

# DENTIN HYPERSENSITIVITY:

## *Consensus-Based Recommendations for the Diagnosis & Management of Dentin Hypersensitivity*

# Dentin Hypersensitivity and Gingival Recession

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Dental patients of all ages are increasingly concerned about their smile and overall appearance, and are particularly unhappy when they have esthetic issues and dental pain associated with exposed roots. Recession seen in healthy patients is mainly due to oral care that is “too much of a good thing” where recession seen in periodontally diseased patients is likely due to a chronic inflammatory process that may represent years of “doing too little of a good thing.” Regardless of the frequency and intensity of oral hygiene, the symptom that brings periodontally healthy and unhealthy patients with recession to the office is a very unpleasant side effect common to both groups—dentin hypersensitivity.

## ETIOLOGY

Perhaps the most important factor in the etiology of dentin hypersensitivity is the exposure of root surfaces from gingival recession.<sup>1,2</sup> There is general consensus that gingival recession usually precedes dentin hypersensitivity and is perhaps the most significant predisposing condition of dentin hypersensitivity.<sup>3-5</sup> Other significant factors contributing to dentin hypersensitivity include loss of the cervical enamel and dentin as a result of excessive oral hygiene habits, or

tooth wear that can be attributed to brushing shortly after consuming erosive dietary foods and drinks.<sup>6,7</sup> The pathophysiology of gingival recession is not well understood. However, limited evidence gleaned from early histologic studies in the rat and monkey models<sup>8,9</sup> showed that periodontal inflammation and epithelial proliferation are essential to the formation of cleft defects in animals, subsequently leading to loss of gingival integrity and gingival recession.

## ANATOMIC FACTORS

While gingival recession is largely preventable, it is known to be exacerbated in the presence of certain anatomic factors:

- Root prominence in the presence of thin mucosa
- Dehiscences and fenestrations in the underlying alveolar bone
- Frenum pulls
- Orthodontic movement of teeth/roots outside the alveolar housing

Because the buccal alveolar bone provides much of the local blood supply for buccal gingivae, loss of the underly-



**Figure 1** 20-year-old female with thin scalloped gingivae, root prominence, and lack of keratinized gingivae on the canines. This patient is at risk for future additional gingival recession. Recession lesions are in the early stages of development on the first premolars. Photograph courtesy of Dr. Terry Rees.

ing bone is associated with loss of buccal gingivae.<sup>10</sup> Thin, fenestrated, or absent alveolar bone predisposes the site to gingival recession, a phenomenon that frequently occurs on the labial surfaces of canines and premolars and the mesial root of molars. Tooth anatomy or position also affects alveolar bone thickness, with facially positioned teeth more likely to be located within or outside of thin alveolar bone. During therapy, orthodontic tooth movement may inadvertently reposition teeth outside the buccal plate, putting such sites at risk to develop gingival recession. Crowding in the lower anterior segment increases the risk of gingival recessions.<sup>11,12</sup>

## ORAL HYGIENE HABITS AND RECESSION

### *Overzealous Toothbrushing*

Clinical studies have reported more gingival recession with good oral hygiene<sup>13</sup> or improved oral hygiene.<sup>14</sup> Indeed, the most brushed teeth with the lowest plaque scores exhibited the most gingival recession.<sup>15</sup> This has led to the description of gingival recession/dentin hypersensitivity as “toothbrush disease.”

Toothbrushing is also known to produce subclinical traumatic lesions of the cervical area in both the soft and hard tissues. In dentally healthy young adults, one study reported frequent signs of inflammation, namely fluid exudate and distortion of gingival contour changes as a result of swelling immediately after the students performed their normal oral hygiene procedure.<sup>16</sup> This was a particularly significant finding, as few if any of the corresponding areas in their mouths had clinically visible gingival damage. Based on this study, it seems reasonable to assume that a significant degree of subclinical gingival inflammation, abrasion, and early exposure of cervical dentin after toothbrushing frequently occurs, undetectable to the naked eye. Because subclinical lesions appear to precede any clinically visible signs associated with destructive oral hygiene habits, early diagnosis and intervention remain challenging aspects in the prevention of gingival recession.

