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Medical Conditions and ETW

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Introduction

As a dental professional, there are many reasons why it is vital that signs and symptoms that suggest that an individual's ETW may be linked to a broader medical problem than just poor diet are picked on. Primarily, spotting an underlying medical cause for erosive tooth wear (ETW) increases the likelihood that further deterioration in the individual's oral health will be prevented. However perhaps more importantly, many of the medical conditions which are commonly related to ETW can have serious and even possibly fatal consequences if left untreated or not diagnosed: namely gastro-oesophageal reflux disease (due to its propensity to lead to premalignant changes in the oesophagus) and eating disorders (especially anorexia) which despite being uncommon, are the leading causes of mental health-related deaths, due to the effects of malnutrition and a result of suicide.

This paper will review the nature of the most common and serious medical conditions related to ETW and will discuss the role of the dental team in the diagnoses, prevention and management of these conditions.

Gastro-oesophageal reflux disease (GORD)

Symptoms of Gastro-Oesophageal Reflux Disease (GORD) are very common and roughly 10% of the population seek medical help for the condition. The prevalence is probably much higher and it has been estimated that as many as 65 % of the population suffer from the condition at some point in their lives (1). Gastro-oesophageal reflux (GOR) is a physiological phenomenon that occurs in the immediate period after eating (postprandial period). The bulk of the refluxate is cleared by peristalsis (coordinated contraction of oesophageal muscles) followed by neutralisation of any remaining acid by saliva. GORD is defined as "a

condition which develops when the reflux of stomach contents causes troublesome symptoms and/or complications. It is normally classified as: two or more heartburn episodes per week and adversely affecting an individual's wellbeing." This is often referred to as the "Montreal definition of GORD" (2).

The oesophagus is a hollow tube which controls the passage of food from the mouth to the stomach. At the lower end separating the oesophagus from the stomach is the lower oesophageal sphincter (LOS) and at the upper end is the upper oesophageal sphincter (UOS) separating the oesophagus from the mouth and pharynx/larynx. The LOS and UOS help stop regurgitated gastric contents into the oesophagus and the mouth and pulmonary system. The LOS allows some regurgitation of the gastric contents which is considered to be normal physiological GOR; however transient relaxations of the sphincter, an incompetent sphincter or problems with the muscles of the oesophagus can result in GORD. In pathological GORD, the number of relaxations of the LOS and hence the number of times the refluxate enters the oesophagus is increased and all the refluxate is not cleared from the oesophagus. In some instances the refluxate can travel further up passed the UOS. This can result in pharyngeal/laryngeal symptoms as well as ETW of the teeth (3).

Pathophysiology of Reflux

Most healthy individuals suffer from "indigestion" which tends to be triggered by consumption of certain foods and drinks including spicy foods, alcohol and large meals. The normal pH in the oesophagus is between 5 and 7. An episode of GOR is defined as pH at or below 4. However for those with GORD symptoms, the number and duration of GOR episodes resulting in oesophageal pH below 4 is increased, no particular triggers are needed

as the transient relaxations of the LOS occur and the symptoms interfere with the quality of life of the individuals (4).

Laryngo-pharyngeal reflux (LPR)

A related condition to GORD that may have more relevance to ETW is laryngo-pharyngeal reflux (LPR). The term is used for refluxate that travels above the UOS. Whilst a small amount of acid above the LOS and into the oesophagus is within normal physiological limits as indicated above, no acid travelling above the UOS and into the pharyngeal /laryngeal areas is considered to be normal. LPR is of particular interest to the dental profession as any acid entering the mouth and resulting in ETW needs to have travelled passed the UOS. The presentation of LPR may be different to typical GORD and this should be considered in diagnosis of GORD/LPR related ETW. Some individuals may suffer from LPR but have none of the typical GORD symptoms and diagnosis in this group of patients can be challenging (5-7) (Table 1)

Manifestations of GORD/LPR

Manifestations of GORD are many and can be classified into oesophageal (symptoms arising directly from the oesophagus) and extra-oesophageal (symptoms arising from structures other than the oesophagus (7-14)). (Table 2)

Oesophageal manifestations

The most typical oesophageal symptoms of GORD are heartburn and regurgitation. Heartburn is defined as a burning/pain sensation along the length of the oesophagus that can be felt in the substernal area but can radiate upwards to the throat. Heart burn is very common and has been reported by 15-31% of the population at least once a month and 15% of those diagnosed with GORD on a daily basis. Regurgitation is another commonly reported symptom which is defined as the movement of fluid into the pharynx/mouth.

