Detection of Sub-Gingival Calculus

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Introduction

The ability to reliably detect sub-gingival calculus is essential for effective debridement of periodontal pockets. It also helps the clinician know when to stop debridement so that cementum is not unnecessarily removed.

The conventional method of detecting sub-gingival calculus is tactile examination using a periodontal probe. This is however difficult for both novice and experienced clinicians and there is limited reproducibility of the results between various operators(Pippin and Feil 1992).

Over the last 20 years, researchers have attempted to come up with novel methods of detecting sub-gingival calculus that are more effective and reproducible.

They include:

A surface recognition device that discriminates dental calculus and tooth surfaces by mathematical analysis of reflected ultrasound waves(Kocher *et al* 2000).

Induced fluorescence emission of dental calculus using a 655-nm-wavelength laser-based technology(Folwaczny *et al* 2004).

Differentiating light reflected from tooth surfaces illuminated with a light emitting diode (LED) with a wavelength of 635 nm(Krause *et al* 2005).

Periodontal endoscope(Geisinger *et al* 2007)

None of the above commercially available methods have been taken off. Manual detection using the periodontal probe remains the common method for clinicians to detect sub-gingival calculus today.

To the author's best knowledge, there has been no detailed description of how to use the periodontal probe to detect sub-gingival calculus in the literature. This paper gives such a description.

Probes commonly used to detect sub-gingival dental calculus

Whilst the conventional method for detecting subgingival calculus is tactile examination using a periodontal probe(Pippin and Feil 1992 ; Sherman *et al* 1990), the Old Dominion University (ODU) 11/12 explorer and sharp caries explorer are also commonly used.

The ODU 11/12 explorer is a double end explorer with angles similar to the Gracey 11/12. In *in vitro* studies, it has been found that the ODU 11/12 explorer was more effective in detecting sub-gingival calculus 0.5 to 1 mm sub-gingival on a typodont model than the WHO probe(Rams and Manos 2021) as well as Differential Reflectometry(Rams *et al* 2017). It is inserted into the periodontal pocket in the same manner as one would use the Gracey's curette.

The tip of the ODU is 3mm long and has a very sharp point. One must be careful when inserting this instrument in the manner as one would use a Gracey's curette into the buccal and lingual/palatal pockets. The sharp tip is likely to lacerate the soft tissue. This same risk applies when one inserts this sharp instrument into a deep pocket.

The ODU 11/12 explorer is therefore a useful instrument to check for calculus 0.5 to 1mm sub-gingivally at the inter-dental areas, but not ideal for use at the line angles, as well as on the buccal and lingual surfaces of roots.

The sharp caries explorer probe is also commonly used. There is an assumption that the sharp tip makes it more sensitive to feel for surface roughness. The clinician can easily check if this assumption is true by comparing for himself/herself the feel of a sharp probe vs that of a periodontal probe on either a tooth or on any convenient surface.

In my experience, for dental undergraduates who I asked to do this simple test, the majority find no difference between using the sharp tip of the explorer and the blunt tip of the periodontal probe. The length of working end tip of most sharp caries explorers is less than 10mm, which makes it more difficult to access the root surfaces of deeper pockets.

The use of sharp probes has been shown to cause irreversible damage on enamel surfaces(Ekstrand *et al* 1987 ; Kühnisch *et al* 2007). Even in the hands of experienced clinicians, there is risk that the sharp tip of the caries explorer

can cause damage to the cementum when used to check for calculus on cementum as well as to the periodontium when inserted into the base of the periodontal pocket.

This author's preference is the periodontal probe, in particular the UNC-15. The periodontal probe is designed to be used safely in the periodontal pocket. The UNC-15 has a long enough working length to access even into deep pockets of up to 15mm.

In addition, the Nabers Probe is a useful probe to feel for calculus in furcation areas.

What does calculus feel like with the probe?

The first step to being able to detect dental calculus with a probe is knowing how it feels like.

In the past, where clinicians carried out root planing instead of root debridement, it may be sufficient to assume that any surface that does not have a "glass like" smoothness and hardness to it is calculus/diseased cementum complex and requires further planing until one feels the smooth hardness of dentine.

This is no longer the case.

What calculus feels like with the probe depends on the morphology of calculus present.

Calculus can have a surface topography like a craggy mountain range (figure 1). The surface could be burnished during root debridement and even feels smooth on the tactile examination, like a hump or bump (figures 2 & 4). If a root surface is covered with a layer of calculus, it could feel uneven (figure 3). If small specks of calculus are left on the root surface, it could feel like small protrusion on a flat surface (figure 4). A very mineralised sheet of calculus could have a surface that feels like sandpaper (figure 4). Cementum feels like smooth plastic.

Angle and movement of the periodontal probe on the root surface

The periodontal probe should be angled slightly against the root surface (figure 5) compared with how it is normally angled while using it to check probing pocket depths. This slight angulation allows the clinician to glide the tip of the probe along the root surface for tactile feel.

The movement should be either downwards, upwards and a slow up and down. The probe tip should always be in

Figure 1 Calculus can have a surface topography like a craggy mountain range.

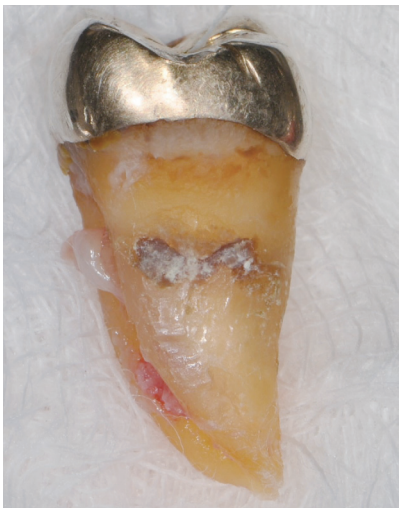


Figure 2 Calculus can feel like a hump or bump.