Another well-designed longitudinal clinical study of dental students demonstrated the presence of increased recession over 5 years in the healthy, highly motivated, oral hygiene-compliant population. Progressive gingival recession occurred despite intensive oral hygiene instruction in the students’ first year of dental school that was subsequently reinforced over time. Instruction was aimed at replacing harmful oral hygiene habits in favor of more acceptable self-care techniques.<sup>17</sup> It is apparent from this study that “too

much of a good thing” is at work in many instances of gingival recession with persons practicing what they perceive as meticulous oral hygiene. Instead, their goal of achieving optimal oral health may lead to over-brushing certain areas of their mouths, ultimately enhancing the frequency and severity of gingival recession in an otherwise healthy dentition (Figure 1).

It has also been reported that recession will increase over time with the use of hard-bristle brushes, excessive force, and frequency of brushing.<sup>18</sup> However, not all sites exhibiting gingival recession and exposed dentin are hypersensitive. When SEM replica models from 28 teeth in ten patients exhibiting hypersensitivity symptoms after acid-etching were compared to non-sensitive sites, an amorphous smear layer was frequently seen coating the area in 88% of unetched non-sensitive specimens, where only 9.3% of specimens showed a few patent narrow dentinal tubules.<sup>19</sup> In the non-sensitive dentin, the acid-etching failed to remove or only partially removed the smear layer, whereas in the hypersensitive dentin, acid-etching always removed the smear layer.



**Figure 2A and Figure 2B** Six-mm recession on tooth No. 6 (upper right canine) was treated with a connective tissue graft to cover the root and treat the dentin hypersensitivity. Similar grafting techniques were contraindicated on the facials of teeth Nos. 5, 10, 11, and 12 due to the previous placement of root surface restorations.



This study suggests that the smear layer plays an important role in reducing permeability of exposed dentin in patients with dentin hypersensitivity. Avoidance of oral hygiene products that remove the smear layer, such as some tartar-control or highly abrasive dentifrices, could ultimately benefit patients and is of particular importance in helping them choose their daily homecare products.

### ***Dentifrice Abrasivity***

Although the relationship is not well-documented in the literature, dentifrices that contain higher levels of abrasive ingredients may also cause soft tissue damage and tooth wear leading to hypersensitivity.<sup>20</sup> Toothbrushing alone has no abrasive or erosive action on dentin; loss of dentin may be a result of the abrasivity of toothpastes.<sup>21</sup> Once gingival recession has exposed root surfaces, the cementum is rapidly lost as a result of brushing with toothpaste and/or professional tooth cleaning. It has been speculated that in some subjects or on some tooth surfaces, defective cementum formation or its partial absence at the enamel-cementum junction could predispose some patients to dentin hypersensitivity.<sup>22</sup>

### ***Periodontal Disease***

Dentin hypersensitivity is seen more frequently in patients with periodontitis.<sup>23</sup> The prevalence of dentin hypersensitivity is between 60% and 98% in patients with periodontitis. Poor oral hygiene may cause gingival recession indirectly by allowing for the development of periodontal disease. Chronic inflammatory periodontitis seldom causes recession on buccal cervical sites until it is well-advanced. However, as the inflammatory disease progresses apically, the facial and lingual marginal bone and gingivae eventually recede as well. Several studies have investigated changes in root dentin sensitivity after periodontal surgery. Nishida et al<sup>24</sup> followed dentin sensitivity for 8 weeks after periodontal surgery. The highest sensitivity occurred 1 week after surgery. In many cases, by 8 weeks postoperatively, the sensitivity had largely

resolved. The teeth of young patients (aged 19 to 29 years) showed a higher incidence and degree of postoperative hypersensitivity than did an older group (aged 40 to 61 years), and the spontaneous decrease in hypersensitivity required a longer time in the young group. During the first 2 postoperative weeks, the degree of sensitivity may be correlated with the width of the exposed root surfaces; however, this correlation is lost as many of the teeth became less sensitive over time.

In another clinical study,<sup>25</sup> there was a more than 100% increase in dentin hypersensitivity after periodontal surgery. After 8 weeks, the control group that received no treatment showed a 34% reduction in hypersensitivity, but it remained above the preoperative level. Some report that root sensitivity is directly related to the extent of root surface exposure after surgery but find no significant effect on immediate root sensitivity from scaling and root planing.<sup>26</sup> Conversely, Sim and Han<sup>27</sup> reported that 1 day after scaling and root planing there was a significant increase in hypersensitivity that continued for 2 to 3 days but decreased after 5 days or more. Periodontally involved mandibular incisors showed increased dentin sensitivity 1 week after root planing. However, by 8 weeks, the increased sensitivity was reduced in five of the six patients.<sup>28</sup> It would appear from most studies that the majority of sensitivity after scaling and root planing disappears or is significantly reduced after 8 weeks.

