Diagnosis, Risk Factors and Management of Dental Erosion: An Evidence Based Report

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Figures: 5 Tables: 5

Abstract

Dental erosion is a condition of growing concern in the dental profession as it causes irreversible damage to the dentition in all ages of the population. This evidence based report reviews the literature on the diagnosis, risk factors, and management of dental erosion in the permanent dentition. A thorough search of electronic databases yielded 660 potential studies, 20 of which were critically appraised in the full text stage and 8 of which were considered relevant for inclusion in this review. Each study was assessed using the appropriate checklist for appraising evidence in health care. There were limited studies on the diagnosis of dental erosion, only one of which was an in vivo study. The evidence was not strong enough to recommend the use of this device for diagnosing erosion so future research regarding this technology is necessary before it can be recommended for clinical use. The studies on risk factors identified a number of intrinsic and extrinsic causes of dental erosion. Studies on the management of dental erosion identified glass ionomer as the best material for restoring erosion lesions. However, there were very few studies investigating the prevention of dental erosion. Review of the clinical evidence indicates that there is a need for further research on this topic, particularly on the diagnosis and prevention of dental erosion.

Introduction

Dental erosion is defined as the progressive, irreversible loss of hard dental tissues due to a chemical process not involving bacteria [1]. It is a common condition in developed societies that affects people of all ages [2]. The prevalence is not well documented since national dental surveys are not commonly conducted and rarely include measures of erosive tooth wear [3]. In addition, it is often difficult to compare the outcomes of different epidemiological studies on dental erosion due to the use of different examination standards, including scoring systems, samples and groups examined [2]. Since there is not currently enough data to draw conclusions about the prevalence of dental erosion, more studies are needed in order to better understand the epidemiology of this destructive condition.

The hard dental tissues, including enamel, dentin, and cementum, are critical to the integrity of the dentition, and the loss of these tissues can have significant consequences for the patient. The clinical appearance of dental erosion includes broad concavities on smooth surface enamel and increased incisal translucency, which can have undesirable esthetic implications [1]. Furthermore, loss of enamel can lead to dentin exposure and hypersensitivity, even progressing as far as pulp exposure in some extreme cases [1].

The clinical diagnosis of dental erosion must distinguish acid-induced hard tissue loss from other forms of tooth wear, such as attrition, abrasion or abfraction. The diagnostic procedure aims to classify wear based on clinically observed morphological features [4]. A number of indices have been proposed to diagnose and quantify dental erosion, but there is a need for standardization of indices and for the development of practical diagnostic tools [4].

Dental erosion is a multi-factorial condition with both extrinsic and intrinsic causes, consisting mainly of erosive acids. The most common extrinsic acids that can lead to erosion are

dietary acids, such as fruit, fruit juices, carbonated drinks, and sports drinks [1]. Behavioural factors can influence the impact of these dietary acids on the dentition. For instance, excessive consumption of acidic food or beverages, or unusual eating and drinking habits such as sipping an acidic drink over a long period of time, will increase the acid challenge to the teeth [5]. The erosive effects of acids are exacerbated by decreased salivary gland function. Saliva is a significant factor in the prevention of dental erosion since it helps to directly neutralize and clear acids, as well as forming a protective coat over the teeth and promoting remineralization [6]. Other extrinsic causes can contribute to erosion including oral hygiene products and medications with a low pH, such as toothpastes, fluoride rinses, and vitamin C tablets [5]. Environmental acids are also potential risk factors. People who work in battery factories are exposed to acid fumes and professional wine tasters sip low pH beverages for long periods of time; thus, these professions have been suggested to be high risk [7].

Intrinsic causes of dental erosion are gastric acids that are regurgitated into the mouth. This is seen in patients with gastroesophageal reflux disease (GERD) or with chronic excessive vomiting such as patients with anorexia, bulimia, alcoholism or gastrointestinal disorders [1].

Prevention of dental erosion is an essential component of managing the condition and protecting the dentition against further damage. If the cause is not correctly identified and treated, the destructive process will continue. For example, in a patient experiencing erosion due to the effects of GERD, it is essential that this be correctly diagnosed and that the symptoms of GERD be treated. Otherwise, any attempts to restore the damage to the teeth will be undermined by the continued loss of tooth structure. Improving salivary flow and applying fluoride to the teeth are also important preventive measures [8]. Restorative therapy of erosion is the other essential factor in the management of the condition. Restorations should be conservative, using adhesive

materials that require minimal preparation of the teeth in order to be effectively adapted to the remaining tooth structure [9].

The aim of this literature review is to examine the available evidence on the diagnosis, risk factors and management of dental erosion.

Methods

Search Strategy (Figure 1)

An initial search on Ovid Medline using a number of keywords and inclusion criteria identified 660 potential articles. A review of titles was performed independently by 2 group members and eliminated 586 articles. Another 54 articles were excluded at the abstract stage, again after review by 2 separate evaluators. Twenty articles were chosen to be read in the full text stage, 1 on diagnosis, 8 on risk factors and 11 on management. Two independent observers then performed a critical appraisal of the full text of each of these articles, leading to the inclusion of 1 article for diagnosis, 2 for risk factors, 1 for prevention and 4 for therapy.

