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Diagnosis, Prevention and Management of Dental Erosion

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2013

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Introduction

Tooth wear is recognised as a major problem in both children and adults. The triad of erosion, attrition and abrasion has been known for many years but the contribution of erosion to tooth wear may be increasing. Dental erosion is the irreversible loss of dental hard tissue due to a chemical process of acid dissolution but not involving bacterial plaque acid, and not directly associated with mechanical or traumatic factors, or with dental caries. Attrition may be defined as direct tooth-to-tooth contact wear, whilst particles moving across and contacting the tooth surface results in abrasion. Erosion usually co-exists with attrition and/or abrasion, but one of these factors may be more significant than the others making differential diagnosis difficult.

B> Epidemiological studies over the past ten years both in the UK and abroad have elucidated the prevalence for dental erosion.[1] Prevalence data from cross-sectional UK studies indicates that dental erosion increases between different age cohorts of young people over time (Table 1).[2-14] Prevalence of any tooth wear in dentate English adults has increased from 66% to 76% between 1998 and 2008; moderate wear that has exposed a large area of dentine on any surface has also increased from 11% (1998) to 15% (2009).[15] This increase, however, is not uniform across age groups with greatest increases in adults seen in the youngest age groups. A recent systematic review reported that the prevalence of tooth wear in adults increases with age.[16] Whilst data could not indicate whether this increase simply reflected the ageing process, it is probable that the increase in moderate tooth wear is small in surveys conducted in England. Wear in younger adults is likely to be clinically important and is suggestive of more rapid tooth wear attributable to factors other than age.

This guideline aims to assist the dentist diagnose, prevent and manage erosion in children, adolescents and adults. This may be complex and require interdisciplinary long-term management and liaison with physicians.

1 Aetiology

Ideally, the aetiology of erosion should be identified prior to patient management. This is not always possible because of the difficulty in gaining an accurate and contemporaneous relevant history or because the patient may withhold important information regarding lifestyle or behaviour. Nonetheless, the identification and reduction of risk factors will improve the success of management. It is important, therefore, to question each patient about their medical history and medication with particular reference to gastro-oesophageal reflux disease and vomiting. The dietary intake of acidic foodstuffs may be quite high in certain cases and careful questioning on the intake of specific items of food and drink is necessary (see Table 2). Dietary associations with erosion are present but weak. Future research may establish causal relationships and the influence of co-factors in the erosive process. *In vitro* studies have identified dietary factors with erosive potential but further research is needed to fully understand causal relationships and co-factors such as risky behaviours that increase the risk of erosion.

In vitro studies show promise with respect to modification of drinks to reduce erosive potential.[17,18] Continuing acid exposure results not only in a clinically detectable defect, but also softens the tooth surface, making it more prone to mechanical impact. Erosion, therefore, rarely has an isolated effect on tooth wear, but interacts with other wear mechanisms (abrasion, attrition) to potentiate their effect.[19,20] The primary causative factor is not always apparent, however, it is clear for example that whilst enamel is scarcely abraded by normal tooth brushing, it is rendered far more susceptible to wear following an acid challenge.[21]

1.1 Intrinsic Acidic Sources

These are of gastric acid origin and may be associated with significant palatal dental erosion. Gastric acid enters the mouth secondary to gastro-oesophageal reflux, vomiting or rumination.

1.1.1 Gastro-oesophageal reflux disease (GORD) <B

This is common with up to 7% of adults in the Western World affected daily and one third every few

days. It is known to cause erosion in susceptible patients and should always be considered a possible cause for erosion in the presence of indigestion, heartburn or epigastric pain.[22,23] Extra-oesophageal symptoms including dental erosion, chronic cough, asthma and laryngitis have significant correlations with gastro-oesophageal reflux disease[24]; furthermore, reflux disease patients with frequent respiratory symptoms appear to have a greater prevalence of dental erosion than those without reflux-associated respiratory disorders.[25] Dental erosion in relation to GORD is less of a problem in children. This may be due to a shorter history of GORD or that refluxing is limited to the oesophagus.[26-28] (Table 3)

1.1.2 Vomiting

Vomiting may be spontaneous or self-induced and is often associated with an underlying medical condition. In children, Cyclic Vomiting Syndrome is recognised to be linked with irritable bowel syndrome, motion sickness, migraine and epilepsy.[29] Prolonged bouts of vomiting (weeks) can begin in pre-school children, occur throughout child development and reduce in frequency by adulthood. It is, therefore, self-limiting.

