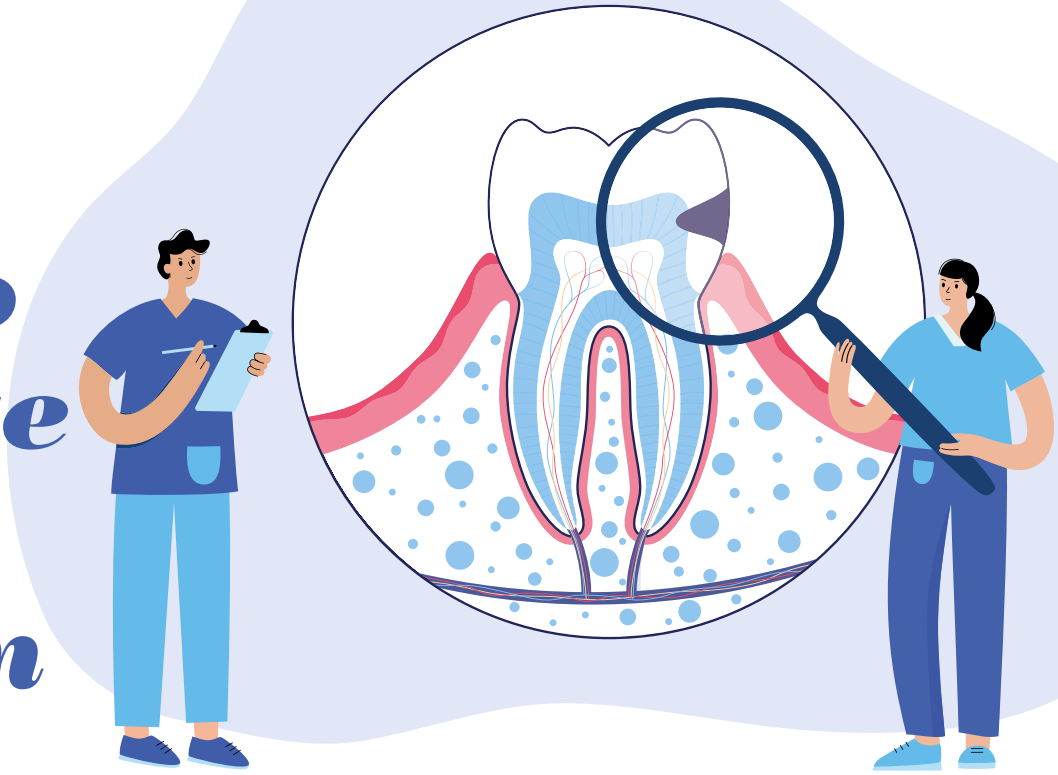
How to manage tooth erosion



Dental hygienist **Yana Mooney**[1] explains the features and causes of tooth erosion and discusses preventative care for 'at risk' patients.

Tooth erosion is a type of tooth wear resulting in irreversible tooth surface loss. It is caused by the chronic exposure of dental hard tissue to acid, not involving bacterial plaque.

Epidemiological studies have highlighted the increasing prevalence of tooth erosion especially among the young.[1] Modern diets, featuring the frequent consumption of smoothies[2] and energy drinks[3] are leading to earlier signs of tooth erosion in younger age groups.

Learning to recognise the physical features of tooth erosion is the first step in the dental hygienist and therapist's (DHT's) management of the condition. In theory, acid erosion can affect any tooth surface. The problems observed can include:

- Tooth sensitivity
- Poor dental aesthetics caused by enamel wear
- Dentine exposure, creating a dark tooth colour
- Chipping of incisal edges caused by attrition (tooth to tooth wear)
- Possible abrasion after heavy-moderate tooth brushing on a weakened tooth surface.

The tooth surface is altered so the enamel appears thinner and tooth morphology may be lost. The tooth surface may appear thin, smooth, shiny and more yellow in colour. Incisal edges become grooved with discrete areas of exposed dentine and occlusal cusps may become dimpled.

The acid causing tooth erosion is generated either intrinsically ie: stomach acid entering the mouth where commonly palatal, upper incisal and lower molar occlusal tooth surfaces are affected. DHTs may also notice soft tissues, such as the soft palate and back of the throat, are reddened and sore. Acid may be generated extrinsically eg: through an acidic diet where commonly buccal and labial areas are affected.

