Instrumentation for Root Debridement

by Mary D. Cooper, RDH, MSEd and Nancy K. Mann, RDH, MSEd

Abstract
The clinical dental hygienist understands that the main purpose of instrumentation is to disrupt bacterial plaque biofilms mechanically. The challenge of instrumentation is minimal with a healthy periodontium, but debridement of root surfaces in a periodontal patient with > 4 mm pockets can be challenging. Knowledge of the root morphology of the dentition, with its concavities (developmental depressions) and furcations, will assist the clinical dental hygienist in the debridement of these areas. In addition, using instruments specifically designed for easier access will increase effective disruption of the biofilm.

Over the years, the understanding of plaque and its association with specific oral diseases has changed. Initially, calculus was believed to be the sole cause of periodontal disease. Its irritation of the soft tissues was believed the main reason for the destruction of the periodontium. At the time, it was not known that pathogenic bacterial biofilms were the main cause of periodontal disease. Later, researchers offered the “nonspecific plaque theory” to explain the cause of periodontal disease. This theory considered all plaque harmful and the cause of both gingivitis and periodontitis.

Soon afterward researchers identified “specific” plaque that caused periodontal disease. Although there are over 500 species of bacteria found in the microcosm of plaque, most are benign. Endotoxins produced from the lysis of gram-negative bacteria are responsible for tissue destruction. However, at that time clinicians’ main focus in nonsurgical periodontal therapy was to remove all calculus and plaque and instruct patients on proper home care. This old paradigm also included planing the root surfaces until a glassy hard surface resulted.

Current research supports the “host–bacterial interaction theory.” This theory maintains that not only are the pathogenic biofilms responsible for disease, but also the response of the host (patient). It is vital to attain a favorable host response in periodontal healing and repair. Pathogenic biofilms mainly found in pockets > 4 mm are resistant to antimicrobial agents and systemic antibiotics. The only effective, reliable means to disrupt these biofilms is mechanically. Effective disruption can be accomplished with a combined approach using manual and ultrasonic instrumentation to thoroughly cover all subgingival areas. With manual instrumentation, periodontal pathology is decreased through the removal of plaque and calculus. With ultrasonic instrumentation, the biofilm is completely disrupted because of the instrument’s cavitational effect.

Root Morphology
Patients with periodontitis are vulnerable to biofilms that are challenging to debride. A dentition with a healthy periodontium provides clinicians easy instrument access to areas surrounding the cementoenamel junction (CEJ). However, root surface morphology can challenge clinicians, especially when periodontal pockets are present.

Knowledge of root surface anatomy can assist clinicians in determining which instruments to use during the debridement process. Many teeth have developmental depressions on the roots. Most are found on proximal surfaces of anterior and posterior teeth as well as the facial and lingual surfaces of molars. Furcations only add to the challenge. On the maxillary molars, the average distance from the CEJ to the trifurcation is 3 mm on the mesial, 4 mm on the buccal, and 5 mm on the distal. In comparison, the average distance from the CEJ to the bifurcation on mandibular molars is 3 mm on the facial and 4 mm on the lingual. Instrumentation in these areas requires instruments with an extended Shank length, ideally an additional 3 mm. Extended Shank lengths for hand and ultrasonic instruments with thinner blades and tips are particularly useful in reaching deeper pockets.

A Choice of Instruments
Current trends in instruments for dental hygienists include a number of innovative changes in materials and design. Instrument companies are researching continuous improvements in metals, such as steel, which are harder and stay sharper longer. These technological improvements provide dental hygienists with an increased selection of instruments with thinner blades, which provide easier access into complicated root anatomy. Newer ergonomic handles have larger diameters made of lightweight materials with comfortable knurls.

Blending hand and ultrasonic instrumentation seems to be the most beneficial approach in treating periodontal patients. Selection of instruments depends upon the following factors:

- Severity of disease (mild, moderate, or severe)
- Pocket depth
- Tenacity of deposit
- Access to root anatomy
- Length of time of appointment
- Skill level of operator

Hand Instruments
The primary functions of instrumentation are to remove and disrupt subgingival biofilm and calculus. Proper instrument selection as well as application is essential to achieve these goals. Clinicians need to evaluate several instrument design features to successfully complete subgingival debridement. One feature is the width and thickness of the blade and tip. The appropriate blade and tip size should be determined by the area being instrumented. Clinicians need to review the clinical attachment loss, consistency of the tissue, amount of calculus, root morphology, furcations, and accessibility of the area. American Eagle Instruments Inc (Missoula, Mont, www.am-eagle.com) has developed XP technology that produces thinner-bladed curets.
with razor-sharp edges that remain sharp throughout debridement procedures and never require sharpening (Figure 1). The thinner blade designs allow clinicians greater access into narrow/tight periodontal pockets, developmental depressions, and furcations, resulting in a more thorough root debridement.

