Chapter 4 Scaling and Root Planing

INTRODUCTION

Ever since Loe demonstrated the role that plaque plays in the development of gingivitis (Loe et al., 1965; Theilade et al., 1966) there has been an emphasis on plaque removal as the primary goal of non-surgical periodontal therapy. With the confirmation that microorganisms are involved in the initiation and progression of periodontal infections, studies have examined the efficacy of various modalities of treatment to eliminate or suppress these microorganisms and reverse the inflammatory changes or damage to the periodontium. Manual scaling and root planing (SRP) are considered the basis of periodontal treatment and as such are often the control to which other modalities are compared. This chapter provides an evidence-based understanding of what can and cannot be achieved with scaling and root planing and how its effectiveness can be optimized.

Scaling refers to the removal of hard and soft deposits from the crown and root surfaces. Root planing denotes the removal of cementum and dentin that is rough or impregnated with bacteria, endotoxins, and calculus to produce a root surface that is smooth and hard. SRP can be performed as either a closed or open procedure. An open procedure differs from a closed one in that it denotes reflection of the gingival tissues, allowing direct visualization of the root surface—this is also known as surgical scaling.

The general purpose of SRP is to reduce or eliminate plaque-associated gingival inflammation (Figure 4.1). Specifically, this is achieved by mechanical instrumentation of the affected root surfaces. The result of this instrumentation is a reduction of bacterial plaque via disruption and/or removal of the microbial biofilm, the removal of accretions from the root surface, and ultimately a shift in the ecology of the pocket from one that favors disease to one that is conducive to health.

Instruments that can be used for scaling can be either manual or power-driven. Power-driven types can be sonic or ultrasonic, rotating instruments such as fine-grained diamonds, reciprocating instruments represented by the Profin Directional System, or lasers. The most commonly used and studied instruments for mechanical debridement are manual scalers and sonic or ultrasonic scalers.

INSTRUMENTATION

Manual Scalers

All manual instruments have three sections: (1) the handle, (2) the shank, which can have bends, and (3) the working end or blade (Figure 4.2). The various scalers differ primarily in the number and angle of bends at the shank, and the shape, curvature, and number of cutting edges at the blade. There are five major classifications: sickle, curette, file, hoe, and chisel. The most commonly used are the sickle and curette. The design of a sickle scaler enables it to be used effectively for supragingival calculus removal, while curettes are better suited for subgingival application.

The working end of a sickle scaler is triangular in cross-section, coming to a point at the tip. The blade faces up and is angled 90 degrees to the terminal shank with cutting edges on both sides of the face. This shape facilitates removal of heavy calculus and access to the area associated with the gingival embrasure and the proximal contact, which can be quite narrow. It is also very useful as an initial instrument to remove large, heavy deposits of supragingival calculus, thus improving access to the subgingival areas with the curettes. While sickle-type scalers are very effective at supragingival sites, they are not designed to be used at subgingival sites because the sharp tip can easily traumatize gingival tissues and gouge the root surface. Furthermore, the blade shape does not adapt well against the often concave, subgingival root anatomy (Figure 4.3).

Accessing the complex subgingival anatomy and minimizing damage to the delicate sulcular tissues is better achieved with curettes. Curettes are subdivided into two types, universal and Gracey. The main difference is that Gracey curettes are area specific; this specificity is realized via differences in the working ends. Gracey curettes have bends in the shank to facilitate access to either of the four sides of a tooth: mesial, distal, oral, or facial. In addition, the face of the blade is angled down 120 degrees to the terminal shank and only the lower side of the blade is sharpened. Thus, the Gracey 11/12 curette is designed to scale only the mesial surfaces of molars and premolars, while the Gracey 13/14 is specific to the distal surfaces (Figure 4.4). On the other hand, the universal curettes are not area-specific; the same instrument

Figure 4.1. One month follow-up demonstrating resolution of gingival inflammation after scaling and root planing.