C> Self-induced vomiting is the commonest form of purging and weight loss in the eating disorders of anorexia and bulimia nervosa. Teenage females are particularly prone to abnormal eating behaviours. Athletes including professional jockeys have also been reported to engage in this habit.

1.1.3 Rumination

C> The ability to relax the lower oesophageal sphincter, reflux gastric contents into the mouth and re-swallow is uncommon but has been reported.[30]

1.2 Extrinsic Acidic Sources

1.2.1 Drinks and gum

B> Much emphasis has been placed on healthy food and drink in recent years with evidence that dietary practices and habits have changed.[31] The consumption of soft drinks with erosive potential, particularly in young age groups, is significant.[32,33] Evidence linking dental erosion with soft drink consumption is now emerging.[34] Some alcoholic drinks, such as dry wine, cider and alcopops are also acidic.[35-37] Alcohol consumption is linked with gastric reflux and erosion may therefore be from intrinsic and extrinsic sources.[38]

Carbonated beverages, fruit juices, including so-called smoothies, fruit flavoured mineral waters and flavoured (acid-based, sugar-containing) chewing gums are tangy or refreshing because of the acidity. Carbonated mineral water (sparkling water) has negligible erosive potential. Unlike demineralisation in caries, there is no clear-cut critical pH for erosion to occur, as even at low pH, other factors (such as beverage mineral content) may be strong enough to prevent erosion and conversely at higher pH, it is possible that chemicals (such as citrate) within beverages may complex calcium and thereby potentiate erosion. Several calcium-enriched beverages are available which reduce their erosive effect.[39] There is also some evidence that warming beverages may increase their erosive potential; this may be relevant with regard to the consumption of hot cordials.[40]

1.2.2 Foods

Fresh fruit, and in particular citrus fruit, have erosive potential as do foods pickled in vinegar. Less well known is the influence of covert acids in food stuffs that have been associated with erosion in teenagers e.g. brown sauce, crisps, ketchup, and vinaigrette.[41] <B

1.2.3 Medication

A number of medications such as vitamin C, aspirin and some iron preparations are acidic.[42] Furthermore, many medications induce a dry mouth and some induce nausea and vomiting. This potential co-morbidity has not been investigated widely.

1.2.4 Lifestyle

Active lifestyles, leisure and fashion trends can be associated with greater risk of erosion.[43,44] The use of mood enhancing drugs such as Ecstasy increases the risk of dental erosion/tooth wear.[45,46]

1.2.5 Environmental

Work related exposure to acids can result in dental erosion.[47]

1.2.5 Predisposing Factors

B> Although the aetiology of erosion is acidic substances from a variety of sources, there are some individual factors that may predispose to erosion, or indeed be protective. Saliva rates, buffering capacity and differing clearance rates from various parts of the mouth may modify the severity and distribution of erosion.[48,49]

2 Presentation and Diagnosis

Although acid erosion can affect any surface, it predominates on the maxillary teeth. Few studies have investigated the site specificity of dental erosion but most reports indicate that the incisal, palatal and occlusal surfaces are commonly affected with buccal or labial surfaces also being involved. Association studies indicate similar aetiology for erosive wear in maxillary incisors and mandibular first molars.[50] As enamel becomes thinner, chamfered ridges or ledges within enamel are visible and can be felt with a probe.

C> Cusp tips may be cupped and incisal edges become grooved with discrete areas of exposed dentine, which increase in area as the erosion progresses. There may also be incisal chipping and teeth may appear darker as dentine is exposed. Patients complain of poor aesthetics once a significant volume of enamel and dentine becomes lost, resulting in shortened upper teeth and/or dentinal exposure. This is the common complaint on presentation rather than sensitivity or any functional difficulty.