Scaling and root planing in moderate to deep pockets causes approximately 1.25 mm to 2 mm of gingival recession respectively. Surgical pocket elimination or other surgical access procedures also routinely cause more recession than non-surgical procedures; however, after non-surgical therapy, residual pocket depths will generally be deeper and more difficult to maintain than surgically treated sites.<sup>29</sup>

Scaling and root planing creates a smear layer on root dentin that occludes the orifices of the tubules of exposed dentin.<sup>30</sup> The presence of smear layers is known to lower the hydraulic conductance of dentin.<sup>31</sup> Several studies



**Figure 3** (A) Initial incision maxillary right premolar. (B) Connective tissue graft taken from palate. (C) Connective tissue graft sutured. (D) Four weeks postsurgery results in nearly 100% root coverage on teeth Nos. 3 and 4.

\*Photographs courtesy of Dr. Poulos, Medical College of Georgia Periodontal Residency Program.

have shown that smear layers dissolve in vivo within 7 days.<sup>32,33</sup> This permits the dentin to increase its hydraulic conductance that is associated with increases in dentin hypersensitivity. Generally, over the next 10 to 14 days, the sensitivity spontaneously decreases as salivary mineral deposits partially occlude the tubules.<sup>33</sup> However, some teeth remain hypersensitive for years after periodontal treatment. The duration of hypersensitivity after periodontal surgery was reported to range from 2 to 3 months to up to 30 years.<sup>34,35</sup>

It is generally shown that transient to long-term dentin hypersensitivity will likely occur after deep scaling, root planing, or periodontal surgery.<sup>36</sup> Therefore, steps should be taken to prevent the sensitivity if at all possible before or in close proximity to the periodontal therapy. Because open dentin tubules are a prerequisite for hypersensitivity, the use of desensitizing dentifrices in preparation for and during periodontal therapy is advised. Additionally, over-instrumentation of exposed roots for the sole purpose of stain removal is not recommended in susceptible patients without concomitant use of desensitizing agents as needed.

### ***Other Causes***

Some recession may be iatrogenic, through self-inflicted wounds with the chronic use of fingernails, toothpicks, or other sharp objects to clean the teeth, or by the placement of tongue or lip jewelry and studs that strip the buccal and lingual gingivae away from the surfaces of the mandibular teeth. Early studies have also identified the increased risk of gingival recession with over-instrumentation of healthy sulci during periodontal therapy by the dentist or dental hygienist.<sup>37</sup> Practitioners are cautioned to resist scaling and root planing in shallow pockets ( $\leq 4$  mm) lest they cause an additional 0.3 mm of gingival recession in shallow healthy sites over time.

## **PREVALENCE**

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Albandar and Kingman<sup>38</sup> reported epidemiological data on 9,689 subjects 30 to 90 years of age in the United States and projected that more than 23.8 million people have one or more tooth surfaces with gingival recession of at least 3 mm or more. They found that the prevalence of recession of 1 mm or more in this population was 58% and that it increased with age.<sup>11,39</sup> Woofter<sup>40</sup> found gingival recession in the third to fourth decade of life. In addition, males have been found to have increased recession compared to females,<sup>41,42</sup> and black males have more recession than Caucasian males.<sup>38</sup> Frequency

of gingival recession increases with age and is greater in men than in women of the same age.<sup>13</sup> Recession was also associated with labially positioned teeth in 40% of patients 16 to 25 years of age and the prevalence increased to an impressive 80% of patients between 36 and 86 years of age.

Receding gums are also a common manifestation of periodontal disease. In a study of 1,460 subjects in an urban Brazilian population, more than half (51.6%) of individuals and 17% of their teeth had  $\geq 3$ mm of recession associated with chronic periodontitis. In addition, 22% of individuals had  $\geq 5$ mm of recession in 5.8% of their teeth<sup>39</sup> and was also shown to be associated with age. Males  $\geq 30$  years of age showed the highest extent, prevalence, and severity of recession in this study. Using a multivariable model approach to the analysis, smoking and the presence of supragingival calculus were also factors most often associated with both localized and generalized recession. Significant associations between gender, socioeconomic status, dental visits, and gingival recession differed among different populations. Therefore, etiologic factors and risk factors may vary across countries and cultures and must be taken into consideration when looking at epidemiologic data relative to gingival recession.

