

A personal perspective and update on erosive tooth wear – 10 years on: Part 1 – Diagnosis and prevention

D. Bartlett¹

In brief

A term used by Europeans to describe tooth wear when erosion is active is erosive tooth wear

Erosive tooth wear is common with up to 30% of Europeans with visible signs of tooth wear

The Basic Erosive Wear Examination is convenient scale to record tooth wear in the clinical records

The role of fluoride- and calcium-based products has the potential to prevent tooth wear

Tooth wear has been recognised as an increasing problem over the past 10 years. Recent data from epidemiological studies indicate that the condition is common with prevalence of dentine exposure in adults ranging between 2% and 10% and visible surface changes on teeth observed up to 30% of European adults. The Basic Erosive Wear Examination (BEWE) was designed for general practitioners to score the severity using similar protocols as the Basic Periodontal Examination (BPE). The role of the BEWE is partly to increase awareness, but also a means to record the severity in the clinical notes. Over the past 10 years toothpaste manufacturers have launched products to prevent progression of erosive tooth wear using specially formulated fluorides or calcium based products. Probably the most important preventive advice is to reduce the frequency of acidic foods and drinks, particularly outside meal times.

Introduction

Tooth wear, and in particular the role of erosion, has increasingly become recognised as an important dental condition. Over the past 10 years the dental profession, and possibly more importantly, the public have realised that erosive tooth wear is important to oral health. Within the same time frame commercial companies have increasingly targeted erosive tooth wear with new products aimed to prevent the condition progressing.

The terminology used to describe tooth wear has become a little confusing. In the UK there is an understanding that tooth wear is formed from the contribution of erosion, attrition and abrasion (Figs 1, 2 and 3; Table 1). In Europe, the concept of erosion is considered to be more important and many see attrition and abrasion acting differently, almost independently. These countries view smooth surface lesions, on the

buccal and palatal surfaces, as being erosion and on any other surface, and in particular, the occlusal surface as attrition. Therefore, in different publications or lectures there is a differing emphasis on erosion from our European colleagues. My personal view is that it is very rare for erosion to occur without the contribution of either attrition or abrasion and therefore my preferred term is erosive tooth wear. This term has increasingly been adopted by international authorities and industry as a compromise on terminology and recognises that when acids, either intrinsic or extrinsic, are relevant it is a combination of erosion with tooth wear.¹

Prevalence

Over the past 10 years better understanding of the condition has been researched and it's probably safe to say that erosive tooth wear is both common and increases in severity with age.²⁻⁵ Systematic reviews have established that tooth wear is present in between 2% and 10% of adults and higher values for children.^{6,7} These data rely on the exposure of dentine to indicate the presence of tooth wear. Recently, a pan European study reported that about 30% of adults had levels of wear which was

visible during a dental examination using the BEWE index.⁸ While there were variations in the severity, across seven countries the overall finding indicated that tooth wear was common and in around 3% of individuals, severe.

An implication from these studies is that the severity of tooth wear increases with age.⁹ There appears to be an underlying natural process, occurring during life, which results in a gradual increase in tooth wear. This is not entirely surprising as teeth that are involved with mastication will wear over time. For example, an 80 year old would be expected to have more tooth wear than a 20 year old. What is not understood is whether there is a natural cumulative process that progresses throughout life or whether the rate changes depending on the impact of risk factors. At the present time there is no data to indicate a normal rate of wear. The most likely scenario is that there are periods of activity, when the rate of wear increases above the natural background levels and when the risk factors are active. When these risks are controlled the rate of wear should reduce to normal levels.^{10,11} This is an important concept because it means that prevention can occur at any stage. Even those teeth with severe wear will benefit from a reduction in the risk factors and so reduce the

¹Kings College London Dental Institute, Prosthodontics, Floor 25, Guy's Tower, London Bridge, London, SE1 9RT
Correspondence to: David Bartlett
Email: david.bartlett@kcl.ac.uk

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rate of wear. Therefore prevention is relevant at any stage even when dentine has been exposed.

For some, high risk, individuals the rate of wear increases above the natural rate and is probably similar to the progression of other chronic conditions, such as periodontal disease. Both conditions have a prevalence of around 10%.¹² Although it is simplistic to compare the two, both show similar characteristics in that they are common, pass through periods of activity and inactivity, and a relatively small proportion of the population have severe levels. Based on this premise the basic erosive wear examination (BEWE) was developed.

Clinical indices

In common with any clinical condition, it is imperative that the severity is recorded with a simple but effective procedure. There are a number of indices that have been devised using the descriptions first suggested by Smith and Knight¹³ to characterise the severity of wear but they have not been internationally accepted by the global research community. The BEWE was developed, within the last 10 years, to record the severity of tooth wear using a broadly similar concept to the BPE (Table 2) and has been adopted by international colleagues and industry.¹⁴ The most severely worn surface of a tooth in each sextant is graded on a scale from 0 to 3 and recorded in the clinical records. In common with the BPE this establishes that the wear has been observed and recorded. The index was not designed to be reproducible and aimed at general practice, but despite this a number of research studies have used the index to record tooth wear in populations.⁸ The intention of the index was to encourage practitioners to record tooth wear and raise awareness, particularly for those patients with visible signs and to show patients and other professionals that the condition had been recognised and the preventive programme commenced. For some the term erosion confuses the usage of the index and may seem to suggest erosion is the only condition that is assessed. The BEWE, was designed to be internationally accepted, and therefore reflects the importance of erosion to international colleagues, but also recognises the impact of tooth wear in progression.