A diagnosis of dental erosion is made more difficult because of the triad of wear mechanisms and therefore careful history taking is important.

3 Management

Early diagnosis may stop the progress of erosion providing patients comply with dentists' advice. Careful examination of the most susceptible surfaces (upper labial & palatal of all upper teeth, occlusal of the lower first molars) under good lighting and on dry teeth facilitates diagnosis.

The main thrust of prevention is to change lifestyle and to record and monitor the erosion. A "wait and see" philosophy is recommended especially if patients have no complaints regarding pain/sensitivity, function or aesthetics. <C

3.1 Patient Information Leaflets

These are very useful and allow the patient to "go over" risk factors, behaviours etc. in their own time. Some companies produce patient information leaflets or they can be made "in house".

3.2 Recording Erosion

In children, study casts and photographs aid the monitoring of dental erosion. In adults, these methods are also satisfactory although safe storage of study casts can be problematic. A silicone putty impression of the worst affected area is more readily stored with the patient notes and may be a helpful tool to assess progression.

At a subsequent recall appointment, the putty index is sectioned labio-palataly and placed over the teeth. Any gap between the putty index and the tooth surface indicates progress of the erosion/wear and possible poor compliance with lifestyle changes. In children, growth and dento-alveolar development will preclude accurate seating of a putty index at review. A recall interval of one year is reasonable. <C

Epidemiological indices such as the Tooth Wear Index are tools for population based surveys and are not really applicable to monitoring at the individual patient level.[51] Dentists who use epidemiological indices to monitor wear should be aware of the diagnostic criteria and the need to maintain good intra-examiner reproducibility. The purpose of an index should be clear and valid. Recent indices assess clinical treatment need in erosion or tooth wear and attempt to monitor and/or screen. The ability to effectively achieve several goals with one index is questionable.[52,53]

3.3 Dietary Analysis

Record a minimum three-day diet history to include a weekend, times of food/drink consumption and bedtime.

3.4 Dietary Counselling

A> Whilst there is some evidence that one-to-one dietary interventions in the dental setting can change patients' behaviour, there is no robust evidence relating to the effectiveness of different strategies to apply when providing dietary advice for the prevention of dental erosion.[54,55]

C> Counselling must be tailored to the individual and is only possible after the diet has been thoroughly assessed. Specific points to emphasise are the limitation of acidic food and drinks to mealtimes. This is the time of maximum salivary flow and increased buffering capacity. Clear explanation of the difference between erosion and caries is often advisable as the public confuse these terms and believe them to be synonymous. This is especially relevant to artificially sweetened diet drinks, which can be as acidic as normal varieties. Chewing sugar free gum increases salivary flow and encourages tooth remineralisation[56] but this may not be the case for acid-containing gums.[57] Finishing a meal with cheese or milk will neutralise intra-oral acid.[58]

3.5 Behaviours

Four or more nutritional acidic intakes per day, in the presence of other risk factors (such as low buffering capacity of stimulated saliva, use of a hard-bristled toothbrush) is associated with higher risk for the development and progression of erosion.[59] Furthermore, increased contact time of acid with tooth substance (via holding or swishing drinks around the mouth) is likely to increase the risk of dental erosion as the drinking method strongly affects tooth surface pH.[60] It is therefore advisable that drinks are consumed quickly or if consumed slowly a wide bore straw placed toward the back of the mouth is advisable in order to reduce contact of acidic fluid with the teeth.[61,62]

3.6 GORD and Vomiting

Many patients with GORD self-medicate with over-the-counter medicines. Dentists should refer, with their permission, to the patient's GMP or a gastroenterologist.