Regurgitation is different to vomiting in that it is an effortless and involuntary movement of gastric contents passed the UOS into the pharynx/mouth. The prevalence of regurgitation is slightly less than heartburn but still high in GORD patients. Other oesophageal manifestations include dysphagia (difficulty swallowing), belching and bloating. These symptoms are not as commonly reported.

Extra-oesophageal manifestations

The extra-oesophageal manifestations can be divided into various categories: cardiac, pulmonary, Ear Nose and Throat (ENT) and Oral.

Non-cardiac chest pain (NCCP) is a symptom of GORD that can result in severe chest pain mimicking a heart problem and causing concern for the sufferer. The diagnosis can sometimes be challenging and cardiac assessments are sometimes carried out to exclude heart disease. This is a referred pain which occurs as a result of GORD.

Pulmonary manifestations can result in a chronic cough or GORD related asthma symptoms. Once the refluxate goes passed the UOS, it can enter the pulmonary system and result in aspiration and irritation of the pulmonary tissues. Pulmonary symptoms have been reported in some cases to be the only manifestations with none of the typical oesophageal symptoms being present.

Pharyngeal/Laryngeal manifestations can present as chronic hoarseness, globus (feeling of a lump in the throat), pharyngitis, laryngitis and inflammation of the vocal cords.

Oral manifestations are present if acid enters the mouth and comes into contact with the teeth. ETW is a well-known manifestation of GORD and the prevalence of erosion in patients with GORD has been reported to be between 5 to 47 % (14-21).

Barrett's oesophagus (BO) and oesophageal adenocarcinoma

The oesophagus in health is lined by squamous epithelium. At the gastro-oesophageal junction this is replaced by columnar epithelium. A change in this normal epithelium within the oesophagus from squamous to columnar is referred to as Barrett's oesophagus. This condition has been of great interest and is becoming increasingly so as it is premalignant, and can develop further into adenocarcinoma of the oesophagus in a small number of patients suffering with GORD. Although the condition affects older adults in the developed world, the incidence is increasing in patients less than 60 years of age. The true prevalence is unknown but it is estimated that 6% of patients with GORD symptoms have Barrett's oesophagus and the longer the symptoms have been present, the higher the risk. The severity of the symptoms is not necessarily indicative of a higher risk. Nocturnal reflux also seems to result in a higher risk. Assessment is by endoscopy and the condition is classified into Long segment Barrett's oesophagus (greater than 3 cm) (LSBO) or short segment Barrett's oesophagus (less than 3 cm) (SSBO). LSBO has a greater risk of progressing to adenocarcinoma. Sufferers of BO have a 40 fold higher risk of developing oesophageal adenocarcinoma compared with the general population (22, 23).

Silent reflux

Presentation of GORD can be divided into three main categories: symptomatic (oesophageal mucosal breaks together with symptoms), non-erosive reflux disease (presence of symptoms but no oesophageal mucosal breaks), presence of oesophageal mucosal breaks but no symptoms (silent reflux). Patients suffering from silent reflux suffer from GORD but do not complain of any symptoms of GORD. Interestingly, ETW can be detected in some patients who suffer from silent reflux and can be the only sign of possible GORD (2, 24).

Traditional methods of diagnosis of GORD

Traditionally GORD is treated by either taking over the counter medications, such as anti-acids, or if more troublesome in general practice by prescription medication and effects on symptoms of GORD. The two main symptoms generally considered are heartburn and regurgitation. In more severe cases and those that do not respond to medications, an endoscopy is carried out that allows visual inspection of the oesophagus for oesophageal mucosal breaks, inflammation or ulceration, as well as changes in the oesophageal lining suggestive of Barrett's oesophagus. This is then followed by 24 hour ambulatory pH monitoring which has been the gold standard for diagnosis of GORD. The specificity and sensitivity of the 24-h pH test is around 80% whereas for endoscopy it is much less (25)

The test however has many drawbacks: the pH catheter is inserted via the nose into the oesophagus and worn for 24 hours and therefore is uncomfortable. The patient is asked to follow their normal activities and diet; however the presence of the catheter affects the outcome. The system only measures acids and therefore is unable to detect non-acidic reflux, 24 hours is a relatively short time in some patients and reflux may not necessarily happen during the test period and hence a false negative diagnosis could be made. Another problem with this method is that the pH sensor is placed at the level of 5 cm above the oesophagus and hence any refluxate that travels high and in particular above the UOS cannot be detected and this may result in inaccurate diagnosis of LPR.