Study Selection

Studies were deemed eligible for inclusion if they met the inclusion criteria. Controlled trials or randomized controlled trials (RCT) were selected for diagnosis and management while case control or cohort studies were included for risk factors. RCT for risk factors were not expected to be found as they would not be ethical. Another inclusion criterion was in vivo studies. On the other hand, non systematic review of articles, case reports, studies that were conducted in the primary dentition and in vitro studies were excluded at the title stage. The studies that were excluded at the full copy stage are listed in a rejection table (Table 1) along with

the critical appraisal that led to their exclusion. Please refer to Table 1 for more detailed information on the rejection of articles.

Validity Instrument

All articles examined at the full text level were scored using the appropriate checklist developed by Leake [9]. The article on diagnosis was scored using the "Checklist for assessing a diagnostic or predictive test" (Figure 2) with the maximum possible score being 10**.** The articles on risk factors were scored using the "Checklist for assessing causation" (Figure 3) with the maximum score being 13. Finally, the articles on management were scored using the "Checklist to assess evidence of efficacy of therapy or prevention" (Figure 4) with the maximum score being 17.

Data Extraction

A data abstraction sheet (Figure 5) was used to extract the relevant information from the articles chosen for inclusion in the literature review. Based on this information, evidence based tables were composed.

Results

Diagnosis

The majority of the articles found regarding diagnosis were in vitro studies and thus were excluded in the title or abstract stage. Only one in vivo study was found during the search (Table 2). In this study, researchers used metal discs as reference points to estimate the amount of wear by using a contacting laser profilometer to scan the impressions [10]. The wear was measured over a 6-month period in 13 patients with palatal erosion, and was compared with 7 controls. The study was not randomized or blinded and the sample size was small. Therefore, it received a low checklist score. Although this method did identify a greater loss of tooth structure in patients with dental erosion, this method is not applicable to a clinical setting because the scanning time was too long (about an hour) and the metal disks can be lost. Therefore, the study was designated as level D evidence since the time and cost involved in using this device for diagnosis does not merit its use. Other diagnostic methods are being investigated in laboratory settings that could hold potential for future use in measuring tooth wear in vivo [11, 12, 13] (Table 3). However, at the present time, no clinical study has been performed to determine the efficacy of these methods.

Risk Factors

The two included studies examining the risk factors of dental erosion identify a number of potential risk factors for the condition (Table 4). Both studies [14, 15] are case control design and scored 9 and 10, respectively, out of 13 on the checklist to assess efficacy. Due to ethical concerns, RCT is not a viable option for studying the potential causes of dental erosion and thus the highest level of evidence, A, could not be allocated to the studies. However, the studies did receive the highest level of evidence given the limitations of the study design, II-2 B. The

statistically significant factors that were associated with dental erosion included citrus fruits consumed more than twice daily, vomiting at least weekly, gastric symptoms, and soft drinks consumed at least 4 to 6 times per week [14, 15]. The non-statistically significant factors were sports drinks and unstimulated salivary flow rate less than or equal to 0.1mL/min.

Management

Two of the studies included on the restorative therapy of dental erosion indicate effective treatments for erosion [16, 17] while 2 of the studies showed no difference with the use of new restorative materials [18, 19] (Table 5). The first study evaluated the clinical performance of class V restorations using different materials [16]. This non-randomized clinical trial received a fairly high checklist score of 14/17 and the level of evidence was determined to be II-1 B due to the lack of randomization. All 3 restoration techniques used in the study were clinically acceptable for a number of criteria but the restorations that included GI were significantly more retentive. The second study [17] also showed increased retention with the placement of a GI liner and had a very high checklist score of 17/18. However, it received a level of evidence I-C because the study did not have a control. Both groups received the GI liner yet the authors concluded GI provided superior retention. Therefore, the evidence was deemed conflicting.

The third study [18] showed no difference in retention or any other property of the restoration when a new hybrid GI-resin composite was placed compared to the standard of care, a microhybrid resin. This randomized study was given a level of evidence I-B instead of the highest level, A, because the hybrid restoration was equally effective and met the ADA standards for approval but was not shown to be superior. The last study demonstrated that flowable resin composite as an intermediate layer in non-carious cervical lesions did not improve the clinical

performance of a microhybrid resin [19]. Since this study was a RCT and received a high checklist score, it was designated as level I E evidence.

The one study included on the prevention of dental erosion examined the potential preventive effects of an iron sulphate mouth rinse on dental erosion (Table 5). This randomized in situ study measures %SMH (Surface Microhardness) and Wear (Profilometry) [20]. It found less change in %SMH of enamel, not dentin, for the group that used the rinse compared to the control group. It also found a significant difference in wear in dentin for the group that used the rinse compared to the group that did not. However, the non-clinical setting of the study as well as the small sample size, short duration and the non-blinded design of the study accounts for the low checklist score (9/17) and the level of evidence II-C. More studies done in a clinical setting are needed to determine the true effectiveness of the mouth rinse in prevention of dental erosion.

