The first statement is true and the second statement is false.
D. The first statement is false and the second statement is true.

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Are You Staying Ahead of the Ultrasonic Curve?

by Dani Botbyl, RDH

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15.	Overall, I would rate this instructor (5 = Excellent to 1 = Poor):	5	4	3	2	1
16.	Overall, this course met my expectations	5	4	3	2	1

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