The concept uses a numerical score to denote changes to tooth surfaces based around whether 50% of the surface is involved. Less than 50% is scored 2 and greater 3, the value 0 indicates no wear and 1 indicates very early

stages. In practice it is very difficult to distinguish between grade 0 and grade 1. In recently erupted teeth it is possible to see that no wear has occurred and grade 0 is an appropriate score. But once wear has occurred, for example when either the cingulum or the mamellons have worn, the value of 1 is more appropriate.

For many patients over the age of 30 years it is inconceivable that they are wear free so the default value would be 1. The distinction between grade 0 and 1 is minor but the most important distinction is between 2 and 3.

While in principle this index is simple there are difficulties, particularly when assessing the



Fig. 1 Erosive tooth wear on the buccal surfaces of the upper anterior teeth. This is probably a combination of erosion and abrasion. The lesions along the cervical margin can be associated with abrasion, but are more likely erosive in nature



Fig. 2 Erosive lesions on the upper premolars and molars. There is probably an attritive component to the lesions and perhaps abrasive

Table 1 Types of tooth wear

Type	Cause
Extrinsic erosion	Extrinsic (citrus fruits, apples, Kiwi, fruit-based drinks, some carbonated drinks)
Intrinsic erosion	Regurgitated gastric juice, eating disorders – anorexia and bulimia nervosa and rumination
Abrasion	Excessive forces used in toothbrushing, habits such as pen chewing, coarse or sandy foods
Attrition	Bruxism

wear on the incisal edges of the upper and lower incisors. On the buccal and palatal surfaces the assessment is straightforward as changes to the shape of teeth are easily identified. But on the incisal edges it creates challenges (Fig. 4). For extensively worn teeth with loss of coronal

height the assessment is again straightforward. But when the wear involves the whole of the incisal edge without loss of tooth height the judgement is more challenging. Assessing the involvement of the occlusal surface of molars is relatively simple because of the large surface

area. Whereas for the incisal surface of upper and lower incisors grading a score of 3 for wear over the whole incisal surface, without loss in tooth height, might seem to be an overestimation of the effect and is confusing. In these circumstances the intention might be to score 2.

Recently, two companies have developed APPs to help understanding of the BEWE and to raise awareness of erosive tooth wear. These are examples of the interlinking and cooperation between the dental industry and dentistry, and follows the highly successful process involved with the BPE.

Recent research

Over the past 10 years the industry has adopted and recognised the importance of erosive tooth wear and followed the evidence from epidemiology that suggested the condition was common. From a preventive perspective the enamel lesion is probably more relevant, so the action of fluoride or other minerals has been more thoroughly investigated.¹⁵ Once dentine is exposed many researchers believe the condition is irreversible but the role of prevention on dentine is relatively under-researched.

Overall, fluoride appears to have similar preventive outcomes as observed in caries and involves either the hardening of enamel, increasing the resistance to demineralisation, or remineralisation.¹⁶ The current view is that in the early stages of erosion a softened layer is formed after exposure to acid, which may remineralise in favourable conditions and results in no tissue loss. Tissue loss follows acid softening, which is then exacerbated by either attrition or abrasion leading to bulk tissue loss. Even after bulk tissue lost, a new lesion can be formed on the surface, which itself can be remineralised and means that erosive tooth wear is not continually progressive and has the capacity to undergo periods of activity and inactivity.

Most researchers recognise that fluoride is an important ion for the prevention of erosive tooth wear. More recently, the concept that different formulations of fluoride might have differing outcomes on enamel has gained interest. Researchers have reported that different metal ions might have more effect on prevention, with sodium, stannous and titanium ions all receiving attention.¹⁶ It has also been recognised that the formulation of the toothpaste or mouth rinse may influence the resistance of the enamel to acids and the role of calcium based products have also been



Fig. 3 Attrition on the incisal surfaces of the upper anterior teeth. The wear is partly caused by attritive wear from the bridge on the lower incisors. The porcelain has worn the incisal surfaces of the upper teeth



Fig. 4 BEWE score for the incisal surfaces of the upper anterior teeth can illicit confusion. When there is no loss of crown height and the lesion affect the whole incisal surface grade 2 is the appropriate score

Table 2 The BEWE (basic erosive toothwear examination)	
Score	
0	No erosive tooth wear
1	Initial loss of surface texture
2	Distinct defect, hard tissue loss <50% of the surface area
3	Hard tissue loss ≥50% of the surface area

recognised in the progression on the erosive lesion. But we still lack any direct clinical evidence.