Discussion

Diagnosis

At the present time, dentists commonly estimate tooth wear by comparing sequential study casts taken over long periods of time [12]. This method satisfies most clinical needs in deciding whether the patient requires restoration and prevention counseling. However, more accurate methods are useful if the dentists would like to detect tooth erosion earlier and begin preventive treatment immediately. Quantitative methods such as ultrasound, profilometry, and quantitative light-induced fluorescence have been suggested by different researchers as potential tools for diagnosing dental erosion more accurately[13, 14, 15]. However, most of these methods have not yet been tested clinically. Further research will determine whether they are suitable for measurement of tooth wear in vivo and thus whether they should be recommended for use in a clinical setting.

An important consideration for the diagnosis of dental erosion is whether expensive technological devices are truly necessary for diagnosis and whether they are worth the cost from the perspective of the patients and the dentists. If a trained clinician can detect the loss of tooth structure in a pattern suggestive of acid wear, then this should be enough to know that the cause of the erosion must be identified and eliminated and the damage must be repaired. Use of a device to measure the amount of tooth loss may not, in most cases, affect the course of action taken to treat the condition. Therefore, better development of standard indices for visual diagnosis may be a more practical and cost efficient goal for future research in the field of diagnosing dental erosion. Currently, erosion indices have been suggested by different researchers including Smith and Knight, Eccles, and Lussi [4]. However, development of a

universally accepted index could offer a means of assessing erosive tooth wear in a standard fashion.

Risk Factors

The two included studies on risk factors identified both intrinsic and extrinsic causes of dental erosion. However, there are some limitations to these studies that must be kept in mind when considering the results [16, 17]. Both studies used questionnaires to obtain information from the patients and there is always the potential for recall bias, especially when patients try to recollect events that took place in the distant past. In addition, the questionnaires included closed ended questions, which are restrictive and often take the form of a yes or no answer. These types of questions will not necessarily allow the patients to disclose all of the relevant information. A better method of obtaining the information would have been to incorporate open ended questions in the dietary questionnaire since these solicit additional pertinent information from the patients such as the frequency or duration of consumption of acidic food or beverages. Identifying this type of information may help the experimenter recognize individuals with extreme intakes or unusual habits who are not representative of the general population.

In one of the studies [17], patients were selected from a metropolitan area in Helsinki. An important consideration is whether data collected from this population can be generalized to the entire global population or whether there is an inherent characteristic of people in Helsinki distinguishing them from the rest of the world. Additional studies on a more global scale are necessary to determine whether the same risk factors apply to the entire population.

Dental erosion is known to be a multifactorial disease with a complex etiology. Therefore, it is difficult to identify individual etiologic factors that predispose people to dental erosion. In many cases, there may be additional factors besides exposure to erosive agents that lead to dental

erosion. For example, patients with enamel or dentin anomalies may be more susceptible to dental erosion and thus will suffer greater damage with exposure to the same erosive agent as patients with fully developed dentitions.

Management

The management of dental erosion consists of two essential components, prevention and therapy. The ultimate treatment for dental erosion is to prevent this irreversible damage from occurring in the first place. It is essential for dental professionals to have a strong understanding of the risk factors for erosion so that they can inform and educate their patients of how to avoid erosive damage. If dentists or hygienists perform a dietary analysis with patients who have a high risk of dental erosion or who are showing early signs, causative factors could be identified and the patients could be instructed as to how to modify their behaviour in order to preserve their dentition. Surprisingly, no studies were found regarding elimination of risk factors as a means of managing dental erosion. One study examined the use of an iron sulphate mouth rinse as a potential preventive measure. It is thought that the ferrous solution precipitates ferric phosphate on the enamel surface by reacting ferric ions from the solution with phosphate ions on the enamel surface, thereby forming a barrier. However, the results from this study were not clear, as the rinse had different effects on enamel and dentin. Further research would be required to recommend the iron mouth rinse for use in a clinical setting.

The other important aspect of managing dental erosion is the restorative treatment of the condition. There are many unfavourable consequences to dental erosion, including sensitivity and compromised esthetics. Restoration of lesions can be effective in resolving many of the problems, but without eliminating the cause of the erosion, the destructive process will continue. Many studies suggest that glass ionomer is the most superior restorative material for these types

of lesions [18, 19]. GI restorations undergo less stress and gap formation due to less polymerization shrinkage and thermal expansion/contraction. Use of a GI liner is thought to reduce microleakages by imparting some flexibility to the restoration.

It is important to recognize the limitations of these studies. The results of all four studies on the restorative therapy of dental erosion [16-19] were provided as a tooth level analysis as opposed to a patient analysis, which is not a valid way of interpreting the results. In these studies, multiple restorations were placed in every patient such that each patient received at least one restoration with every material being tested. It is invalid to assume that all the teeth restored in one patient are independent, as was the case in the interpretation of the results of these studies. In order to be accurate, the studies should have taken the mean value of each patient and compared those values at a patient level.