The chemistry of acid erosion

The dental hard tissue is made up of inorganic calcium hydroxyapatite crystal Ca10(PO4)6(OH)2, which becomes weakened during an acid attack. Calcium is released from the crystal structure – and substituted by relatively weakly attached minerals: sodium, magnesium, phosphate (PO4) and/or carbonate (CO3), and therefore the reformed hydroxyapatite crystal is more susceptible to acid dissolution,[4] creating a weaker softened enamel structure which is vulnerable to physical wear.

Medical history

On identifying a patient with the signs of tooth erosion, careful questioning is required to discover the potential risk factors.

Taking a medical history may reveal the patient has a condition such as 'Gastro-oesophageal reflux disease' (GORD) where stomach acid leaks via the oesophagus and

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into the mouth, eg hiatus hernia. Research shows that one third of adults in the West are affected by GORD every few days.[5] Remember patients may be unaware they have a condition like GORD and may describe an unpleasant sour taste in their mouth, possible heartburn or chest pains – in this case DHTs may recommend a GP appointment to eliminate any undiagnosed gastric problems.

If the DHT suspects that the eroded teeth may be a result of an eating disorder, it is important that questions are asked gently, eg: Are you aware of any acid reflux occurring in the past, where stomach acid may have entered your mouth? Patients with an eating disorder may have a history of bulimia or anorexia where self-induced vomiting has occurred. It shouldn't be assumed that only thin looking patients may be anorexic or bulimic. An adult patient's teeth may show evidence of acid reflux but this may have occurred as a result of purging food as a teenager. If the patient reacts awkwardly to your question, it's probably best to move on from the subject, recording details in the clinical notes. At this point, it may be worth suggesting your patient carry out a diet diary to help identify the cause of tooth erosion.

Diet

If a medical history is inconclusive in determining the cause of tooth erosion then a diet analysis is necessary. Extrinsic acids are acids introduced to the teeth generally through diet. In addition to smoothies and energy drinks, carbonated drinks, wines and fruit juices can also cause tooth erosion. The patient should be asked to carry out a four-day diary (including a Saturday and Sunday – as diet tends to alter slightly over the weekend) recording all the food and drink they consume. The recordings should include breakfast, lunch and dinner with snacks and drinks in between meals, remembering details like the type of tea drunk, if sugar is added, if it's a diet food and any sauces.

Analysis of the diet diary should be carried out by the DHT and advice given to the patient to help avoid potential erosive food and drinks.

The DHT should also consider the patient's social history. For example: the patient who has an active lifestyle, enjoys working out at the gym, athletics or body-building may rely on certain foods and drinks to improve their training and performance. The DHT should have an awareness of which food and drinks may be harmful and advise a possible alternative. A study carried out to determine the dental hazards associated with eight different sports drinks found that while sports drinks have erosive potential drinks, those which contain higher concentrations of calcium, phosphate and fluoride will reduce this erosive potential.[3] Diluting orange juice with water may be an option as well as choosing a drink that's fortified with Calcium and Vitamin D.

In summary, preventative advice might include:

- Avoid grazing on acidic foods or acidic drinks in between meals as the pH of the mouth is being frequently lowered which increases the risk of further tooth erosion
- Use a straw when drinking carbonated drinks, rather than sipping the liquid, to minimise contact on the teeth and avoid holding/swilling the acidic carbonated liquid in the mouth
- Avoid drinking acidic drinks at night time as saliva flow is reduced and acid contact may be most damaging to teeth
- Check the content of sports drinks and opt for those with healthy additives like calcium, phosphate and fluoride – or better still drink water or milk
- Avoid diet drinks – they can be more erosive.

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DHTs should always cross check medications taken by patients to find out if they are any side effects that may contribute to tooth erosion, eg: nausea, vomiting and/or dry mouth. For example, chemotherapy can cause vomiting, painkillers contain codeine which can cause sickness and nausea; meanwhile, antidepressants are known to reduce saliva flow causing dry mouth and so the natural buffering capacity of saliva is reduced and the acid neutralisation potential lost. Effervescing medicines like Vitamin C and dispersible aspirin can also be acidic. Pregnancy may cause regular nausea and spontaneous vomiting contributing to acid wear.[6,7]