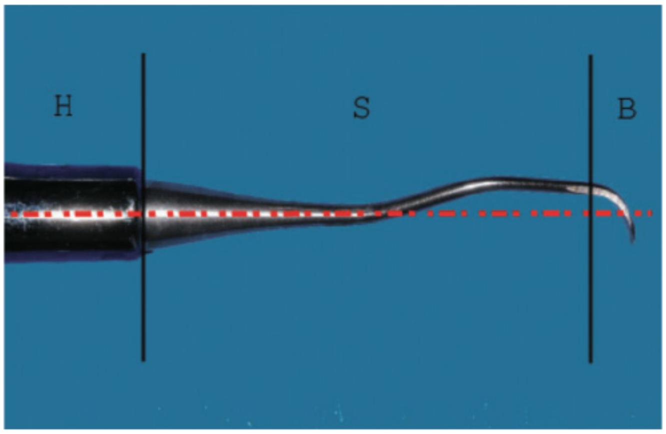

Figure 4.2. Scaler design. H: handle, S: shank, B: blade. Note that the blade is centered to the handle for ideal force transmission.

can be used anteriorly or posteriorly and for any of the four sides of the tooth. This is because both sides of the blade are sharpened and the angle of the face to the terminal shank is 90 degrees (Figure 4.5). Neither is objectively better than the other and thus operator preference based on an understanding of the instrument's design and the dental anatomy being scaled determines which instrument is best for any particular circumstance.

Power-driven Scalers

Power-driven scalers are classified as either sonic or ultrasonic; the ultrasonic variety are sub-classified as magnetostrictive or piezoelectric. They are broadly distinguished

Figure 4.3. Contrast between the sharp tip of a sickle scaler (above) and the rounded toe of a curette (below).

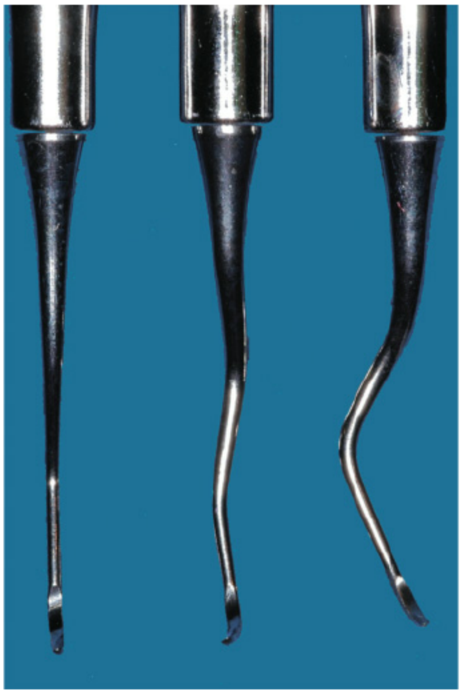

Figure 4.4. Series of Gracey scalers from left to right: 1/2 (anteriors), 11/12 (mesial of posteriors), and 13/14 (distal of posteriors). Note the increasing angle of bends in the shank to allow access to more posterior sites.

according to the type of tip movement and tip vibration frequency. The sonic scalers operate at low frequencies ranging from 3,000 to 8,000 cycles per second (Cps) with a tip movement that is generally orbital, while both types of ultrasonic scalers operate at much higher frequencies. The magnetostrictive range is from 18,000 to 45,000 Cps with an elliptical tip movement, while piezoelectric units have a Cps in the 25,000 to 50,000 range and a tip movement that is generally linear.

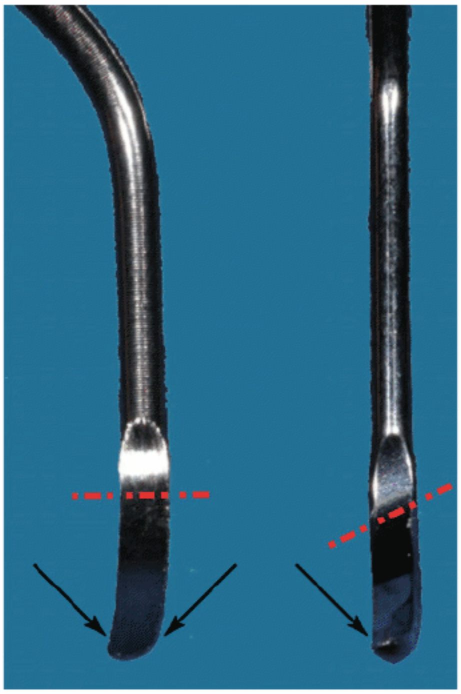

Figure 4.5. Key differences in blade design between universal and Gracey curettes. Universal: the face of the blade is 90 degrees to the shank (red dotted line) with both sides sharpened (arrows). Gracey: the face is angled 120 degrees to the shank (red dotted line) with only the lower side of the blade sharpened (arrow).