Subjects with an eating disorder should receive appropriate medical help and psychological counselling although care is needed regarding the maintenance of confidentiality in teenage patients. <B

3.7 Oral hygiene, Remineralisation and Desensitisation

3.7.1 Fluoride mouth rinses, varnishes and desensitising agents, to aid remineralisation and decrease sensitivity.[63,64, 65,66]

3.7.2 Novel 'Enamel care' and high fluoride concentration toothpaste (caution in children under six years).[67]

Toothpaste application prior to an erosive challenge seems to be favourable compared with post exposure tooth cleaning. In practice it may seem unlikely that patients prone to erosive toothwear will execute a fluoride regime prior to an acid attack such as vomiting, although application prior to sleeping and overnight reflux may therefore be of benefit.[68] Nevertheless, the effectiveness of fluoride in typical toothpaste concentrations may be dependent on the acid attack.[69] However, some newer 'enamel care' dentrifices have been shown to provide enhanced resistance of enamel and dentine to acid challenge and aid remineralisation, although prospective randomised clinical trials have not been reported to date.[70-72]

3.7.3 Appropriate oral hygiene technique and low abrasive toothpaste.[73] <C

3.7.4 Sugar free chewing gum to increase salivary flow and aid remineralisation.[56]

3.7.5 Dentine bonding agents applied to areas of exposed dentine.[74]

Recent in vitro studies suggest that the modification of the enamel pellicle may play a role in the prevention of erosion.[75]

4 Restorative Treatment

Ideally, in both children and adults aetiological factors should be identified and brought under control. This may involve a period of monitoring as previously outlined before definitive restorative treatment is commenced. Clearly, the patient's desire to improve appearance and/or reduce sensitivity may hasten the start of interventional treatment.

4.1 Primary Dentition

In the primary dentition, if the child is not experiencing any symptoms restorative treatment is not indicated. If teeth are sensitive, small areas of erosion may be covered with composite resin.

C> Larger areas may require placement of composite crowns on anterior teeth and stainless steel crowns on posterior teeth. For severe symptoms, extraction of the offending teeth may be necessary.

4.2 Mixed dentition

In the mixed dentition stage, the permanent dentition should be treated conservatively by either long term monitoring or the addition of dental composite resin to eroded surfaces. Dentine bonding agents (without dental composite addition) can offer short-lived dentine protection (up to three months) whilst unfilled fissure sealant in combination with a compatible, self-etching, single-stage adhesive has been shown to confer protection to the palatal surface of maxillary anterior teeth from tooth wear for periods up to nine months.[76,77] The adaptive capacity of the stomatognathic system during growth may be greater than in adulthood and thus restoration of the eroded occlusion including guiding surfaces has not resulted in reports of postoperative problems.

C> Minimal space is required to bond composite resin without increasing the occlusal vertical dimension (OVD). Cupped and grooved surfaces can be restored to the enamel rim, which does not usually involve an increase in OVD. Dentine surfaces should be cleaned with pumice/water or slow speed rosehead burs prior to etching in order to remove the salivary pellicle and enhance bonding resin infiltration/penetration of sclerotic dentine. The poly-alkenoates or glass ionomers are themselves susceptible to acid erosion/dissolution and have no application in the eroding dentition.[78] There is also weak evidence that the surface hardness of microfilled composite and resin-modified glass ionomer is significantly reduced following short immersion in acidic beverages, although this has not been examined *in vivo*.[79]

4.3 Permanent Dentition

The management of erosion in the permanent dentition follows the guidance in the previous section.

Assessment of the space in intercuspal position (ICP) is essential. The bonding of composite resin is reversible, reduces any sensitivity and improves appearance. Eroded labial, buccal and palatal surfaces can be restored with composite, veneers or dentine bonded crowns. Cupped occlusal sites are very amenable to composite in-fill. A flow chart to aid treatment planning is shown in Table 4. <C

Direct composite resin restorations can provide an acceptable functional and aesthetic outcome whilst being cost effective, well tolerated and minimally invasive. Several longitudinal studies report good medium term success of restorations in both the maxillary and mandibular anterior dentition as outlined below. There should, however, be careful explanation of the trade-off between significant biological benefit with regard to the far less destructive nature of these adhesive restorations, versus their maintenance compared with more traditional restorative methods. <B

4.3.1 Palatal erosion of upper anterior teeth with no inter-occlusal space

The well-established management of this difficult restorative problem has been to provide a removable Dahl appliance.[80] This is in effect an anterior bite platform which provides a posterior open bite. It allows relative extrusion of posterior teeth and

intrusion of anterior teeth in order to gain space for the restoration of shortened, eroded upper anterior teeth.