The two studies showing no difference in a new treatment [18, 19] did not provide power, which is another important limitation to keep in mind. In order to conclude that there is no difference in treatment, power should be stated.

The available literature regarding the restorative therapy of dental erosion mainly tested restorations in cervical non-carious lesions, including erosion as well as abfraction and abrasion lesions. Future studies focusing specifically on erosion lesions would provide more definitive evidence regarding the best material for restoring these lesions.

Conclusion and Evidence Based Recommendations

The current evidence on the diagnosis of dental erosion was determined to be II-1 D. Use of the available technological devices for diagnosis is not recommended due to the time and cost involved in using these devices. There is fair evidence (II-2 B) regarding the risk factors of dental

erosion, which identifies a number of predisposing factors. The predominant causes of dental erosion are citric fruits and gastric reflux. The evidence concerning the preventive effect of an iron mouth rinse is conflicting (I-C) due to the differing influence on dentin and enamel. While there is fair evidence (I/II-1 B) to recommend the use of GI as a restorative material in the treatment of dental erosion, there is strong evidence not to use flowable resin composite as an intermediate layer (E) since there was no improvement in the restoration but there was an added cost to using the material.

Recommendations for Future Studies

There is a need for more studies regarding both diagnosis and prevention of dental erosion. While many devices have been tested in vitro to diagnose erosion, clinical studies are necessary in order to establish their application to a clinical setting. Since diagnostic instruments will inevitably be expensive and may serve only to confirm the presence of a condition that had already been suspected, a more pragmatic goal for future research would be to create standard indices for visually diagnosing the condition. The current evidence surrounding the prevention of dental erosion is extremely limited. Prevention is a critical aspect of the management of this condition since any restorative therapy placed in an erosive lesion will not protect the rest of the remaining tooth structure from erosion. Unless the causative agent is eliminated, the destructive process will continue. Further research is needed regarding the best means of identifying and removing the cause of the erosion in order to prevent the worsening of the condition