Recent developments in diagnosis of GORD/LPR

In recent years new methods of diagnosis have been introduced to overcome the problems mentioned above. Multiple pH catheters together with impedance measurements can overcome the problem of detection of acids higher up in the oesophagus as the pH sensors

are placed at various positions within the oesophagus. Impedance measurement allows detection of acidic or non-acidic refluxate.

Wireless pH monitoring, where a capsule is placed at 5 cm above the LOS at the time of endoscopy, allows more reliable diagnosis as it is more comfortable and better tolerated by patients and allows pH measurements for periods up to 96 hours. One such system is called the Bravo capsule (Bravo, Given Imaging, Yoqeam, Israel), which utilises radio-telemetric methods to detect acids.

The above methods are invasive. Ideally non-invasive and simple methods of diagnosis would have many advantages. One such method being developed is by the use of biomarkers in saliva and sputum. One such biomarker is pepsin, proteolytic enzyme that digests dietary proteins. Presence of pepsin in saliva and/or sputum could indicate the possibility of LPR. More work is needed to confirm the validation and accuracy of diagnosis by pepsin detection (6, 26-31).

Management of GORD

Traditional methods of management of GORD

Proton pump inhibitors (PPIs) are the first line of treatment of GORD symptoms and very effective in majority of patients. Other medications such as H₂ receptor antagonists and over the counter anti-acids are also used in some cases. PPIs inhibit gastric reflux and hence improve reflux symptoms. Although very effective, there are side effects associated with their long term use as well as a high cost to the NHS. Some of the reported side effects include gastrointestinal infections and hip fracture. There is also the problem of increased rebound gastric acid production which results in more severe symptoms once patients stop taking the medication which often results in

them having to continue taking the medication. Anti-reflux surgery is also used in patients who do not respond to PPIs well or in patients who do not wish to take PPIs long term. Both methods are effective but there is of course some morbidity and in rare cases mortality associated with surgery (32-34).

Non-pharmacological methods of management of GORD

Life style modifications in mild cases or in conjunction with medication in more severe cases are effective and safe. They are generally more effective in the management of GORD and not so effective in LPR, which is more difficult to treat. The general advice given is also very useful for the dental team to provide the patient with and a non-invasive method of management for their symptoms. These include: eating smaller meals and avoiding eating large meals, in particular prior to sleeping, decreasing alcohol consumption, cessation of smoking, reduction of weight and management of stress. Certain types of foods are also refluxogenic and should be limited, such as fatty foods, spicy foods, citrus fruit, coffee etc. Chewing gum has also been investigated as a useful method of control of symptoms and reduction of acid in the oesophagus. It is effective, harmless and beneficial in terms of oral health. Although some studies have investigated active ingredients in chewing gum to neutralise the acid, the main function of chewing gm is improvement in the salivary clearance and neutralisation. Chewing gum increases salivary flow rate and buffering capacity and increases the rate of swallowing. Clearance of acid from the oesophagus is via peristalsis and clearance of volume of the refluxate, which swallowing improve, followed by clearance and neutralisation by saliva (35).

Differences in the presentation of GORD and LPR

Table 1 below compares typical GORD with LRP. It is apparent that there are differences in the type of symptoms experienced, typical GORD being the more typical oesophageal symptoms such as heartburn and regurgitation; whereas with LRP the most commonly experienced symptoms of extra-oesophageal such as hoarseness, cough and globus. Pharyngeal pH measurement provides more accurate diagnosis for LRP as the refluxate travels high up in the oesophagus and beyond the UOS. In terms of treatment LRP is harder to treat successfully and a more aggressive treatment with PPIs are needed.