For deep pockets, the instrument’s shank and angulation should be evaluated to ensure it reaches specific areas. If the tissue is distended and loose, access will be easier to obtain than if the tissue is tight and fibrotic. The challenge for clinicians increases if residual calculus is embedded in deep pockets and furcations with tight tissues. Small, thin, sharp blades are essential to achieve not only access, but also removal of the calculus. Studies using periodontal endoscopes to view root surfaces with great magnification support the importance of complete calculus removal. This can be achieved by using curets or ultrasonic instrumentation.

The new thinner-bladed curets offer increased access into several areas including furcations, line angles, and deep, tight pockets on the facial and palatal surfaces. These curets are used with straight vertical as well as horizontal strokes when accessing the pocket or developmental depressions just below the CEJ. For maxillary furcations, the 7/8 Gracey curet offers the most versatility. For facial furcations, clinicians can use the 5/6, 11/12, or 15/16 Gracey curets for the mesial surfaces of the mesiobuccal and distobuccal roots. For the distal surfaces of these same roots, the Gracey 13/14 curet can be used (Figure 2). Table 1 details which instruments are best used on maxillary root surface anatomy. For mandibular facial furcations, clinicians can use the 7/8, 11/12, and 15/16 Gracey curets to debride the mesial surfaces of the mesial and distal roots. For the corresponding distal surfaces, use the 13/14 Gracey curet. For patients who cannot open wide, the 17/18 Gracey curet can be used for easier access on distal surfaces of molars. Table 2 details which instruments are best used on mandibular root surface anatomy.

### Table 1—Root Surface Anatomy: Maxillary Dentition

<table>
<thead>
<tr>
<th>Tooth</th>
<th>Root Morphology</th>
<th>Hand Instruments of Choice*</th>
<th>Ultrasonic Tips of Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral incisor</td>
<td>Deep lingual groove that extends on the root for part or all of its length</td>
<td>-Anterior Gracey curets, such as 5/6</td>
<td>Straight slim tip</td>
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<tr>
<td></td>
<td></td>
<td>-Diamond-coated file scalers</td>
<td></td>
</tr>
<tr>
<td>Canine</td>
<td>Developmental depressions at proximal surfaces; distal aspect more pronounced</td>
<td>-Anterior Gracey curets, such as 5/6 or 7/8</td>
<td>Straight slim tip</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Diamond-coated file scalers</td>
<td></td>
</tr>
<tr>
<td>First premolar</td>
<td>Developmental depressions and bifurcation</td>
<td>-Gracey curets, such as 5/6, 7/8, and 15/16</td>
<td>Straight slim tip</td>
</tr>
<tr>
<td>Molar</td>
<td>Deep developmental depression on the buccal; depression on distobuccal root; trifurcation</td>
<td>-Gracey curets, such as 7/8, 11/12, 13/14, 15/16, and 17/18</td>
<td>Straight and contra-angled slim tips</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Diamond-coated file scalers</td>
<td></td>
</tr>
</tbody>
</table>

*Gracey curets with prethinned, shortened blade length and width with extended-length shanks preferred.
In addition to curets, clinicians can use diamond-coated file scalers to debride the root surfaces with light, multidirectional strokes. Diamond-coated file scalers help remove embedded or burnished calculus and biofilm from deep pockets, developmental depressions, and furcations (Figure 3).

**Ultrasonic Instruments**

Evidence shows that clinical outcomes are the same whether hand or ultrasonic instrumentation is used for periodontal debridement. However, ultrasonic instruments are more efficient, require less labor, and increase convenience. Advantages include increased patient comfort, less fatigue for the patient and clinician, time savings, and complete biofilm removal.

The latest innovations in magnetostrictive ultrasonic insert designs include lightweight handles with larger diameters, thinner tips with various shapes, lighted working ends, and swiveling as well as soft-padded shanks. All of these features increase clinician comfort by eliminating hand fatigue. Some examples of these inserts include the Bellissima line (Dentsply Professional, York, Pa, [www.dentsply.com](http://www.dentsply.com)), Swivel Direct Flow (Hu-Friedy Manufacturing Co, Inc, Chicago, Ill, [www.hu-friedy.com](http://www.hu-friedy.com)), and the Protégé LED inserts (Discus Dental, Culver City, Calif, [www.discusdental.com](http://www.discusdental.com)).