Sonic and ultrasonic instruments were originally only used for supragingival plaque, calculus, and stain removal. They were found to leave an uneven root surface, and thus it was thought that manual root planing was required following ultrasonic scaling to smooth the root surface. Over the years, there have been many modifications in the instruments, including smaller tip diameters, longer working lengths, different angles, and diamond coatings. These developments, along with a better, evidence-based understanding of the root surface alterations, has allowed powered scalers to be used safely and effectively in deep subgingival probing depths and difficult anatomy such as furcations, without having to be supplemented with subsequent manual instrumentation.

It should be noted that manual and sonic/ultrasonic scalers are used in a very different manner. The blade of a curette is inserted within the sulcus apical to the deposit at the base of the pocket. The calculus is then engaged and removed as the scaler is pulled coronally out of the sulcus. On the other hand, sonic and ultrasonic scalers engage the deposit at its coronal extent. The instrument is inserted within the pocket like a dental probe, with the working end parallel to the root surface and the tip pointing into the sulcus. Calculus is removed with multiple, light apically directed strokes. It is beyond the scope of this chapter to discuss how each instrument is used and maintained. However, it should be understood that all scalers are technique sensitive. It is critical that the clinician be fully aware of an instrument's design and its proper use because incorrect application of a scaler will result in poor calculus removal and damage to the root surface or gingival tissues.

Manual vs. Power-driven Scalers

The advances in ultrasonic and sonic instrument design and the expansion of their use to subgingival sites has resulted in a body of literature that compares their effectiveness with hand scalers. These studies have examined the efficacy of the debridement to bring about improvements in clinical endpoints such as probing depth and bleeding on probing, as well as shifts in the microbiological profile of the sulcus. Researchers have also considered alterations to the root surface and whether there is any advantage with powered scalers in accessing difficult anatomy or reducing the time required to effect this debridement.

Clinical Endpoints

Generally, the studies show that there is no statistical difference in clinical endpoints such as reduction in bleeding on probing, pocket depth reduction, attachment level gain, and reduction in sites with plaque (Loos et al., 1987; Badersten et al., 1984; Copulos et al., 1993; Boretti et al., 1995; Laurell and Pettersson, 1998). The reduction in probing depths with sonic or ultrasonic instruments ranges from 1.2 mm to 2.7 mm (Drisco et al., 1996). This compares favorably with the reductions achieved with manual scalers of 1.29 mm to 2.16 mm (Cobb, 1996). The microbiological changes are related to the clinical outcomes. Here, as well, there does not appear to be a clear difference between the two types of debridement; both treatments result in similar shifts in the microbial flora (Baehni et al., 1992; Oosterwaal et al., 1987).

Access to the Base of the Pocket or Difficult Anatomy

In relation to the similarity in clinical and microbiological endpoints achieved, it should be noted that in their systematic review, Tunkel et al. point out that most studies comparing powered and manual scaling are either done on single-rooted teeth or they group the results of single- and multi-rooted teeth, and that more research is required to assess the efficacy of powered instrumentation on multi-rooted teeth (Tunkel et al., 2002). In this regard there is evidence that suggests that ultrasonic instruments have an advantage over hand scalers for the debridement of furcations (Leon et al., 1987; Oda et al., 1989). These studies have found that both types of instruments are equally efficacious in Class I furcations, but in Class II and III situations the ultrasonic scalers are more effective. If one considers that anatomical studies have found that the entrance to a furcation is often smaller

Figure 4.6. The smaller tip size of an ultrasonic scaler (left), designed for access into a furcation, contrasted with a curette (right).

than the width of a curette (Bower, 1979), then it is not surprising that specialized ultrasonic tips with widths of 0.55 mm or less would have an advantage (Figure 4.6).

Other modifications of ultrasonic tips are designed to allow improved penetration into the base of deep pockets. These tips, which are slimmer and probe-like in shape, can reach closer to the base of the pocket (0.78 mm) than manual curettes (1.25 mm) (Dragoo, 1992). This result was confirmed recently by Barendregt et al., who also found that ultrasonic tips penetrated deeper, particularly in moderate (4 mm to 6 mm) and severe (≥7 mm) pockets (Barendregt et al., 2008).

In both of these papers, the greater penetration depth for ultrasonic scalers was on untreated periodontitis patients. The relevance of this point is highlighted by the Barendregt paper, which found that unlike the results observed for the periodontitis group, the maintenance group (less inflamed gingival tissue) showed equal penetration depth for manual curettes and ultrasonic instruments. It is likely that in the periodontitis group some of the greater depth reached by the ultrasonic scaler could be explained as ingress of the ultrasonic tip through the epithelial attachment and into the connective tissue. This has been observed when using a periodontal probe to measure pocket depth in inflamed tissues where the difference in probing depths between treated and untreated pockets amounted to approximately 1.2 mm (Fowler et al., 1982). Even if all of the deeper access cannot be explained by connective tissue invasion, it has yet to be established if greater penetration translates to improved calculus and plaque removal.