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Figure 1: Search Strategy

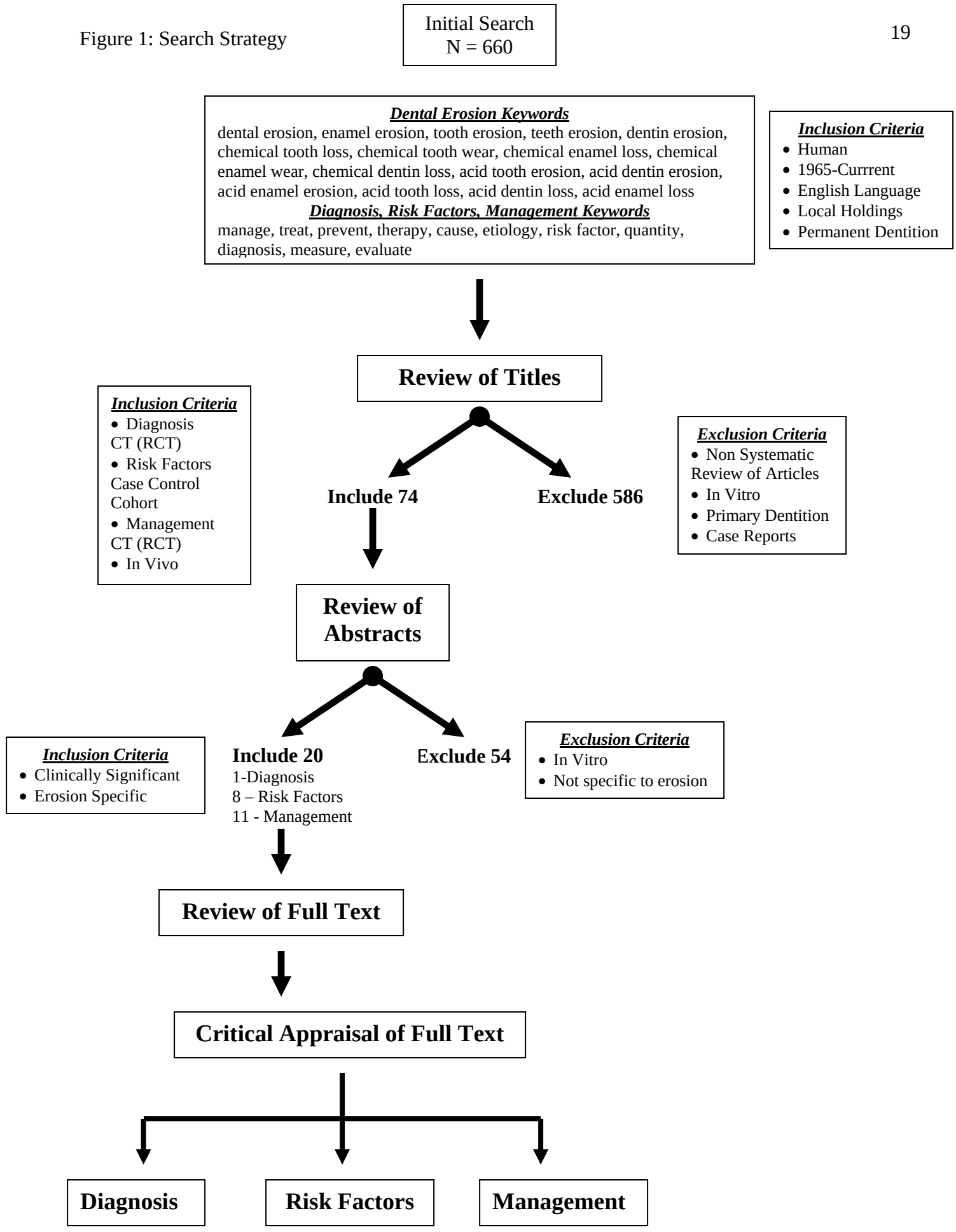

Figure 2: Checklist for Assessing a Diagnostic or Predictive Test

Checklist for Assessing a Diagnostic or Predictive Test

Citation: _____
_____

1. Was the study ethical? ____

2. Is the test clearly described (including the cut-off values)? ____

3. Was the test evaluated against a valid gold standard? ____

4. Were the test results and disease status determined independently? ____

5. Was the test evaluated using patients with a range of severity of disease? ____

6. Was the test evaluated among patients with diseases that might be confused with, or are closely related to, the disease of interest? ____

7. Is the test performance reported using sensitivity/specificity, likelihood ratios or ROC curves? (Note: if predictive values, only, are reported, was the background prevalence of disease similar to that of your patients ____

8. Is the effect of moving the cut-off point reported? ____

9. Does this test give better results than the current or standard test? ____

10. Is the test likely to be acceptable to patients? ____

Figure 3: Checklist for Assessing Causation

Checklist for Assessing Causation

Citation: _____
_____

Is the etiological agent infectious? If "Yes", use 5A) test. If "No", use 5B) tests.

1. Was the study ethical? ____

2. Was a strong design used to assess causation or risk? ____

3. Were cases defined validly and reliably measured? ____

4. Were the risks validly and reliably measured? ____

5. For diseases with multi-factorial risks, were the risks assessed controlling for other factors and was the model's prediction power strong ____

6. Do the findings meet the tests for causation? (Use either A or B tests)

A) Koch's test for infectious agents
1. Was the organism present in every case? ____
2. Was the organism isolated and grown in a pure culture? ____
3. Was the organism able to produce a specific disease when inoculated in an animal model? ____
4. Was the same organism recovered from the sick animal? ____

B) Tests for causation of non-infectious agents.
1. Did the "cause" precede the effect? ____
2. Was the estimate of risk beyond chance, and large? ____
3. Was there a dose-response relationship? ____
4. Was reversibility demonstrated? ____
5. Is the "cause" consistently observed in different times, places? ____
6. Is the "cause" biologically plausible? ____
7. Is the "cause" specific to that disease? ____
8. Is the "cause" analogous to another established disease/exposure? ____

Figure 4. Checklist to Assess Evidence of Efficacy of Therapy or Prevention

Checklist to Assess Evidence of Efficacy of Therapy or Prevention

Citation: _____
_____

1. Was the study ethical? ___

2. Was a strong design used to assess efficacy? ___

3. Were outcomes (benefits and harms) validly and reliably measured? ___

4. Were interventions validly and reliably measured? ___

5. What were the results?

    Was the treatment effect large enough to be clinically important? ___
    Was the estimate of the treatment effect beyond chance and relatively precise? ___
    If the findings were "no difference" was the power of the study 80% or better ___

6. Are the results of the study valid?

    • Was the assignment of patients to treatments randomised? ___

    • Were all patients who entered the trial properly accounted for and attributed at its conclusion?
    i) Was loss to follow-up less than 20% and balanced between test and controls ___
    ii) Were patients analysed in the groups to which they were randomised? ___

    • Was the study of sufficient duration? ___

    • Were patients, health workers, and study personnel "blind" to treatment? ___

    • Were the groups similar at the start of the trial? ___

    • Aside from the experimental intervention, were the groups treated equally? ___

    • Was care received outside the study identified and controlled for ___

7. Will the results help in caring for your patients?
    Were all clinically important outcomes considered? ___
    Are the likely benefits of treatment worth the potential harms and costs? ___

Figure 5: Data Abstraction Sheet

Abstracting the evidence for a proposed new treatment

Authors, (Title), Year of Publication

Population description: (Location, age, sex, representative or special, disease status)

Intervention (Test treatment)

Control (Control treatment or placebo)