GORD/LRP and ETW

There is good evidence in the literature that GORD and ETW are related. Regurgitated or vomited stomach contents are highly acidic and repeated contact with the enamel and dentine results in ETW. The process is complicated and many factors influence the outcome. The duration of GORD, number and duration of episodes or reflux, whether the reflux happens during the day or at night (nocturnal reflux), how far up the refluxate travels and therefore how frequently it reaches the mouth, salivary flow rate and buffering capacity and individual variations in saliva and acquired enamel pellicle (AEP), as well as management of the symptoms are all factors that influence the presence and severity of ETW. The most commonly affected surfaces of the teeth are the palatal surfaces of the upper anterior teeth and occlusal surfaces of molars (Figure 1 and Figure 2), although this pattern can change depending on the direction of travel of the refluxate. As an example in Figure 3 only one side is affected in a patient who had nocturnal reflux and had a habit of sleeping on the same side (18, 36-41).

The essential role of the dental team in diagnosis and management of GORD/LRP

The dental team have a fundamental role in diagnosis and management of GORD-related ETW. ETW in these patients is severe and there is often catastrophic destruction of many teeth. Management and treatment of the affected patients is complicated, prolonged and costly. Correct diagnosis, prevention and minimally invasive management at an early stage are fundamental to future success and providing patients with a good quality of life and maintenance of teeth for life. Once the diagnosis is confirmed control of acid reflux is the main approach to prevent further destruction of the teeth, together with strengthening and protection of the teeth. This can be achieved by various available Fluoride containing products, protection of the teeth with dentine bonding agents, fissure sealants or resin composite restorations. Often in more complicated cases there is a need for changes in the occlusion and the OVD and most of the teeth need to be restored. This is due to the dento-alveolar compensation associated with the wear process (42-45).

The dental team however also has a fundamental role in detection and appropriate referrals so that a correct diagnosis can be made. As mentioned earlier, some patients who suffer with reflux disease do not have symptoms (silent refluxers), however they may suffer from ETW. The role of the dental team is not only to diagnose the ETW but also make appropriate referrals for possible diagnosis of GORD. Bearing in mind current methods of diagnosis and management of GORD, most of which are fairly invasive, and balancing that against conditions such as Barrett's oesophagus and oesophageal cancer, the decision to refer is not easy or straightforward. Patients who clearly have symptoms of GORD/LPR and ETW should be informed about the condition and the need to see their General Medical Practitioner in the first instance. Those without any other symptoms other than ETW need to be managed and counselled more carefully to make the correct decision. A thorough history and

examination taking all aetiological factors as well as a comprehensive history of all possible typical and atypical manifestations of GORD/LPR and ETW is essential. In future more minimally invasive methods of diagnosis such as detection of biomarkers like pepsin and non-pharmacological management of GORD GORD/LPR could improve the dilemma and decision making. There is no harm in providing the patients with preventive advice regarding ETW as well as possible GORD/LPR in terms of minimally invasive/non-pharmacological methods of management including the use of chewing gum in conjunction with close monitoring until such time that a referral may be appropriate.

Eating Disorders

The dental team also have a fundamental role in the management of eating disorders. Firstly because of clear links between poor oral health (namely ETW) and eating disorders (46, 47) also secondly because eating disorders are one of the leading causes of mental-health related deaths, whether due to the systemic effects of malnutrition or due to suicide (48). The dental team should be aware that the cardinal signs of an eating disorder are persistent abnormal behaviours designed to avoid food and food related activities, resulting in impaired physical and psychosocial functions (49). The two eating disorders with the strongest links to poor oral health are anorexia nervosa and bulimia nervosa, these are closely related but distinct conditions, shown in Table 3. Individuals with Anorexia relentlessly pursue 'thinness' and have a body weight which is lower than 85 % of ideal body weight. In contrast, bulimia is characterised by binge eating episodes followed by behavioural responses aimed at avoiding body weight gain, such as purging and laxatives, however body weight may be within or greater than normal limits (50).