B> Good patient understanding of the treatment is a prerequisite for success of this technique. Once space has been gained then restoration of the anterior teeth may be carried out by a variety of means.

Clinical studies have supported the concept of restoring the worn upper anterior teeth at an increased occlusal vertical dimension (OVD) without the interim stage of a removable Dahl appliance as the restorations themselves have a Dahl effect.[81] Localised temporary increases in the occlusal vertical dimension are extremely well tolerated and have become entirely predictable as a treatment modality.

B> There is good evidence that both direct and indirect palatal composite restorations placed according to manufacturers' instructions at an increased vertical dimension of occlusion perform favourably in combination with dentine bonding agents, although opinion suggests that these should be placed in relatively thick section to maximise their longevity.[82,83] Hybrid composites outperform microfilled composites and are therefore the composite of choice.[83] In general, major failure is uncommon in the first five years after placement, although minor wear, marginal discolouration and marginal fracture are likely.[83-85] The advantage with composite restorations, however, is their relative ease of maintenance, thus providing a viable, conservative short to mid-term treatment option with high patient satisfaction.

For localised maxillary palatal erosion, even contacts with restorations should typically be obtained on the six anterior teeth, with canine guidance in lateral excursions where possible. Periodontal health is a prerequisite to limit the possibility of teeth drifting. Direct composite application can be freehand or with the use of customised matrices. Various techniques have been described which are largely dependent on operator preference and the degree of laboratory support available. Contemporaneous summaries describing these methods are referenced for further support.[86,87]

4.3.2 Generalised erosion

Generalised erosion of many surfaces may also result in mandibular overclosure, but in many cases compensatory over-eruption is likely to maintain the existing OVD. Evaluation of the freeway space (FWS) has also been recommended in order to determine the need or otherwise of encroaching upon it in order to restore the teeth.

It is considered that in situations where the FWS is normal, management is more difficult. Restoration of worn teeth results in an increased OVD and the interim use of an acrylic appliance at the desired new OVD has been recommended. Clinical studies in adults have not reported any long term increase in temporomandibular dysfunction (TMD) or dental problems.[88-91] Restoration may be by way of conventional crown work or the application of adhesive technology such as composites or resin/dentine bonded crowns. Caution must be exercised in cases where full mouth rehabilitation is planned. Whereas application of bonding techniques is regarded as reversible involving minimal preparation, the preparation of multiple teeth for conventional crownwork requires great care in planning and execution. <B

Direct Posterior Composite Restorations

Few studies to date have examined the use of composite restorations for the restorative management of worn posterior teeth. Whilst an early study reported a high failure rate (fracture or complete loss of restoration),[92] a microfilled composite material was used and a hard acrylic stabilisation splint was not provided; later case reports using a hybrid composite resin and full coverage heat cured acrylic resin splints for ongoing supportive care may explain a far greater level of success, albeit on limited numbers of patients.[93]

Explanatory Notes

1 Aetiology

1.1 Intrinsic acid sources

1.1.1 Gastro-oesophageal reflux disease (GORD)

Reflux is the passive or effortless movement of regurgitated acid into the mouth. Vomiting involves a host of physiological events, co-ordinated in the medulla, resulting in the forceful propulsion of stomach and upper intestinal contents toward the mouth. Hypersalivation is a feature of both. Signs and symptoms associated with reflux are heartburn, retrosternal discomfort, epigastric pain and hoarseness or asthma-like symptoms.