Where studies have shown clear differences is in the time required to clean the root surface. A review of the evidence indicates that manual instrumentation takes 20% to 50% longer to achieve the same clinical results as with powered scaling (Cobb, 1996).

Surface Roughness and Cementum Removal

Since the introduction of sonic/ultrasonic instruments there have been investigations to determine if these instruments remove less or more root surface than hand scalers, as well as the smoothness of the resultant surface. Recent evidence suggests that ultrasonic scalers remove less cementum (Vastardis et al., 2005; Ritz et al., 1991) but leave a rougher surface than curettes (Kocher et al., 2001; Schlageter et al., 1996). However, as will be discussed later, the clinical significance of a rougher surface has yet to be elucidated. Irrespective, sonic and ultrasonic instrumentation can result in excessive cementum removal if used improperly. Increasing instrument pressure, contact time, or tip to tooth angle can all cause more root damage. In this regard it has been suggested that the ultrasonic scaler be used at low or medium power with multiple, *light* overlapping strokes and with the tip angled parallel to the root surface (Flemmig et al., 1997). The importance of light strokes is underlined by a study which found that increasing the application force from 0.3 N to 0.7 N resulted in a twofold increase in root surface loss (Jespen et al., 2004).

Summary

In general, studies have found that a comparison of clinical endpoints shows manual and power-driven instruments to be equally effective. Thus, if the desired therapeutic outcome is reduction in inflammation, reduction in probing depth, and removal of root surface accretion, then either manual or powered instruments can be used. Despite these findings, powered scalers demonstrate some advantages, particularly with respect to time efficiency and access to challenging root anatomy. It remains to be seen if continued advances in tip design and ultrasonic energy generators will further improve the efficacy of these instruments.

SCALING AND ROOT PLANING

Objectives

As indicated above, effective scaling and root planing can be achieved by either powered or manual instrumentation. Although advances in technology may engender advantages to one instrument or the other, the focus of the therapy remains constant: the primary objective of mechanical non-surgical therapy is the removal of bacterial plaque from the tooth surface. This is affected by removal of the soft microbial biofilm on the root surface as well as the hard accretions or calculus that harbor bacteria within their structure. With this mechanical reduction or disturbance of the microbial community, we expect resolution of the inflammatory changes in the tissues of the periodontium, which in turn precipitate a change in the local environment of the sulcus from one that supports inflammatory destruction to one that is conducive to the maintenance of periodontal health.

To gain a holistic understanding of mechanical non-surgical therapy we need to consider not only the response of the periodontium to our hygiene efforts but also the factors that modify this response. In this way we can better optimize our results as well as understand the limits of and limitations on this form of therapy.

Changes in Clinical Endpoints

The most common endpoints used to evaluate the clinical outcome of mechanical therapy are probing pocket depth and clinical attachment level. Although there is only a weak correlation between bleeding on probing and continued disease activity (Lang et al., 1990), decreases in the percentage of bleeding sites continue to be considered a surrogate indicator for the resolution of gingival inflammation. In this regard it is useful to note that collectively, studies investigating all forms of mechanical therapy show reductions in gingival inflammation by 45% in 4-mm to 6.5-mm pockets (Cobb, 2002). In addition, this resolution of inflammation is affected largely by subgingival instrumentation, with supragingival plaque control alone providing little or no benefit (Cobb, 2002).

Many researchers have investigated the effect of scaling and root planing on probing depth and clinical attachment level. Cobb conducted a review of these papers and presented the results of the collective data reported in these studies (Figure 4.7). He found that in sites with initial probing depths of 1 mm to 3 mm there was a pocket depth reduction of 0.03 mm with a loss in clinical attachment of 0.34 mm. At sites measuring 4 mm to 6 mm the probing depth reduction was 1.3 mm with a gain of 0.55 mm in the clinical attachment level. The greatest improvements were gained at pocket depths ≥7 mm with probing depth reductions of 2.16 mm and gains in the clinical attachment level of 1.19 mm (Cobb, 1996). A systematic review by Van der Weijden reported that in sites measuring ≥5 mm the reduction in probing depth was 1.18 mm with an attachment gain of 0.64 mm (Van der Weijden et al., 2002). Both studies found that the effect of treatment on clinical outcome measures was related to the initial pocket depth; improvements in sites with initially deeper probing depths were greater than in those that were initially shallower. They also found that half of the decrease in probing depth could be attributed to attachment gain and thus the remaining decrease was the result of a change in the gingival margin position.