It has been estimated that in the UK, based on UK hospital admissions data from 2012 to 2013, that there are currently over 725,000 people with an eating disorder in the UK, of whom approximately 90% are female (51). In addition the number of people being diagnosed and entering inpatient treatment for eating disorders in England alone has increased at an average rate of 7% year on year since 2009 (51). This high prevalence and increasing incidence is even more worrying when one considers the average treatment and recovery cycle lasts 6 years at the end of which there is a 63% relapse rate, carrying a risk of fatal consequences to the individual and an overall cost to society of around £15 billion per annum (51). Therefore as dentists our role of spotting the early subtle signs and making appropriate arrangements may be helpful in early identification which has a far better outlook for successful management (48).

Anorexia Nervosa

Patients suffering from this condition display an abnormal relationship with food which is driven by altered body image, despite being already thin. Anorexia has two clinical and overlapping subtypes: a restrictive type (i.e. calorific intake restriction) and binge/purge type (i.e. binge eating followed by purging aided by laxatives). The risk of developing any eating disorder is highest between for young men and women between 13 and 17 years of age, however females are diagnosed 10 times more commonly than males. The initial presentation is of gradual behavioural changes designed to limit high-calorie foods and later reliance on 'safe foods' without any calorific value. This manifests itself as missing meals or obsessively counting calories and the diagnosis of anorexia is made when less than 85% of target weight is reached. Depressive symptoms continue to perpetuate an altered body image distorting self-awareness despite obvious body changes to friends and family. Thus

treatment of anorexia is multilevel and multidisciplinary, involving a combination of psychological therapy (such as tailored cognitive behavioural therapy) followed by supervised weight gain, mostly through outpatient care however compulsory in-patient care via sectioning may be required *in extremis*. Recently published NICE guidelines have clarified the optimal nature of the multidisciplinary care that may be required for individuals : most commonly a multi-disciplinary team provide a combination of outpatient hospital care, cognitive behavioural therapy, family therapy and, for the most severe cases, inpatient care which can be long term and compulsory depending on the level of severity (52).

Bulimia nervosa

Bulimia nervosa involves cycles of binge eating an excessive amount of food followed by self-induced vomiting. The diagnosis is made when binge eating and vomiting occur more than twice a week for at least 3 months. The body weight for bulimics is generally within normal limits however but if weight drops then anorexia becomes part of the condition. Reliable data for the prevalence of bulimia in the UK is difficult to find, however as with all eating disorders, women are much more likely to develop bulimia than men, although this is changing, with an increased incidence amongst men. The condition can occur at any age however on average, it's onset is slightly later than anorexia, starting at around the age of 18 or 19.

Dental Implications of Eating Disorders

The connection between poor oral health and eating disorders has been shown in several studies, with the key pathology being enamel damage from gastric juices entering the oral cavity leading to ETW, however the lack of a healthy balanced diet can also lead to dental

caries (53, 54). Most commonly, the key presenting oral feature of an eating disorder is erosion of the palatal (lingual) surfaces of the maxillary anterior dentition (47).

2017 NICE guidance on recognition and treatment of eating disorders provides dentally focussed recommendations for mitigating the impact of vomiting on oral health. Specifically the guidance advised health professionals to encourage people with an eating disorder who are vomiting to: (52)

- have regular dental and medical reviews
- avoid brushing teeth immediately after vomiting
- rinse with non-acid mouthwash after vomiting
- avoid highly acidic foods and drinks.

It is important to note that the NICE guidance also states that dietary counselling should only be offered as part of a multi-disciplinary approach therefore as dental professional it is probably most important to focus our advice regarding the timings of oral care routines (especially with regard to vomiting as stated above) and also to consider the role that normal salivary flow plays in protecting enamel from erosion. Rytömaa et al. (55) reported decreased salivary flow rate in bulimics which was further corroborated by another study of 35 subjects with eating disorders also reported decreased unstimulated salivary flow rate and reduced bicarbonate levels. Therefore, it is likely that the abnormal salivary protection may exacerbate the dental erosion; however it is not easy to ameliorate this with clinically available methods despite the role of the saliva in erosion being an focus for ongoing research (18, 37, 56).

Rumination

Rumination is a rare condition that can cause severe ETW, in a pattern of ETW presenting similar to other eating disorders. Affected individual consciously regurgitate ingested stomach contents and then swallow again. They repeatedly raise their intra-abdominal pressure after meals and regurgitation occurs when one of these compressions coincides with swallowing and the associated relaxation of the LOS. Rumination occurs commonly in people with learning difficulties but it can affect other members of the population as well (57). The pathophysiology of rumination is poorly understood and has been incompletely studied. It is generally considered to be a psychological disorder although it has also been suggested that patients might suffer from GORD. The pattern of dental erosion is similar to other intrinsic causes with the first signs developing on the palatal surfaces of the upper incisors.