Figure 3 If a root surface is covered with a layer of calculus, it could feel uneven.

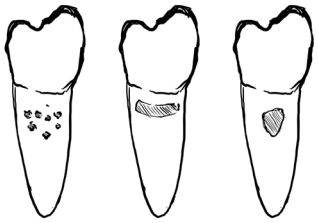


Figure 4 Calculus feel like small protrusions on a flat surface, a hump or like a sheet of sandpaper.

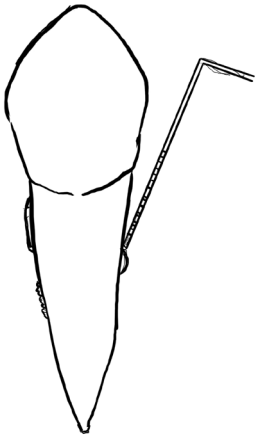


Figure 5 The periodontal probe should be angled slightly against the root surface such that the tip of the probe is in light contact with the tooth.

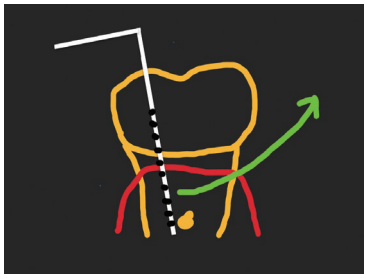


Figure 6 The probe can also be moved in a diagonal sweeping manner beneath the contact area to cover all the root surfaces.

contact with the root surface to pick up any catch, bumps, small protrusions or surface roughness.

Dental calculus often forms parallel to the cemento-enamel junction. The movement of the probe should therefore not be a lateral one as the tip of the probe could run on the crest of a calculus hump and it will feel smooth and regular. It is only by running the probe downwards and upwards along the long axis of the tooth that the bump/hump of the calculus can be picked up by the probe.

When the probe is run downwards along the root surface into the pocket and hits an obstruction that feels hard, many inexperienced clinicians may stop probing further downwards and think that the probe has reached the base of the probing pocket. The base of the probing pocket is made of connective tissue and offers a soft resistance, not a hard obstruction. This hard obstruction the probe feels is dental calculus, and the clinician should run the probe over the calculus, which often feels like a hump or craggy mountain top, until the probe navigates beyond the calculus deposit.

A feather-light touch pressure should be applied when running the probe along the root surface. The probe should be controlled with finger movements rather than using the wrist, which would give better control and tactile feel.

Buccal, lingual and line angles

For the buccal and lingual surfaces of the roots, the periodontal probe should be used as described above in a downward and upward movement along the long axis of the tooth. The probe should also be placed at the line angles of the tooth and moved in an up and down direction along that line.

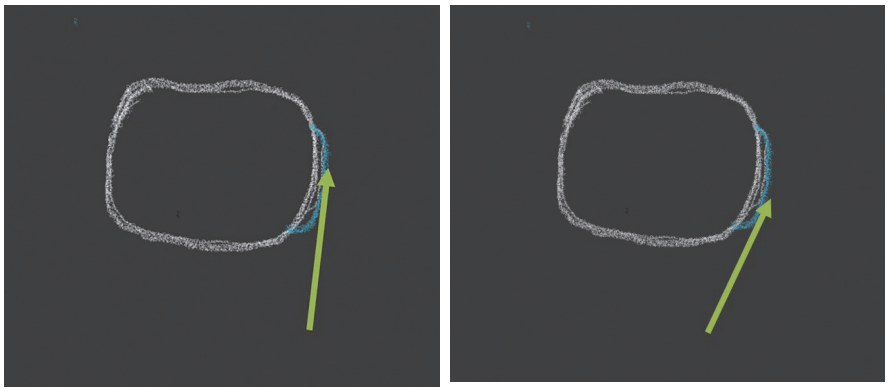
Interdental areas

At the interdental areas, the probe can also be used in an up and down direction as above. However, because of the contact area between two adjacent teeth, the probe has to be moved in a diagonal direction in order to examine the area of the root beneath the contact point (figure 6). In addition to an up and down movement, the probe can also be moved in a sweeping manner to try to examine all the root surfaces (figure 6).

The probe can also be positioned perpendicular to the long axis of the tooth to be inserted into the interdental space, and the side of the first 2mm of the working tip can be used to detect calculus. Because the tooth is not flat but a curve, it is important that the probe is continually adjusted as it moves from the line angle towards the contact area so that the probe is constantly positioned tangential to the curvature of the tooth, so that the sides of the probe tip is always in contact with the tooth (figures 7 & 8).

Furcations

The Nabers Probe can be used to access and feel root surfaces within the furcation which the periodontal probe is unable to reach.



Figures 7 & 8 Because the tooth is not flat but a curve, it is important that the probe is continually adjusted as it moves from the line angle towards the contact area so that the probe is constantly positioned tangential to the curvature of the tooth, and the sides of the probe tip is always in contact with the tooth.

Using visual with aid of magnification

With the aid of a high enough magnification (4x magnification) this author has also found that it is often possible to see sub-gingival calculus by pushing the gingiva slightly away from the tooth with the scaler tip while using an ultrasonic instrument. The water irrigation from the scaler helps flush away blood and keeps the field clean to assess the root surface visually.

Conclusion

Checking for sub-gingival calculus with the periodontal probe is like a golf swing. In the golf swing, the minor details matter. Likewise, the minor details of how to move the probe and keep the tip of the probe in contact with the root surface matter.

They both seems simple and intuitive but are not. Both the golfer and the clinician will benefit from clear instructions. The golfer can eventually 'feel' the strike of the ball with hours of practice, and the competent clinician the awareness of the presence of sub-gingival calculus.

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