## **LOCATION OF GINGIVAL RECESSION**

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The most common location of recession is on the facial aspect of canines, premolars, and molars.<sup>43-47</sup> The teeth most commonly affected are canines > premolars > incisors > molars.<sup>44,45,47,48</sup> Interestingly, a significantly higher proportion of left vs right contralateral teeth was reported in right-handed patients with dentin hypersensitivity.<sup>15</sup> Other studies report significant differences in severity between the right and left halves of the mouth depending on the dominant hand of the brusher. In the case of right-handed people, more recession is usually seen on the left half of the upper and lower facial surfaces according to Addy et al,<sup>15</sup> but conversely, on the right side according to Tezel et al.<sup>41</sup> Regardless of the side affected, recession is highly associated with vigorous and overzealous or improperly executed brushing.

## **TREATMENT IN THE PRESENCE OF GINGIVAL RECESSION**

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### ***Nonsurgical Therapy***

Hypersensitivity with minimal exposure of dentin is usually the most easily treated symptom of gingival recession. Dentifrices containing potassium nitrate are shown to be



effective in reducing dentinal sensitivity within the first few weeks of daily use in a large segment of the population with mild or transient hypersensitivity. Specific lasers used at specific settings have also been shown to be nearly or equally as effective for treating hypersensitive roots as dentifrices.<sup>49</sup> Laser treatment is significantly more expensive than a dentifrice, but may be indicated for immediate relief of severe sensitivity in localized areas. Restorative materials can also be used to block the open tubules or to restore the contour of lost tooth structure. However, placement of restorative materials in the root surface complicates the ability of the surgeon to cover the roots by a graft procedure in the future time. The materials are designed to block the tubules and may prevent the formation of a new epithelial or connective tissue attachment to the root without first removing the part of the root surface impregnated with the filling material (Figure 2A and Figure 2B).

Long-term relief of moderate-to-severe dentinal sensitivity associated with gingival recession more than 1 mm is more difficult to achieve and may require multiple surgical interventions to cover the exposed root. In addition, exposed dentin may increasingly become more sensitive, and recession may present significant esthetic problems, prompting the patient to seek more invasive solutions, including surgical root coverage, that are capable of addressing both concerns.

### ***Surgical Correction of Gingival Recession***

A variety of root-coverage techniques are available that have been shown to be highly successful over time.<sup>50</sup> Recent meta analyses of certain root-coverage techniques show 95% to 100% success over 5 years.<sup>50</sup> The most common procedure used by dentists worldwide for root coverage is the connective tissue graft (Figure 3A through Figure 3D).

Selection of a particular surgical technique is routinely based on the depth and width of the recession according to the Miller Classification system,<sup>51</sup> which also considers the height of the interproximal bone, a strong predictor of the potential root coverage in each classification of recession defects.<sup>51</sup> Other considerations in selecting a particular surgical technique are based on the number of teeth with recession, the width and thickness of the keratinized gingiva at the recession site, and availability of host tissue that may be transplanted from one area of the mouth to another. When several adjacent teeth are in need of root-coverage procedures, multiple surgical procedures may be needed to treat large recession areas. Fortunately, within the last few years, acellular dermal allograft material has become available<sup>52</sup>

that may be used in lieu of autogenous grafts harvested from distant donor sites within the mouth. Although use of the acellular dermal allograft material is highly technique-sensitive, success rates are similar to autogenous grafts.<sup>53,54</sup>

## **CONCLUSION**

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- Excessive oral hygiene and plaque control habits produce gingival abrasion lesions that may ultimately lead to short- and long-term recession in an otherwise healthy mouth.
- Dentin hypersensitivity associated with gingival recession is very common in periodontitis patients and is usually more acute immediately after periodontal therapy but may persist for weeks to months or even years.
- Periodontal evaluation to determine the feasibility of root-coverage procedures should precede the placement of restorative materials on the root surfaces to reduce dentin hypersensitivity.
- Treatment of sensitive roots with restorative materials may negatively influence the success of future gingival grafting or root-coverage procedures.
- More research is needed to specifically guide the practitioner in the selection of appropriate desensitizing products for their patients with hypersensitivity in the presence of recession.
- Minimal recession of 1 mm or less with transient dentin hypersensitivity can often be treated by the recognition and correction of destructive oral hygiene habits in conjunction with the use of a desensitizing dentifrice.
- Early diagnosis and intervention would likely prevent the subsequent development of recession associated with dentin hypersensitivity in the majority of cases.

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