Outcome

Critical appraisal comments/score

Conclusion

Design strength and classification of recommendation

Table 1. Rejection Table for Risk Factors and Management

Risk Factors

Article	Reason for rejection
Valena V, Young W. Dental erosion patterns from intrinsic acid regurgitation and vomiting. [Journal article] Australian Dental Journal. 47(2):106-115. 2002	• no criteria or protocol as to identifying or scoring cases in the study. No severity of disease was examined. • Subjects were not reflective of the general population. Only incorporated individuals that came from a certain region to a dental clinic for tooth wear. • Used structured verbal interview rather than anonymous questionnaire to ask patients whether they had bulimia nervosa or GORD. High chance of underreporting of cases. • Study was too long in duration. Time frame and recall for examination and controls exceeded two years. • Score for critical Appraisal for causation <9/13
Bader J, McClure F, Scurria M, Shugars D, Heymann H. Case-Control study of non-carious cervical lesions. [Journal Article] Commun Dent Oral Epidemiol.24:286-91. 1996	• Poorly defined cases. Absence of well defined clinical anatomical features introduced subjectivity. • Subjects were not reflective to the general population. Subjects recruited from North Carolina school of Dentistry treatment planning clinic for diagnostic examinations. • Questionnaire did not capture accuracy and extent of change concerning medical history, diet. Closed-ended questions • Questionnaire contained medical terminology and jargon that could confuse the patient. • Score for critical Apprasal for causation <9/13.
Arnadottir I, Saemundsson S, Holbrook P. Dental Erosion in Icelandic teenagers in relation to dietary and lifestyle factors. [Journal Article] Acta Odontol Scand. 61:25-28. 2003	• Subjects were not reflective of the general population. Study only looked at 15 year old boys. • Poorly controlled for confounding factors. Did not incorporate salivary flow rate, GERD etc. • Questionnaire was based on a multiple choice format. • Score for critical Appraisal for Causation <9/13.
Milosevic A, Lennon M, Fear S. Risk factors associated with tooth wear in teenagers: a case control study. [Journal Article] Community Dental Health. 14:143-147. 1997.	• Loss due to follow-up and no response of 40% of subjects in the study. • Study over-looked all age groups except fourteen year olds. • Questionnaire included non-relevant questions including attrition and clenching habits which are not associated with dental erosion.

	• Questionnaire failed to capture very high intake of dietary food products, thereby preventing a possible dose-response relationship • Score for critical Appraisal for Causation <9/13.
Schroeder P, Filler S, Ramirez B, Lazarchik D, Vaezi M, Richter J. Dental Erosion and Acid Reflux Disease. [Journal Article] Annals of Internal Medicine. 122(11):809-815. 1995	• Small sample size in control group. Study contained only 12 cases. • Not all patients had 24hr-esophageal pH testing, indicating a possible selection bias. • Salivary flow rate was not measured in controls • Score for critical Appraisal for Causation <9/13.
Moazzez R, Anggiansah A, Bartlett D. The Association of Acidic Reflux above the Upper Oesophageal Sphincter with Palatal Tooth Wear. [Journal Article] Caries Research. 39:475-478. 2005	• Cases and Controls were not matched 1:1. Study examined 31 cases and only 7 controls • Study very short in duration. Only a three month investigation. • Cases were significantly older than controls. (avg years: 43.2yrs vs 22.6 yrs) • Lack of statistical analysis: no OR, PAR included. Study incorporated only non-parametric methods (interquartile range, and median) • Score for critical Appraisal for Causation <9/13.

Management

Charbeneau GT, Bozell RR. Clinical evaluation of a glass ionomer cement for restoration of cervical erosion. *JADA* 1979; 98: 936-939	• Not randomized • No statistical/data analysis • No Confidence Intervals utilized • Did not utilize USPHS • Short Duration (6 Months)
Peumans M, Meerbeek BV, Lambrechts P, Vanherle G. Two Year clinical effectiveness of a resin-modified glass-ionomer adhesive. *American Journal of Dentistry* 2003; 16(6): 363-378	• Not randomized • No statistical/data analysis • No Confidence Intervals utilized • USPHS not used
Tyas MJ. Clinical evaluation of five adhesive systems *American Journal of Dentistry* 1994; 7(2): 77-80	• Short Duration (14 Months) • Not Blinded • Groups not similar at start of trial • Groups were not treated equally

	• Author suggests further ”external validity” required
Powell LV, Gordon GE, Johnson GH. Clinical evaluation of direct esthetic restorations in cervical abrasion/erosion lesions: one year results *Quintessence International* 1991; 22 (9): 687-692	• Not randomized • No Power given • Short duration (1 year) • Not blinded • No information provided about the cases/control groups
Van Dijken JWV. A 3-year evaluation of Gluma and Gluma/ Scotchband for restoration of cervical erosions. *Scand J Dent Res* 1990; 98: 341-344	• Not randomized • Treatment effect not large enough • Treatment effect not beyond chance • No Power provided • Not Blinded
Trombelli L,Scapoli C, Tatakis DN, Grassi L. Modulation of clinical expression of plaque-induced gingivitis: effects of personality traits, social support and stress. *J clin Periodontol* 2005; 32: 1143-1150	• Study has nothing to do with dental erosion • Not clinically significant to the topic of interest

Table 2. Evidence Based Table for Diagnosis

Evidence-based Table for Diagnosis

Author, Date, Title	Population	Outcome	Critical Appraisal Comment	Conclusion, strength of evidence and classification
Bartlett, D.W. et al, 1997. Measurement of tooth wear in patients with palatal erosion.	13 Pt with erosion; 7 controls	Using profilometry, Pt with erosion were measured with 36.5um (range: 17.6 – 108.2um) of wear and controls had 3.7um (range: 0.5 – 15.8 um) of wear over six months	-No blind evaluation -Not randomly assigned -Small sample size -Problem with metal disc retention	II-1, D At present, unacceptable clinically because scanning of impression is too slow.