Image not available in the electronic edition

Figure 4.7. Summary of pocket depth and attachment level changes following SRP.

As a caveat, it should be noted that in many of the classic scaling studies very proficient clinicians spent 10 minutes or more per tooth. Thus, the gains achieved represent an ideal result rather than the usual clinical reality, in which considerably less time is spent and possibly with less proficient operators. Additionally, most studies group molar and non-molar sites. There is limited evidence to suggest that the improvements obtained at multi-rooted furcation involved teeth with probing depths measuring ≥4 mm are less than those achieved at single-rooted teeth (Kalkwarf et al., 1988; Claffey et al., 1990; Loos et al., 1989). In these studies pocket depth changes at moderately deep sites (4 mm to 6 mm) ranged from 0 to 1.02 mm, and at deep (≥7 mm) sites the range was 0 to 1.52 mm, which is considerably less than the 2.16-mm decrease observed when all teeth are grouped.

Microbiological Changes

In general, studies show that subgingival debridement results in a decrease in gram-negative microbes with an accompanying increase in the numbers of gram-positive cocci and rods. This shift in the composition of subgingival plaque from one with many pathogenic bacteria to one dominated by beneficial species usually results in a decrease in gingival inflammation, resulting in an improvement in clinical outcome measures such as pocket depth and bleeding on probing (Cobb, 2002).

Cugini et al., in a recent study using DNA probe counts, found that SRP resulted in decreased prevalence and levels of *Porphyromonas gingivalis*, *Tannerella forsythensis*, and *Treponema denticola*. This decrease in pathogenic species was concomitant with an increase in prevalence and levels of beneficial species such as *Actinomyces* species, *Fusobacterium nucleatum* subspecies, *Streptococci* species, and *Veillonella parvula*. It should be noted, however, that while SRP appeared to be effective in lowering the numbers of selected periodontal pathogens, none of these species was completely eliminated from any subject by this therapy. Another important observation is that SRP was only effective in reducing a specific subset of the subgingival microflora. Specifically, reductions in pocket depth were most strongly associated with decreases in *Tannerella forsythensis*, which suggests that individuals with non-susceptible (to scaling) species or low numbers of susceptible pathogenic species would experience limited benefits from non-surgical mechanical treatment (Cugini et al., 2000). This finding correlates well with a number of other studies (Mombelli et al., 2000; Haffajee et al., 1997; van Winkelhoff et al., 1988; Shiloah et al., 1994) that have found that *Actinomyces Actinomycetemcomitans* and *Porphyromonas gingivalis* are more resistant to removal by non-surgical mechanical means and that the persistence of these bacteria has been associated with poor response to scaling and root planing.

To better understand these findings it is useful to know that bacteria exist at three areas within the pocket: the tooth surface, on and within the gingival tissues of the sulcus wall, and in planktonic form in the pocket space between the tooth and sulcus wall. It may be that the ability of particular bacteria to invade the gingival tissues allows them to evade removal by mechanical means.

Another limitation in microbiological changes is pre-treatment pocket depth. Haffajee et al. found that although the greatest reduction in counts of periodontal pathogens was found at deep (greater than 6 mm) sites, the counts at all time points (three, six, nine, and 12 months) were always higher in deep sites than at the shallow sites (less than 4 mm). Deep sites continue, even after treatment, to be an environment conducive to certain pathogenic bacteria (Haffajee et al., 1997). Thus, gingival health does not necessarily follow thorough debridement. In this regard, Haffajee et al. reported that mechanical non-surgical therapy resulted in improving clinical parameters only 68% of the time and that 32% of the time there was no benefit.

Additionally, it should be noted that the shifts in the microbial flora are transient, particularly in pockets with residual probing depths of ≥6 mm, with reestablishment of a pathogenic microflora at varied time points depending largely on the frequency of supportive periodontal therapy and proficiency of oral hygiene. Various mechanisms have been proposed for the transient character of this shift, including re-colonization from other intra-oral niches such as tongue and mucosa (Quirynen et al., 1999), re-colonization from tissue-invading bacteria, particularly *Actinomyces Actinomycetemcomitans* and to a lesser extent *Porphyromonas gingivalis* (Cugini et al., 2000), high post-treatment plaque levels due to incomplete eradication of the pathogenic bacteria (Sbordone et al., 1990), and the level of patient oral hygiene (Sbordone et al., 1990).