Chronic Alcoholism

Chronic alcoholism is a serious and complex condition with potentially life-threatening complications, and although difficult to precisely quantify the prevalence up to 10 % of the population are thought to drink over the recommended limits. Many alcoholics present with dental erosion related to regurgitated or refluxed stomach juice, although attrition due to bruxism has also been reported in alcoholics and perhaps more significantly alcohol increases the risk of oral cancer. The role of alcohol in ETW is two fold: primarily alcohol can result in gastritis and provoke gastroesophageal reflux and secondly alcoholics are less likely to have a healthy balanced diet and tend to eat more acidic foods and drinks. In studies linking alcoholism to tooth wear, the palatal surfaces of the upper anterior teeth were the worse affected (46).

Conclusions

This paper has reviewed the most common and serious medical conditions that are linked to Erosive Tooth Wear. There is a clear benefit to patients from the dental team picking up on the early signs of these conditions, which may be very subtle and difficult to detect. The dental examination should include the possibility of detecting signs of GORD and eating disorders and if detected appropriate referral and liaison with medical professional instigated. This will have benefits from protecting the enamel from erosive wear and more importantly may even lead to saving the patient's life.

Figures and tables



Figure 1 ETW affecting the palatal surfaces of upper anterior teeth and occlusal surfaces of the posterior teeth



Figure 2 Historical ETW affecting the palatal surfaces of the upper anterior teeth. These surfaces are generally affected by regurgitation ETW and as the staining is an indication that the wear may now be stable



Figure 3 Showing regurgitation erosion predominantly affecting one side of the mouth due to preferred sleeping position

Table 1 showing the differences in symptoms, test results and response to treatment for GORD and LPR

Symptoms	GORD	LPR
Heartburn and/or regurgitation	++++	+
Hoarseness, cough, dysphagia, globus	+	++++
Test Results		
Abnormal oesophageal pH monitoring	++++	++
Abnormal pharyngeal pH monitoring	+	++++
Response to Treatment		
Effectiveness of dietary and lifestyle modifications	+	+
Successful treatment with single-dose PPIs*	+++	++
Successful treatment with twice-daily PPIs	+++	++++

Table 2 showing typical and atypical symptoms of GORD

Oesophageal symptoms	Extra-oesophageal symptoms
Heartburn	Cardiac-Non cardiac chest pain
Regurgitation	Pulmonary-chronic cough, asthma
Bloating	ENT-hoarseness, laryngitis, pharyngitis
Belching	Oral-ETW
Dysphagia	

Nausea	
Barrett's oesophagus	
Adenocarcinoma	

Table 3 Possible Behavioural and Psychological signs and symptoms that someone may have an Anorexia Nervosa, Bulimia Nervosa or another eating disorder

	Signs that someone may have Anorexia Nervosa or another eating disorder	Signs that someone may have Bulimia Nervosa or another eating disorder
Behavioural Cues	<p>missing meals, eating very little, or avoiding eating any fatty foods</p> <p>obsessively counting calories in food</p> <p>taking appetite suppressants, laxatives, or diuretics (a type of medication that helps remove fluid from the body)</p> <p>leaving the table immediately after eating so they can vomit</p> <p>repeatedly weighing themselves or checking their body in the mirror</p> <p>physical problems, such as feeling lightheaded or dizzy, hair loss, or dry skin</p>	<p>an obsessive attitude towards food and eating</p> <p>an overcritical attitude to their weight and shape</p> <p>frequent visits to the bathroom after eating, after which the person might appear flushed and have scarred knuckles (from forcing fingers down the throat to bring on vomiting)</p>
Psychological Cues	<p>an obsessive attitude towards food and eating</p> <p>unrealistic opinions about body weight and shape</p> <p>depression and anxiety</p> <p>isolation – losing interest in other people</p>	<p>an obsessive attitude towards food and eating</p> <p>unrealistic opinions about body weight and shape</p> <p>depression and anxiety</p> <p>isolation – losing interest in other people</p>

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