It seems likely that erosive tooth wear progresses in two phases. A slow but cumulative effect over a lifetime, and which does not influence the longevity of the tooth. The other active phase is related to risk factors and involves periods of higher activity. The challenge is to identify these periods of activity and to then assess if the preventive agents are effective. At the present time we lack any reliable clinical signs or symptoms to indicate active tooth wear. Until we can easily identify patients with higher rates of tooth wear it is going to be too challenging to scientifically assess the outcome of these products. So we rely on surrogate investigations that attempt to associate prevention with progression.

Probably as important as fluoride application is the recognition that the diet influences progression.^{17–19} Ten years ago there was a blunderbuss approach and advice was given to avoid all acidic foods and in particular carbonated drinks. Over time, epidemiological studies have repeatedly identified that the frequency of acid intake is the most important risk factor and not necessarily the content of the food or drink.^{20,21} Fruit and fruit-based drinks are repeatedly reported as being important in the development of erosive tooth wear. But there is a conflict in that these same foods are recognised as part of a healthy diet. The important distinction is that the frequency of intake or consumption is the most important factor and not what fruit or fruit drink is consumed. It is essential to recognise that fruit is part of a healthy balanced diet but snacking on fruit throughout the day significantly increases the risk of developing erosive tooth wear.

Recently the role of saliva, and in particular the pellicle, has received research interest. One recent study reported that patients with erosion appeared to have less pellicle compared to matched controls.²² There may also be differences in the composition of the pellicle in erosion patients. It seems likely that the pellicle provides a barrier to the action of acids on the mineralised enamel or dentine. Repeated exposure to acids may over time result in a weakening or a reduction in thickness of the pellicle. Currently, this area is a very active area for research and the role of specific proteins and the thickness of the pellicle is being investigated.

One group of patients with severe tooth wear are those who suffer from regurgitated or refluxed acid from the stomach. This is

seen either with eating disorders or those with repeated regurgitation of gastric reflux and the outcome of the wear can be severe.²³ Considering that stomach juice contains proteolytic enzymes and hydrochloric acid it might be possible to predict that the enzymes breakdown the pellicle to allow intimate contact of the hydrochloric acid to the enamel surface. I suspect more research will be focused on the role of the pellicle and ways to investigate if it can be altered to improve the barrier to acids.

Prevention

The most important realisation was that the frequency of acidic foods and drinks consumption is important to the progression of erosive tooth wear. Dietary sheets and advice are essential to identify what foods or drinks are increasing the risk. Many patients view fruit and fruit-based drinks as healthy options and do not readily consider them as risks. Therefore, when asking patients to describe their dietary habits the questions need to be phrased and repeated to overcome this barrier. But it is often possible to discover a dietary habit, such as snacking or swilling acidic foods and drinks, and to give advice accordingly.

The situation with gastric reflux is more challenging.²⁴ Often those patients with more severe tooth wear may have an underlying or undiagnosed gastric reflux. The difficulty is how this is managed. If they have symptoms, which interfere with their quality of life, then a referral either to a general medical practitioner (GMP) or gastro-enterologist is needed. But quite often these patients have no symptoms and a referral to a GMP is impractical. In these situations it's worthwhile mentioning the possibility to the patient and if they develop symptoms to seek medical advice.

It is not the intention of this paper to review the role of attrition or abrasion. But the situation with bruxism has not significantly changed over the last 10 years and remains a small but important group of patients. In the UK, management is almost exclusively focused on splint therapy. These splints or mouth guards should provide full coverage of the occlusal surfaces and made in either heat cured acrylic or vacuum formed materials. They can be worn in either the upper or lower jaws.

Abrasion of teeth was recognised in the 1960s and was considered unlikely to be attributed to toothbrushing or toothpastes, unless the patient used excessive force.²⁵ Most

modern toothpastes are formulated to have minimal effect on wear. However, what has changed is the realisation that patients with dentine sensitivity have a similar clinical presentation to those with erosion. In patients with erosion or hypersensitivity they present with clean and plaque-free dentitions and the presence of caries and periodontal disease is rare. These patients tend to be highly motivated on oral hygiene practises. For both conditions the frequency of acidic food and drink consumption is important to the activity of the condition and so the same concepts of management are used to prevent the condition. Advice should be given to reduce the frequency of acidic food and drink intake and de-sensitising toothpastes used to control the conditions.

Restorative management is beyond the scope of this article, but in addition to fluoride application, sealing erosive lesions with a dentine bonding agent or fissure sealant (linked with a dentine bonding agent) are options for prevention.²⁶ Many patients either cannot afford or do not need their teeth restored with crowns or composites. In many cases the restorations lead to significant impact on maintenance and increased cost. Therefore, minimal intervention techniques are essential together with dietary control. It is also worth remembering that any restorative material placed in a tooth wear lesion may not last as long as a conventional restoration. When the underlying mechanism is purely erosion, which is rare, the prognosis is good, but in most cases there are additive effects particularly from bruxism, which significantly influences the outcome.

Conclusion

Tooth wear and in particular erosive tooth wear are common clinical findings which if left may compromise the longevity of teeth. Dietary control and fluoride or calcium based toothpastes have the potential to prevent progression.

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