Table 3. Table for Non-clinical studies on Diagnosis

Author, Date, Title	Sample size	Outcome	Conclusion
Tagtekin et al, 2005. Thickness Measurement of Worn Molar Cusps by Ultrasound	12 extracted human molar twith worn cusp	Ultrasonic and histological measurements were oderatly correlated ($r = 0.601$, $p < 0.01$)	Potential for nondestructive method to measure enamel thickness. But improved accuracy is needed
Ganss, C et al, 2005. Comparison of Calcium/Phosphorus Analysis, Longitudinal Microradiography and Profilometry for the Quantitative Assessment of Erosive Demineralisation	237 human molars specimen for each analysis.	CA and PA, PM and LMR revealed a good linear correlation, erosive loss was linear over time	All methods can only be used to measure tooth slabs in vitro and in situ.
Pretty, I.A. et al, 2004. The validation of Quantitative light-induced fluorescence (QLF) to quantify acid erosion of human enamel	30 extracted human premolars	Strong positive correlation between QLF and Tranverse Microradiography (TMR). $r = 0.91$	Non destructive, longitudinal tool for use in vitro, in situ and possibly in vivo

Table 4. Evidence Based Table for Risk Factors

Author, date	Population (Age, sex, location	Outcome	Critical appraisal comments/ strength of study / conclusion
Järvinen, Rytömaa, Heinone, 1991	Questionnaire of dietary intake, saliva sample and gastric symptoms Cases: n=106 (avg 33.1 yrs) Controls: n= 100 (avg 36.3 yrs) -representative of Helsinki population	*Adjusted Odds Ratio and Population Attributable Risk for Factors Associated with Dental Erosion:* Citrus fruits: OR=37 95% CI: 4-369 PAR: 26% Vomiting: OR=31 95% CI: 3-300 PAR: 23% Other gastric symptoms (acid taste in mouth, belchcing, heartburn, stomach-ache, gastric pain): OR: 10 95%CI: 4-22 PAR: 67% Apple vinegar: OR:10 95% CI: 2-57 PAR: 15% Soft drinks: OR: 4 95% CI: 2-10 PAR:26% Sports Drinks: OR: 4 95% CI: 1-14 PAR: 15% Saliva unstim: OR: 5 (<0.1mL/min) 95% CI: 1-18 PAR: 19%	II-2 B -logistic multivariable regression -Dose response obtained -Issue of generalization beyond the Helsinki popluation
Moazzez, Bartlett, Anggianseh, 2004	Questionnaire of dietary intake 24 Ambulatory pH monitoring, salivary flow and buffering capacity. Cases: n=106 (avg 44 yrs) F:M, 44:31 Controls n=31 (avg 42 yrs) F:M 18:13	*Outcome measure of Mean (standard deviation), score 2 and above and score 3 and above on all tooth surfaces using Smith and Knight tooth index for Dental erosion.* Score 2 and above: cases (23.8 +/- 53.4)vs controls (8.2 +/- 8.6) $p<0.001$ Score 3 and above: cases (5.4 +/- 18.5) vs controls (0.2+/- 0.9) $p<0.005$	II-2 B No significant differences in age or gender between groups Non parametric methods Mann-Whitney-U test for comparison 24 hr ambulatory pH study

Table 5. Evidence based table for Management

Author, Date, Title	Population Description	Intervention (Treatment) Type	Control Group	Conclusion, Critical Appraisal
THERAPY				
L V Powell/G H Johnson/ G E Gordon, 1995, Factors Associated with Clinical Success of Cervical Abrasion/Erosion Restoration,	- 25 Patients (Min 3 non-carious lesions) - All lesion 1mm in axial depth - Total of 116 lesions - Population (42-85 yrs) mean 70yrs	- 3 treatment types placed in each patient having 3 or more non carious lesions - Type 1: glass ionomer restorative material (Ketac-Fil) - Type 3: composite with dentin bonding agent and glass ionomer liner (Silux, Scotchbound and Vitreobond)	- Type 2: composite with dentin bonding agent (Silux with Scotchbound)	- All 3 Techniques, GI cement (Type 1), CR with dentin bonding agent (Type 2) and CR with dentin bonding agent and GI-liner (Type 3) were clinically acceptable for color match, minimal marginal staining, surface texture, and caries development. - The GI cement (Type 1) and GI liner restorations (Type 3) were significantly more retentive. - Study is focusing only on older age group (mean 70 yrs) and thus study needs to look at various age groups to avoid bias results - Not randomized - No background on the voluntary subjects and ethics board - II-I-B (14/17-Checklist Score) - All results were tooth analysis and not patient analysis
Bruce A. Matis/Michael J. Cochran Timothy J. Carlson/ Christanne Guba/ George J. Eckert, 2004, A three year clinical evaluation of two bonding agents	- Recruited patients requiring treatment - At least 2 non-carious premolars or canines with abfraction/abrasion/ erosion - Restored 40 sets of lesions placing no more two sets on each subject	- Group 1 - Beautiful Giomer-hybrid of GI and resin-based composite	- Group 2 - Silux Plus micro micro-filled resin)	- The lesions did not differ significantly from each other when receiving the two different materials - Treated teeth did no differ significantly in stain/color/anatomic form/caries/marginal discoloration/ marginal adaptation/surface roughness/sensitivity - No significant difference in retention between the two materials and thus both meet ADA criteria for clinical acceptance - I-B (14/18-Checklist Score) - All results were tooth analysis and not patient analysis