B> However, symptoms are not reliable indicators of the presence or absence of GORD. Patients may be symptom free despite continuation of reflux and are described as silent refluxers. These patients can remain undiagnosed. Nearly 25% of adult patients presenting with extensive palatal erosion had pathological GOR diagnosed by standard criteria but did not have any symptoms of reflux.[22] In silent reflux, therefore, dental erosion may be the only clinical sign that reflux is occurring.

Excessive intake of alcohol, carbonated drinks and certain foods such as spicy food, and fatty food can provoke GORD. Neurologically impaired children have significantly higher levels of gastric reflux than healthy children with over 70% of children with cerebral palsy having abnormal reflux activity.[26]

The following are indications for referral to gastroenterology:

- If symptoms interfere with daily life
- Previous tests for GORD were either inconclusive or equivocal
- If after elimination of dietary factors and after a period of review, erosion progresses
- When there is no other obvious cause of erosion
- Severe erosion is present, which may be unilateral and affecting buccal surfaces

1.1.2 Vomiting

Vomiting may be spontaneous or self-induced and may be associated with a variety of medical problems. The prevalence of eating disorders (anorexia and bulimia nervosa) appears to be rising. Although it is often relatively easy for dental personnel to recognise these disorders, initiation of medical help is a sensitive undertaking.

In eating disorders, the frequency and duration of <B self-induced vomiting and the product of the two, the total number of vomiting episodes, were not linearly associated with the severity or number of eroded teeth.[94]

1.2 Extrinsic acid sources

1.2.1 Drinks

Mean consumption figures of soft drinks can hide important facts. Soft drink intake is much higher in younger age groups: soft drinks have been reported to provide as much as one fifth of the added sugars in the diet of 11-12 year old children and 42% of fruit drinks are consumed by children age between two and nine years.[95] Titratable acidity and the pH of the drink are important in evaluating the drink's erosive potential.

Frequency of, rather than total intake, may be critical <B in the erosive process. Drinks from a feeding bottle, used as a comforter, may be particularly harmful to infants with reported extreme dental destruction resulting from abuse of fruit juices.[96]

It is apparent, therefore, that those most likely to show the effects of erosion in the dental tissues from excessive fruit juice intake are children. Patterns of dietary intake in early life may well continue into adult life. In 1995 it was projected that 12-25 year olds would be drinking 50% more soft drinks by 2000.

1.2.3 Medication

An early report highlighted the erosive potential of chewable vitamin C tablets as well as iron preparations.[42] It is unlikely that these are in widespread use amongst children and adult population groups.

1.2.4 Lifestyle

It is not just the total exposure to acidic substances that appears to have increased in recent years; there have also been changes in habits and general lifestyle.

Undoubtedly there has been increased emphasis on a healthy diet and this involves a necessary increase in fruit and vegetable consumption. National campaigns for healthy eating have emphasised the importance of eating five pieces of fresh fruit or vegetables per day. More people are becoming vegetarian and this tends to be a more acidic diet. Lacto-vegetarians were reported to have significant dental erosion although the study has not been repeated in order to confirm this association.[97]

The frequency of intake of food is changing with greater numbers of snacks being consumed and a reduction in the number of meals eaten at home. This is commonly known as "grazing". A habit of frothing up carbonated beverages in the mouth has also developed along with constant sipping from canned drinks.

Encouragement to take regular exercise is of benefit to general health but excessive and frequent consumption of acidic sports drinks is not to be recommended.

In a multi cultural society there will be different habits, various traditional drinks, varieties of food not necessarily indigenous to the UK and different methods of food preparation. Little is known about these influences on dental erosion. Slaking palm with lime juice, betel nut chewing, crunching of chicken bones to savour the bone marrow have all been reported to increase the risk of tooth wear and erosion. Although not common amongst western cultures these habits will be common amongst other cultures that live in the western world. Dentists should be aware of these cultural differences and question patients about any habits that may increase the risk of wear.