Stimulating saliva flow

Saliva has a natural buffering capacity. It contains bicarbonates and urea which neutralise acid in the mouth returning oral pH to a safe pH of 5.5. Patients should be encouraged to chew sugar-free gum after eating or drinking. Chewing gum stimulates saliva which can neutralise the action of acidic foods and drinks on the teeth and can be a useful adjunct in the prevention of tooth erosion. Studies have shown chewing sugar free gum stimulates saliva production for up to two hours, and increases in both flow rate and pH is seen after chewing for 20 minutes.[8,9]

Oral hygiene instruction

Oral hygiene instructions should be tailored to a patient who is at risk of tooth erosion. The patient should be advised not to use a hard bristled toothbrush and to avoid a heavy scrubbing technique as this would encourage further wear on an already weakened tooth surface. Also consider if the dentine layer is exposed, as this layer has a lower inorganic mineral content, and toothbrush abrasion would be more likely. It would be best for patients to use a medium to soft manual toothbrush with a gentle brushing (modified bass technique) motion. Some patients may prefer to use an electric toothbrush to avoid a scrubbing technique by placing the rotating or vibrating head on the tooth surface still for two seconds. An electric toothbrush can help to limit the application of excessive force too as many have warning devices – like a flashing red light (Oral B Professional Range) – or bleep/buzz sound (Philips Sonicare Flexcare) - to alert patients when they are pushing too hard.

Patients should also be advised not to brush teeth immediately after consuming acidic foods or drinks or after an episode of acid reflux as the erosive action may be magnified by rubbing the acid on the tooth softened dental surface.

Fluoride advice

A recent review of literature has shown that fluoride can strengthen teeth against acid erosion. Receiving daily fluoride through toothpaste and mouthrinse and/or high-concentration fluoride toothpaste is the best method for protecting the teeth against acid erosion.[10] This is because the fluoride mineral incorporates into the dental hard tissue to form a stronger, more acid resistant Fluoro-hydroxyapatite crystal structure and is less susceptible to acid dissolution during acid challenges than the Calcium-hydroxyapatite crystal.[11]

Patients therefore should be encouraged to brush with a fluoride toothpaste twice a day and to spit out the fluoride toothpaste and not rinse with water after brushing to allow a fluoride residue to remain on the tooth surface. Regular use of a fluoride mouthrinse during the day, after lunch for example, can help remineralise the tooth surface. It may also be appropriate to encourage patients at risk of tooth erosion to use toothpaste with a higher concentration of fluoride eg: Colgate Duraphat 2800 ppm, and Duraphat 5000 ppm.

DHTs may wish to apply a fluoride varnish (high concentration fluoride) to a tooth surface which is at most risk of erosion. The protective varnish film containing fluoride will reduce direct contact between tooth surface and acid while delivering fluoride to strengthen enamel and dentine surfaces. An *in vitro* study on the 24-hour effect of Duraphat (2.26% F) varnish on molar teeth prior to submersion in a cola drink revealed that the fluoride varnish treatment increased enamel hardness and therefore limited enamel softening during the acid attack.[12]

Which toothpaste?

The wide choice of toothpastes on supermarket shelves can be baffling for consumers. It may be helpful if DHTs show patients how to read and recognise ingredients in toothpaste that can prevent tooth erosion.

For example: Toothpaste should contain 1450 parts per million fluoride as standard and may be presented as 'Sodium Fluoride (NaF) (1450 ppm F-)' or 'Sodium Monofluorophosphate 1.1% w/w (1450ppm F-)'.

In 2009, an evaluation of different fluoridated toothpastes found that *in situ* all toothpastes containing sodium fluoride had the ability to re-harden enamel previously softened with an erosive challenge and that in particular Sensodyne Pronamel and Sensodyne Pronamel Gentle Whitening offered a superior anti-erosion effect than other commercially available fluoride toothpastes.[13] Patients who are considered at high risk of erosion or exhibit dentine exposure may benefit from a toothpaste that is less abrasive and delivers fluoride.