Efficacy of Plaque and Calculus Removal

A review of the literature indicates that although scaling and root planing is effective for the reduction of plaque and calculus, it cannot affect the complete removal of deposits. Rather, what we find is varying degrees of success in producing calculus-free teeth depending on a variety of factors. Variables that have been investigated are: (1) initial probing depth, (2) surgical access, (3) furcation involvement, (4) level of operator training, and (5) manual vs. machine-driven scalers.

The most significant limitations on the residual amount of plaque or calculus following mechanical therapy are the depth of the pocket and furcation involvement. Although studies demonstrate a wide range of residual calculus left on roots, from 5% to 80%, the general trend is that as probing depth increases the effectiveness of mechanical debridement diminishes. In probing depths measuring 3 mm or less there is a good chance of removing all of the subgingival plaque. But in pocket depths ranging from 3 mm to 5 mm, the chance of failure to completely debride the root exceeds the chance of success. Furthermore, in pockets measuring 5 mm or more, failure becomes the dominant result (Stambaugh et al., 1981; Rabbani et al., 1981).

Studies investigating the concept of visualizing the root surface to improve the efficacy of scaling and root planing have found that surgical (open) access allows the operator to be much more effective in achieving calculus-free teeth but only in ≥4 mm depths. In shallow pockets of less than 4 mm, non-surgical debridement is as effective or only slightly less effective than surgical debridement (Brayer et al., 1989; Buchanan et al., 1987; Caffesse et al., 1986). Nevertheless, even with direct visualization, scaling efficacy was reduced with increasing pocket depth. Furthermore, most of the residual calculus was found in grooves, fossae, and furcations (Caffesse et al., 1986). Together, these observations suggest that root anatomy has a significant influence on the thoroughness of debridement.

The effect of anatomy on treatment results was also investigated by Wylam et al., who found that although the effectiveness of scaling and root planing on multi-rooted teeth was significantly improved with open access over closed (54.3% vs. 33%), if the results were restricted to an examination of the furcation areas there remained heavy residual calculus regardless of the type of access. In addition, increased time spent did not correlate with improved calculus removal (Wylam et al., 1993). Fleischer also found that even with open access difficult areas such as furcations often had more residual calculus than other surfaces after scaling and root planing (Fleischer, 1989).

These finding are not surprising when one considers that the width of a molar furcation is often not large enough to allow insertion of a standard Gracey curette. Bower observed that 58% of molar furcation entrances had a width of less than 0.75 mm and 81% were less than 1 mm, while an average curette was 0.75 mm to 1.1 mm wide (Bower, 1979). It should be noted that both the Wylam and Fleischer papers used manual instruments, and while the Fleischer study did use ultrasonic instrumentation, it was with a P-10 tip, which is indicated for supragingival use. Their results are not transferable to powered scalers using tips designed for subgingival and furcation sites. In fact, it is in these areas that ultrasonic instruments with tips measuring .55 mm or less have shown an advantage (Oda et al., 1989).

Operator experience also appears to play a role in the efficacy of root surface debridement. Studies have found that inexperienced dentists (Kocher et al., 1997) and periodontists in training (Brayer et al., 1989; Fleischer et al., 1989) left residual calculus on a greater number of root surfaces than trained periodontists. These studies also found that experienced periodontists took more time to scale, suggesting either a better understanding of the time required to scale teeth or a more sensitive tactile endpoint.

An interesting finding was that use of ultrasonic instead of hand instruments does not improve results for inexperienced operators, and thus the ultrasonic scaler should not be considered an instrument for less skilled operators.

Summary

Regardless of the variables affecting the efficacy of mechanical therapy, complete debridement of the root surface does not appear to be a realizable goal. Even surgical access only makes a slight improvement, and thus it seems a likely inference from all of the studies that the limitations on the effectiveness of scaling are related only in part to operator experience, instrument type, and direct visualization, and that ultimately efforts to completely remove calculus are hampered by difficulty in accessing both the macroscopic anatomy such as furcations, concavities, and grooves, and the microscopic anatomy such as erosions and porosities. In any event, healing following scaling and root planing is a clinical reality, which raises questions regarding which aspects of mechanical debridement are important to success. It may be that all are required, at least in the short term, to cause a disturbance of a pathogenic subset of the microbial biofilm or achieve an as yet undetermined threshold of debridement, and that thoroughness of debridement is more relevant to long-term maintenance of the initial resolution of inflammation.

