# **Erosion and Tooth Surface Loss**

David W. Bartlett, BDS, PhD, MRD, FDS RCS (restorative) Senior Lecturer Department of Conservative Dentistry, Guy's, King's and St Thomas' Dental Institute London, UK

### What We Now Know

Data on the prevalence of tooth wear suggest that wear of enamel is common, with estimates varying between 30% and 60% of subjects, whereas dentin exposure is comparatively rare with only around 3% to 8%.1,2

Perceptions relating to the relative importance of the acid erosion process are geographically polarized, with apparently lower recognition in North America of the potential consequences of acids in tooth wear. This apparent conflict arises from a differing interpretation of definitions and the etiology of tooth wear.<sup>3</sup> European research tends to focus on the role of acids, whereas in North America the role of attrition and abrasion are more emphasized.

The 2 main causes of erosion are acids consumed depending on diet and those regurgitated into the mouth from the stomach. Common dietary acids are citrus fruits and citrus-based drinks, including those that are carbonated. It appears that the frequency of consumption of acids is important in the pathogenesis. Oral pH measurement shows that acids are quickly buffered in the mouth by saliva in around 5 minutes.4 This should be contrasted with dental caries where bacterial fermentation of carbohydrates is much longer, approaching 30 to 40 minutes. Therefore, frequent consumption and drinking habits, such as holding acidic drinks in the mouth prior to swallowing, are believed to be more important than the drink itself.

There is relatively weak evidence based on community studies to support the role of dietary acids in tooth wear.5,6

Gastric causes of tooth wear remain relatively uncommon, but probably account for more of the severe cases.<sup>7</sup> Subjects with diagnosed regurgitation erosion appear to have poor esophageal motility<sup>8</sup> and prolonged acid exposure, particularly around the upper esophageal sphincter.<sup>9</sup> Acid reflux pooling around the larynx has the potential to reach the mouth to cause erosion.9

Tooth wear appears to be a surface effect whereas dental caries occurs within the subsurface. A possible pathogenesis is that acids partially or completely demineralize teeth, and that processes such as abrasion or attrition subsequently remove the surface, exposing new tooth tissue for wear.

The surface effect of wear has implications for remineralization and fluoride in progression of wear. If the surface is removed each time wear occurs, the potential for remineralization and fluoride to prevent wear is reduced.

The multifactorial nature of tooth wear means understanding that the pathogenesis is complex. Individual variations in saliva, acid clearance, dietary habits, gastric regurgitation, bruxism, and abrasion mean identifying the cause can be difficult. Progression of tooth wear after dietary advice and prevention appears to be slow.10

## What We Still Do Not Know

Tooth wear appears to occur in discrete phases which may be age related. The risk factors associated with wear in adolescents and adults are unknown. From the data on prevalence, a small percentage of children have severe tooth wear. What causes this destruction is unclear. There is a suspicion that stopping drinking habits or reducing acid reflux might prevent progression of tooth wear, but more research is needed. Individually, prevention can be shown to work, but in community studies when the cause of wear is multifactorial, preventive techniques have not been conclusively shown to work.

Studies on the role of fluoride have shown there is some potential for remineralization in laboratory and in situ studies; the evidence is relatively weak.11 Most laboratory-based studies have prolonged remineralization phases which may not be clinically relevant. More in situ and in vivo studies are needed to assess the role of fluoride and remineralization of eroded, abraded, and attrited surfaces. The role of saliva continues to be unknown. Data from different studies have shown a role in some cases, and in others none at all.12

### **Research Strategies**

- 1. Assess the prevalence of tooth wear and erosion in North America.
- There has been little change over the past few years on the 2. imbalance between North America and Europe on the role of erosion in tooth wear. There has also been little research on prevalence from North America compared to Europe, where researchers have shown more interest. But researchers in Europe should move away from the research on erosion, and instead focus on attrition and abrasion.
- 3. Assess the role of the diet in erosion. The role of the diet has become clearer over the past few years, with emphasis now being placed on drinking habits rather than the drink itself. Prolonged acid exposure commonly caused by holding or retaining acidic drinks in the mouth dissolves enamel and dentin. The acid removes the top surface of either enamel or dentin. What is not clear. however, is how deep the effects are and what are the differences, if any, between enamel and dentin.

## **Tooth Surface Changes**

There is evidence that the tongue and other soft tissues play an important role in tooth wear due to acids.13,14 More evidence of the interplay of attrition is needed, particularly in laboratory studies.

## The Role of Gastric Juice

The role of gastric juice and erosion has become clearer. The retention of acid within the upper esophageal area may be responsible for the erosion in susceptible patients.<sup>9</sup> Data from studies on patients presenting with reflux disease and having their tooth wear measured suggests that gastric acids are important,<sup>7</sup> but more research is needed. There remains a suspicion that gastric acids produce more severe tooth wear, but this hypothesis needs more research.

#### Saliva

There has been little research in this area over the past few years, which reflects the difficulties and inaccuracies of measuring saliva in large epidemiological studies. Until new methods are developed that measure saliva or identify which aspect of saliva is important in tooth wear, there is unlikely to be significant change in this area.

#### Measurement

There have been some developments in methods used to measure tooth wear. Profilometry, either contacting or noncontacting, remains the most accurate method to measure wear. However, comparing sequential images of wear over time remains problematic. The use of superimposition of data points to measure wear is probably ideal, but a few theoretical problems remain.<sup>15-17</sup> Some researchers have started to compare wear rates in the mouth to preventive strategies, which needs more development.<sup>18</sup> Identifying the specific risk factors that make individuals susceptible to tooth wear should be the next stage in research.