1.2.5 Environmental

In adults, extrinsic acid sources include environmental causes such as contact with acids as part of work or leisure activity. Although reports of dental erosion in battery workers, sheet metal workers, laboratory technicians, professional wine tasters and competitive swimmers have been made, environmental factors are probably not common risks for dental erosion.[43,47,98]

3 Management

3.4 Dietary counseling

Counseling can only be given after thorough dietary analysis. It must be tailored to the individual on a positive basis to maximise compliance. Avoidance of acidic food and drink between meals, at bedtime and during the night is highly recommended. Although there is huge individual variation in salivary flow and buffering capacity it has been suggested that the use of chewing gum may help increase salivary flow and aid enamel remineralisation.[56] Finishing a meal with milk or cheese is also useful as this will help bring the oral environment back to a neutral pH.[58] Tooth brushing after an acid challenge is not advisable as acid softened tooth surfaces are more susceptible to abrasion.

3.7 Oral hygiene, remineralisation and desensitisation

Toothbrushing should be delayed for at least 20 minutes after an erosive attack and possibly up to 60 minutes because of the increased risk of abrasive wear on the softened/eroded surface.[99,100] <B

Patients with significant erosion and dentine exposure may complain of tooth sensitivity. It may also be an indication that the erosion is still active. The use of fluoride mouthrinses and varnishes are helpful but they must be used frequently and regularly. A high fluoride toothpaste may be helpful as long as it is not also highly abrasive. Other products such as specially formulated toothpastes for sensitive teeth or Tooth Mousse® may also be useful.

Table 1: Prevalence Studies

AUTHOR	YEAR OF PUBLICATION, NOT YEAR SURVEY CONDUCTED	AGE	SAMPLE SIZE	% WITH DENTINE EXPOSED	% WITH PALATAL/ OCCLUSAL/ LABIAL DENTINE EXPOSED	TEETH	SURFACES
O'Brien et al [2]	1994	5 12/14	{17,061}		24 2	U1" Incisiors U2" Incisiors	Lab/P Lab/P
Millward et al [3]	1994	4-5	178	48		All 1" teeth	All
Milosevic et al [4]	1994	14	1,035	30%	8	All 2" teeth	All
Jones & Nunn [5]	1995	3	135	17		U1" Incisiors	Lab/P
Hinds & Gregory [6]	1995	1½-4½	1496	-	8	U1" Incisiors	Lab/P
Smith & Robb [7]	1996	<26->65	1007	26% with extensive TW		All 2" teeth	All
Bartlett et al [8]	1998	11-14	210	-	2	All 2" teeth	All
Williams et al [9]	1999	14	525	11	1	U2" Incisiors	Lab/P
Walker et al [10]	2000	4-6 7-10 11-14 15-18	363 500 518 345		19 18 3 5	U1" or 2" Incisors First 1" or 2" Molars	Lab/P Occ
Al-Dlaigan et al [11]	2001	14	418	52		All 2" teeth	All
Dugmore & Rock [12]	2004	12	1,753	3		Incisors & First Molars	Lab/P B/O/L
Bardsley et al [13]	2004	14	2,351	53	10	All 12 anterior and occ of first molars	Lab, I, Pal
Chadwick and Pendry [14]	2004	5 12/15	{12698}		22 5	U1" Incisors U2" Incisors	Lab/P Lab/P