It is important to note that tips wear over time. Complicated root anatomy cannot be accessed with inefficient tips. One millimeter of wear in the tip can result in a 25% loss of efficiency. Manufacturers make templates where tips can be measured for metal loss. It is recommended that the tips be compared regularly with the template to determine when they need to be replaced. Tips must be replaced after 2 mm of wear, which results in a 50% loss of efficiency.

Although magnetostrictive ultrasonic inserts are active 360° around the instrument tip, correct application of the insert increases scaling efficiency because the face, back, lateral surfaces, and point produce varying amounts of energy (Figure 4). The point of the tip produces the greatest amount of energy vibrations, which are so highly concentrated that contact with the tooth should be avoided. However, the tip can be placed directly on tenacious calculus to accomplish removal. The concave face of the tip produces the second greatest amount of energy vibrations. The back of the tip (convex surface) produces less energy than the face or the point. The lateral surfaces of the tip produce the least amount of energy vibrations. With piezoelectric tips, the energy lies in the lateral surfaces.

When scaling with an ultrasonic tip, remove calculus from the crown to the base of the pocket. This motion is opposite of hand instrumentation. The insert tip is placed into the pocket parallel to the tooth surface. Using the correct adaptation of the tip along with light lateral pressure and the proper power setting is essential. Applying these features enhances maximum scaling effectiveness especially when negotiating complicated root anatomy.

**Strokes**

In the past, hygienists were taught to use fast, haphazard strokes when performing ultrasonic instrumentation. However, slower, overlapping strokes have been shown to be more effective. An overlapping stroke pattern in small, methodical, vertical channels with a light touch on the root will help accomplish access into concavities and convexities. The tip should be kept in constant motion, but not necessarily moving rapidly. Slower strokes enable the energy needed to remove calculus to move from the terminal few millimeters of the tip to the hard and soft deposits. Removal of hard deposits will require standard-sized ultrasonic tips and a power setting between medium and high. Soft deposits, such as attached and unattached biofilm, including endotoxins, are
removed by the cavitation that occurs when water meets the vibrating tip. This disruption of biofilm increases healing in the pocket, especially in cases of advanced bone loss where spirochetes and motile rod counts are reduced.\textsuperscript{18}

**Adaptation**

Straight inserts/tips hinder access to curved surfaces. However, ultrasonic inserts are manufactured with curved shanks that bend to the right and to the left, allowing easier access into varying root morphology, especially in posterior teeth (Figure 5). One of the many challenges in periodontal instrumentation involves narrow furcation openings. More than half of the molars seen in clinical practice have furcation entrance diameters < 0.75 mm.\textsuperscript{18} Tips that are < 0.5 mm in diameter are needed for maximum access. The offset design of curved inserts allows access into furcation areas that are not possible with straight inserts/tips. Using an ultrasonic insert, place the convex surface of the insert against the tooth with the terminal shank parallel to the long axis of the tooth and the tip directed apically.\textsuperscript{13} Extraoral fulcums increase access capability and decrease pressure against the tooth. A traditional intraoral finger rest will inhibit the vibrations needed to remove deposits.

Before entering the pocket, activate the ultrasonic insert. The water supply will allow the insert to flow smoothly into the pocket. The inactive insert can be used as an explorer although tactile sensitivity may be decreased compared with using an 11/12 explorer. The use of multidirectional strokes is acceptable with ultrasonic instrumentation. Knowing the root topography will assist in choosing the best approach for each patient. As with hand instrumentation, every square millimeter of root surface should be covered.

**Conclusion**

The general consensus is that the use of ultrasonic instrumentation for gross debridement, with subsequent follow up with hand instruments, will enable clinicians to thoroughly remove tenacious calculus and biofilms that lead and contribute to periodontal disease. Hand instrumentation should include area-specific curets and diamond-coated file scalers designed to fit well into varying root anatomy. Extended length blades offer an additional 3 mm in the shank of the instrument and should be considered for more advanced cases requiring access into deep pockets. Curets with half of the traditional blade width are also available, providing for maximum root-blade contact and adaptation into root anatomy. These thinner-bladed curets should be used when instrumenting deep narrow pockets.

The latest generation of instruments offers dental hygienists increased efficiency, access to root concavities and furcations, thoroughness of debridement, and, most importantly, superior outcomes for nonsurgical periodontal therapy.

**References**


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