#### **Treatment Strategies**

Progression of tooth wear appears to be slow.<sup>19</sup> Therefore, treatment is not always necessary and the potential for monitoring wear over long periods of time remains a cost-effective and preventive approach.<sup>20</sup> The use of adhesive resins to protect against tooth wear has shown some promise in the laboratory and in situ studies,<sup>21</sup> but in vivo validation is needed. Bonding restorations directly to worn dentin surfaces has become routine.<sup>22-24</sup> More work on the wear of materials used to restore the worn dentition is needed, particularly in light of the knowledge that erosion and attrition occur together, especially on the occluding surfaces of teeth.

### **Educational Strategy**

Developments in tooth wear education remain relatively slow in the undergraduate curriculum. Knowledge of the etiology of tooth wear is probably well understood in most dental schools, but the treatment is less so. Problems presented by tooth wear and the difficulty in management means that treatment is often complex, requiring a special level of knowledge not necessarily achieved at the undergraduate level. Prevention and simple treatment are possible in the undergraduate programs, but more complex treatment demands specialist care.

#### References

- Bardsley PF, Taylor S, Milosevic A. Epidemiological studies of tooth wear and dental erosion in 14-year-old children in North West England. Part 1: The relationship with water fluoridation and social deprivation. Br Dent J 2004;197:413–416.
- Dugmore CR, Rock WP. The prevalence of tooth erosion in 12-year-old children. Br Dent J 2004;196:279–282.
- Bartlett D, Phillips K, Smith B. A difference of perspective-the North American and European interpretations of tooth wear. Int J Prosthodont 1999;12:401-408.
- Moazzez R, Smith BGN, Bartlett DW. Oral pH and drinking habit during ingestion of a carbonated drink in a group of adolescents with dental erosion. J Dent 2000; 28:395–397.
- Dugmore CR, Rock WP. A multifactorial analysis of factors associated with dental erosion. Br Dent J 2004;196:283–286.
- Milosevic A, Bardsley PF, Taylor S. Epidemiological studies of tooth wear and dental erosion in 14-year old children in North West England. Part 2: The association of diet and habits. Br Dent J 2004;197:479–483.
- Moazzez R, Bartlett DW, Anggiansah A. Dental erosion, gastro-esophageal reflux disease and saliva: How are they related? J Dent 2004;32:489–494.
- Bartlett DW, Evans DF, Anggiansah A, Smith BGN. The role of the esophagus in dental erosion. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000;89:312–315.
- Moazzez M, Anggiansah A, Bartlett DW. The association of high reflux and tooth wear. Caries Res 2005; in press.
- Bartlett DW. Retrospective long term monitoring of tooth wear using study models. Br Dent J 2003;194:211–213.
- Attin T, Weiss K, Becker K, Buchalla W, Wiegand A. Impact of modified acidic soft drinks on enamel erosion. Oral Dis 2005;11:7–12.
- Milosevic A, Dawson LJ. Salivary factors in vomiting bulimics with and without pathological tooth wear. Caries Res 1996;30:361–366.
- Gregg T, Mace S, West NX, Addy M. A study in vitro of the abrasive effect of the tongue on enamel and dentine softened by acid erosion. Caries Res 2004;38:557–560.
- Widodo G, Wilson RF, Bartlett DW. Oral clearance of an acidic drink in patients with erosive tooth wear compared with that in control subjects. Int J Prosthodont 2005; 18:.
- Shah S, Sundaram G, Bartlett D, Sherriff M. The use of a 3D laser scanner using superimpositional software to assess the accuracy of impression techniques. J Dent 2004;32:653–658.
- Chadwick RG, Mitchell HL, Ward S. Rationalization of quantitative tooth surface loss data for epidemiological research. J Oral Rehabil 2004;31:42–46.
- Chadwick RG, Mitchell HL, Ward S. A novel approach to evaluating the reproducibility of a replication technique for the manufacture of electroconductive replicas for use in quantitative clinical dental wear studies. J Oral Rehabil 2004;31:335–339.
- Chadwick RG, Mitchell HL, Manton SL, et al. Maxillary incisor palatal erosion: no correlation with dietary variables? J Clin Pediatr Dent 2005;29:157–163.
- Bartlett DW. Long term monitoring of tooth wear with study casts. Caries Res 2002;36:174–222.
- Bartlett DW, Palmer I, Shah P. Using study casts to monitor tooth wear in practice. Br Dent J 2005; in press.
- Azzopardi A, Bartlett DW, Watson TF, Sherriff M. The surface effects of erosion and abrasion on dentine with and without a protective layer. Br Dent J 2004;196:351–354.
- 22. Bartlett DW. The use of dentin adhesives to restore worn teeth. Int J Prosthodont 2005;18:.
- Redman CD, Hemmings KW, Good JA. The survival and clinical performance of resin-based composite restorations used to treat localised anterior tooth wear. Br Dent J 2003;194:566–572.
- Chadwick RG, Linklater KI. A retrospective observational study of the effect of surface treatments and cementing media on the durability of gold palatal veneers. Oper Dent 2004;29:608–613.

Copyright of International Journal of Prosthodontics is the property of Quintessence Publishing Company Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.