ROOT SURFACE SMOOTHNESS

Another aspect of scaling and root planing that has been explored is post-treatment root surface changes and their effect on plaque accumulation and resolution of inflammation. A smooth root surface is often used as a clinical endpoint for thorough debridement. At a microscopic level it has been found that the different root planing instruments achieve varying degrees of root surface smoothness. Although these differences cannot be detected clinically, they have been investigated for their effect on rate of plaque accumulation and ultimately tissue healing.

It is generally agreed that rougher surfaces promote and increase the rate of plaque accumulation (Leknes et al., 1994; Quirynen et al., 1995). However, with respect to root surface smoothness following root planing, no instrument leaves behind a smooth surface. An in vivo study on root surface roughness following scaling by various instruments found that 15 μm rotating diamonds and Gracey curettes left the smoothest surface followed by the piezoelectric, 75 μm diamond and sonic scalers with roughness values (R_a) ranging from 1.64 μm to 2.1 μm (Schlageter et al., 1996). The point of the paper that is relevant to this discussion is that all of the tested instruments left a root surface that was eight to 13 times rougher than the smoothness threshold of 0.2 μm, which was determined in a literature review to be the R_a value above which plaque accumulation is facilitated (Quirynen et al., 1995). Thus, it appears that even if we accept that the rate of biofilm formation decreases with smoother surfaces, the root surface roughness subsequent to scaling, regardless of instrument choice, will always facilitate plaque accumulation.

Furthermore, despite the correlation between surface smoothness and plaque accumulation, it has not been established that a rougher surface is significant for healing. An early study using closed scaling failed to find an effect on gingival inflammation (Rosenberg and Ash, 1974) and later, in vivo studies using direct visualization (surgical access) failed to find differences in healing after flap surgery between root surfaces that were smoothed after being cleaned and those that were intentionally roughened with a diamond (Khatiblou and Ghodossi, 1983; Oberholzer et al., 1996).

These findings reinforce a point previously made, that healing subsequent to SRP is not dependent on complete removal of plaque but rather a disruption of the biofilm sufficient to change a pathogenic microbial profile to one that is conducive to periodontal health.

FULL-MOUTH DEBRIDEMENT

An area that has received recent attention is the difference in clinical and microbiological results when standard therapy—defined as four quadrants of root planing, each separated by one or two—is compared to full-mouth root planing, whereby all four quadrants are scaled within 24 hours. The philosophy behind this alternative treatment regimen is that it prevents re-colonization of instrumented sites by bacteria from non-instrumented sites. It is also claimed that multiple scalings within 24 hours can stimulate an immune response, supplementing the mechanical effect of debridement on plaque.

A number of papers from a group of researchers based out of the Catholic University of Leuven, Belgium, have demonstrated additional gains in pocket depth reduction of about 1 mm at moderately deep pockets (4 mm to 6 mm) and 1.6 mm to 1.9 mm at deep (≥7 mm) sites. In addition, these studies found greater reductions in proportions of spirochetes and motile rods, although these differences were no longer statistically significant after two months (Quirynen et al., 1999; Mongardini et al., 1999; De Soete et al., 2001). In contrast, studies from other centers have all failed to find any statistically significant differences (Apatzidou et al., 2004; Jervoe-Storm et al., 2006; Nagata et al., 2001). Thus, although the concept behind full-mouth scaling may seem reasonable, conflicting results have been reported in the literature. Regardless, both treatment regimens seem to provide at least comparable gains and thus the choice of modality may be better based on practical concerns for the patient such as convenience, comfort, and financial considerations.

PRACTICAL ASPECTS

Given the plethora of instruments on the market, with new ones being continually introduced, it is imperative to use the literature to make educated practical decisions regarding both instrument selection and their correct application. Taking the studies collectively, it appears that the most important factors influencing complete debridement are instrument access and dental anatomy. Root concavities and grooves, the cementoenamel junction, interproximal areas, deep pockets, and furcations all complicate the debridement process and are the sites most likely to exhibit residual calculus.

Many advances in scaling instrument design are intended to improve access to the complex root anatomy that impedes calculus removal. Thus, maximizing the quality of debridement requires both an understanding of an instrument's design and an intimate knowledge of root anatomy. Knowing the physical characteristics of the working end of a scaler enables the practitioner to choose the instrument most appropriate for the anatomy being scaled. For example, when scaling a root groove or through a constricted entrance in class II and III furcation involvements, the narrow tip of an ultrasonic scaler would be more efficacious than a curette. There may also be an advantage of ultrasonics in deep, narrow pockets. Here the thin, probe-like shape can provide less traumatic calculus removal than the larger blade of curettes. Because there is individual variation in root shape, even among similar teeth, an experienced tactile sense also plays an important part.