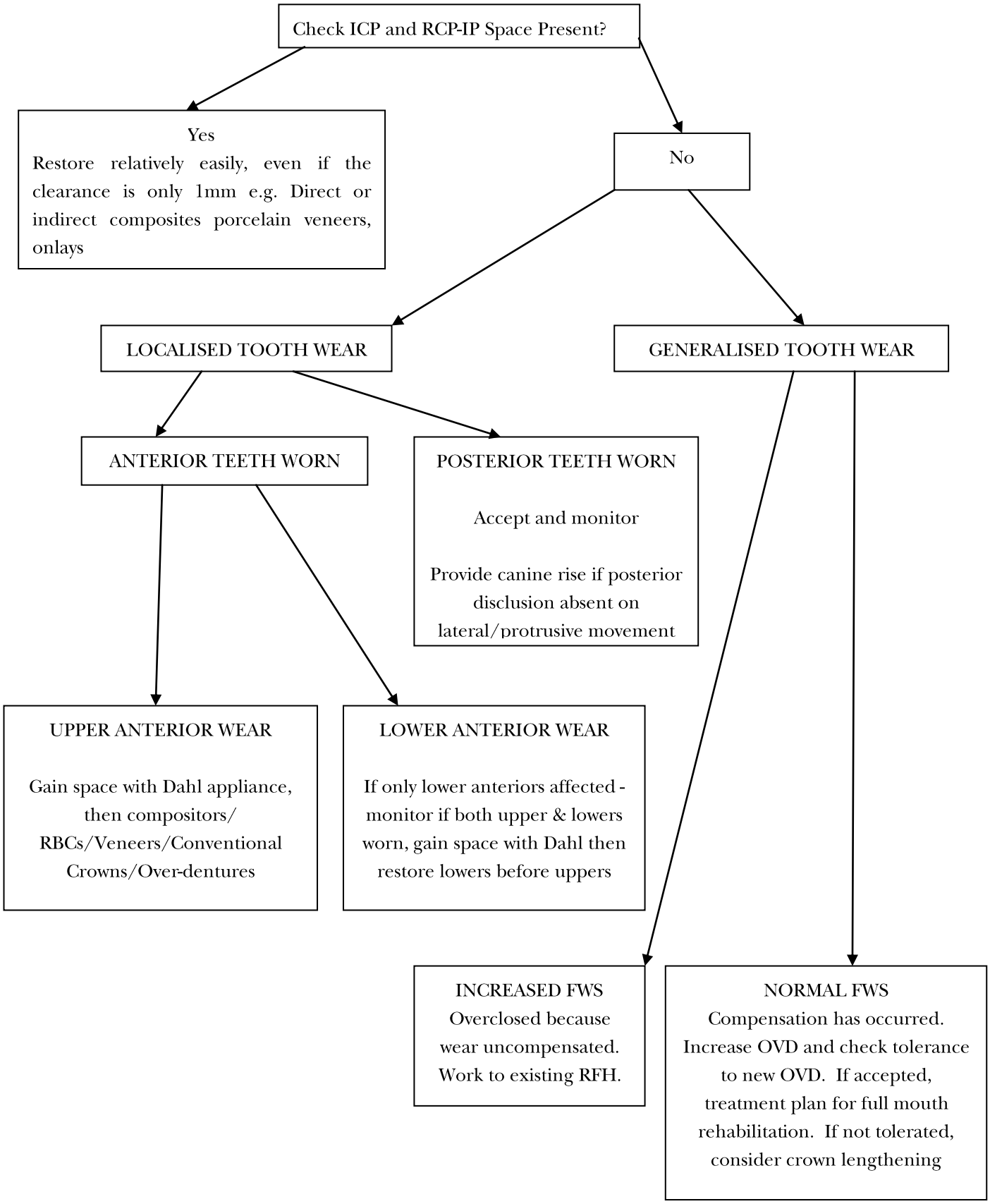
Table 2: Dietary Items With Erosive Potential

Beverages
Energy drinks
Carbonated or fizzy drinks excluding ordinary unflavoured sparkling water
Fruit juice excluding Ribena ToothKind
Certain alcoholic drinks e.g. alcopops, cider, white wine
Herbal Teas
Iced tea
Foods
Fruits especially citrus, grapes, sour apples
Sauces e.g. Ketchup, Brown Sauce
Snack foods e.g. salt & vinegar crisps
Vinegar and pickled foods
Habitual replacing of flavoured (acid based) gum*[95]
*Dentine erosion

Table 3: Principal Causes Of Gastro-Oesophageal Reflux

Sphincter incompetence:
Oesophagitis
Alcohol
Hiatus hernia
Pregnancy
Diet
Drugs e.g. Diazepam
Neuromuscular e.g. Cerebral Palsy
Increased gastric pressure:
Obesity
Pregnancy
Ascites
Increased gastric volume:
After meals
Obstruction
Spasm

Table 4: Flow Chart To Aid Treatment Planning For Tooth Wear



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