A 2012 study on the effect of Sodium Fluoride (NaF), Stannous Fluoride (SnF2) and Titanium Tetrafluoride (TiT4) toothpaste on enamel and dentine erosion-abrasion found that toothpaste containing (SnF2) (1100 ppm F-)/(NaF) (350 ppm F-) combined eg Oral B Pro Expert toothpaste and (TiF4) (1100 ppm F-)/NaF (350 ppm F-) combined was the most effective in reducing enamel wear post acid exposure. The study also revealed that brushing with water alone was less abrasive and showed less enamel wear than brushing with a non-fluoride toothpaste.[14]

Professional remineralising products

As well as the use of fluorides, there is ongoing research into new agents such as GC Tooth Mousse CPP-ACP: Caesin Phosphopeptide-Amorphous Calcium Phosphate and GC Tooth Mousse Plus - Caesin Phosphopeptide-Amorphous Calcium Phosphate with fluoride and how they can help remineralise erosive lesions. A recent study illustrates how these agents control acid erosion by supersaturating the dental hydroxyapatite crystal with bio-available calcium and phosphate ions, limiting demineralisation and promoting remineralisation.[15] DHTs could consider advising patients to use GC Tooth Mousse as a daily alternative to toothpaste to help remineralise erosive lesions.

Conclusion

As DHTs it is our duty of care to recognise and help our patients prevent dental erosion. From the outset, it is essential that thorough dental records are taken, including photographs and study models, so a historical document and visual record of the teeth is available and tooth changes may be monitored over time. If DHTs observe from records that tooth wear is progressing, it may be necessary to consult with a dentist colleague regarding who will help decide on the best intervention for your patient. Discussions should be had on a suitable in-house protocol on how to manage, prevent and treat dental erosion.

References

1. Nunn J H, Gordon P H, Morris A J, Pine C M, Walker A. Dental erosion – changing prevalence? A review of British national children's surveys. *Int J Paediatr Dent* 2003; **13:** 98–105.
2. O'Sullivan E, Barry S, Milosevic A, Brock G. *Diagnosis, prevention and management of dental erosion*. 2013. Available at: https://www.rcseng.ac.uk/-/media/files/rcs/fds/publications/dental-erosion-2013.pdf (accessed October 2021).
3. Milosevic A. Sports drinks hazard to teeth. *Br J Sports Med* 1997; **31:** 28–30.
4. Featherstone J D B, Lussi A. Understanding the chemistry of dental erosion. *Monogr Oral Sci* 2006; **20:** 66–76.
5. Barlett D W, Evans D F, Anggiansah A, Smith B G N. A study of the association between gastro-oesophageal reflux and palatal erosion. *Br Dent J* 1996; **181:** 125–132.
6. Grace E G, Sarlani E, Kaplan S. Tooth erosion causing chewing aspirin. *J Am Dent Assoc* 2004; **135:** 911–914.
7. Giunta J L. Dental erosion resulting from chewable vitamin C tablets. *J Am Dent Assoc* 1983; **107:** 253–256.
8. Dawes C, Kubieniec K. The effects of prolonged gum chewing on salivary flow rate and composition. *Arch Oral Biol* 2004; **49:** 699–705.
9. Pollard K E, Higgins F, Orchardson R. Salivary flow rate and pH during prolonged gum chewing in humans. *J Oral Rehabil* 2003; **30:** 861–865.
10. Magalhães A C, Wiegand A, Rios D, Buzalaf M A, Lussi A. Fluoride in dental erosion – A Review. *Monogr Oral Sci* 2011; 22: 158–170.
11. Hicks J, Garcia-Godoy F, Flatiz C. Biological factors in dental caries enamel structure and the caries process in the dynamic process of demineralization and remineralization (part 2). *J Clin Pediatr Dent* 2004: **28:** 119–124.
12. Sorvari R, Meurman J H, Alakuijala P, Frank R M. Effect of fluoride varnish and solution on enamel erosion in vitro. *Caries Res* 1994; **28:** 227–232.
13. Barlow A P, Sufi F, Mason S C. Evaluation of different fluoridated dentifrice formulations using an in situ erosion remineralization model. *J Clin Dent* 2009; **20:** 192–198.
14. Comar L P, Gomes M F, Ito N, Salomão P A, Grizzo L T, Magalhães A C. The effect of NaF, SnF(2) and TiF(4) toothpastes on bovine enamel and dentine erosion - abrasion in vitro. *Int J Dent* 2012; doi: 10.1155/2012/134350.
15. Somani R, Jaidka S, Singh D J, Arora V. Remineralizing potential of various agents on dental erosion. *J Oral Biol Craniofac Res* 2014; **4:** 104–108.

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