Considering that manual instrumentation requires more complex hand movements (with respect to firm, stable fulcrums and specific blade angulations against the root surface), increased chair time, and greater stamina, it may be that ultrasonic scalers will become the instrument of choice. Nevertheless, whether the clinician prefers manual or powered scalers, a dogmatic adherence to one type of scaler limits the armamentarium of the clinician. An integrated approach with both powered and manual scalers enables the clinician to approach each tooth individually and use the advantages of any instrument to reach the desired endpoint.

As discussed, increasing pocket depth greatly diminishes the efficacy of debridement, and although surgical access is not immune to the variable of pocket depth, it does nevertheless significantly enhance results over closed scaling in pocket depths measuring greater than 4 mm. An interesting twist is introduced into our decision-making process when a paper by Lindhe is considered. Lindhe et al. looked at the surgical modality from the perspective of critical probing depth, defined as the pocket depth above which there was an improvement in clinical attachment level for surgical over non-surgical scaling. The value was 4.5 mm for molars, compared to 6 mm to 7 mm for incisors and premolar teeth; a shallower depth was required for molars before surgery provided a better result (Lindhe et al., 1982). These results can be understood in the context of access and root anatomy, both of which are generally more complicated at molar teeth. Thus, when considering improving visualization with surgery, the pocket depth must be considered in the context of the tooth with which it is associated.

A final important practical aspect is the matter of how one determines if a root surface has been adequately debrided. Originally, roots were scaled and planed aggressively to a hard, glossy finish. This was intended to completely remove plaque, calculus, and cementum contaminated by bacteria and their endotoxins. This practice has recently been called into question due to observations that endotoxins form a superficial layer on cementum that can be removed with gentle scaling (Cheetham et al., 1988) or ultrasonic debridement (Smart et al., 1990). In 1996, the consensus report of the World Workshop in Periodontics stated that the removal of cementum for the purposes of endotoxin removal was no longer considered prudent (Cobb, 1996). However, it is still relevant to plane roots to some degree because short of using endoscopy or surgical visualization, without smoothing roots we cannot evaluate the completeness of calculus removal. Although scaling is certainly indicated for the removal of plaque and calculus, root planing should be used judiciously to avoid unnecessary and excessive removal of root substance.

In this respect it is advantageous to use ultrasonic scalers for the bulk of the debridement because although manual scalers produce a smoother surface than sonic/ultrasonic scalers, they do so at the expense of greater root substance removal. One may consider the difference to be small (in the order of microns) and not of clinical consequence, but years of repeated root planing at regular maintenance visits will add up to a clinically significant amount.

CONCLUSION

Although it is well accepted that plaque biofilms are the main etiologic factor for periodontal disease, we now understand that there are other considerations that need to be taken into account if we are to fully understand the pathogenesis of periodontal disease. Genetic, environmental, and host systemic factors all play an important role in modulating the progression of periodontal disease and the response to periodontal therapy. Nevertheless, scaling and root planing remains the primary therapy for dealing with periodontal infections. Mechanical debridement can affect the composition of the bacterial plaque directly, affect the host response to bacteria, or alter the habitat; alterations of any of these factors can have an impact on the remaining factors in this triad.

To successfully use scaling and root planing in the armamentarium to combat periodontal disease, the trained professional must gain a thorough understanding of the evidence for what can be realistically achieved, how one can optimize those gains, and what factors can limit the efficacy of this modality of treatment. As discussed, due to microbial, environmental, or anatomical limitations, mechanical debridement alone is not always successful in controlling periodontal disease or its progression. Thus, although scaling and root planing is the predominant form of periodontal therapy, it should be understood from the outset that it is to be regarded as a component of an overall treatment plan and, if required, may be supplemented by other forms of non-surgical therapy such as local or systemic antimicrobials or surgical means. The determination can be made on a patient-by-patient basis at the re-evaluation appointment or at subsequent maintenance visits.

When considering the evidence on the benefits of scaling and root planing we must take into account the endpoints being evaluated. Most commonly our attention is directed toward clinical changes in inflammation, probing depth, and attachment level. As important as these changes are, a holistic approach to patient care must also take into account other factors including efficiency, costs, compliance issues, and a host of others. Thus, when planning treatment, consideration should be given not only to the expected gains from scaling and root planing but also to what more may be required to maintain any gains or prevent the initiation of disease in new sites or its progression in existing sites.

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