	- Categorized according to 40% ,40-60% and 60% +circumferential enamel - Random order placement - 12 men / 18 women - Age 30-75 years (mean 45 years)			- Power for study not provided
A Reis/ AD Loguercio , 2006, A 24-month Follow-up of Flowable Resin Composite as an Intermediate Layer in Non-carious Cervical Lesions	- Patients enrolled were healthy and had at least 20 teeth - Poor hygiene or bruxism excluded from study - At least 2 pairs of equally sized cervical lesions (erosion/attrition/abfraction) under occlusion required - Lesion had no undercuts/ no more then 50% of cavosurface margin involved enamel - Cervical wall needed to be in cementum - Lesions of hypersensitivity excluded - Patients blinded	- Each patient randomly (coin toss) received at least two restoration treatments - Group 1 - Single Bond along with Filtek Flow (+/- 1.5mm) applied	- Group 2 - Single Bond no flow	- The use of Filtek Flow as an intermediate layer did not improve the clinical performance of Class V restorations after 24-months - It showed a trend towards dark yellowing which was unexplainable - I-E (17/18-Checklist Score) - All results were tooth analysis and not patient analysis - Power for study not provided

	to treatment location - 19 patients (mean 40 yrs) (19-63 yrs) - 74 Restorations placed, 34 each group			
Jan W.V. van Dijken, 2005, Retention of a resin-modified glass ionomer adhesive in non-carious cervical lesions, A 6 Year follow-up	- 73 Class v restorations in 35 patients (11m/24f) - Mean age 58 yrs (34-84yrs) - Restorations placed in non-retentive lesions, localized in dentin	- Evaluate the clinical retention of new resin modified glass ionomer cement (Fuji Bond LC) based adhesive combined with (a)hybrid resin composite (Tetric Ceram)	(b) poly acid modified resin composite (Hytac)	- It was concluded that the resin-modified glass ionomer showed superior retention when placed in combination with the resin composite with 2% annual failure rate - No control group identified - All results were tooth analysis and not patient analysis - I-C (17/18-Checklist Score)

PREVENTION				
S.H.C. Sales-Peres/ J.P. Pessan M.A.R. Buzalaf, 2007, Effect of an iron mouthrinse on enamel and dentine erosion subjected or not to abrasion: An in situ/ex vivo study	- 10 volunteers wore intraoral palatal devices with 12 specimens (6 dentin/6 enamel) arranged in 3 horizontal rows (4 specimens each) - Ten adults (5 males/5 females) - Average age 23.2 yrs (19-30 yrs) - Each had normal salivary flow rate >1mL/mim (10mmol-1/L) - Volunteers did not smoke/no active caries lesions and no fluoride application 2 weeks prior to study	-Group 1) In one phase immersed the device in cola drink 150mL for 5 min - Row one teeth no treatment - Row two teeth brushed 1 min dentifrice (0.3g) (10 brush strokes/soft end rounded toothbrush) and then placed in mouth - Row three brushed after 30 min After immersion volunteers rinsed with 10mL ferrous sulphate solution for 1 min - Volunteers avoided eating acidic food-and wore device throughout the study phase - Removed only during meals and oral hygiene purposes - Asked to avoid touching device	- Group 2) No Rinse Used (NR) after immersion in cola drink 150mL for 5 min - Row one teeth no treatment - Row two teeth brushed 1 min dentifrice (0.3g) (10 brush strokes/soft end rounded toothbrush) and then placed in mouth - Row three brushed afer 30 min	- % SMH no significant difference in Dentin between R and NR groups - Significant difference in wear analysis when using iron rinse (I.e. R) vs NR regardless of condition for Dentin - % (SMH) was smaller for R compared to NR for erosion in Enamel - No significant difference in wear analysis between R and NR (although) R was lower then NR in Enamel - May be useful to use iron rinse after and erosive attack but more studies needed to determine ideal dose for maximum protection and minimum side effects - I-C (9/17) - In Vitro/Vivo study not clinical - small sample size - Short Duration - Not Blinded - What are side effects

		with tongue to avoid abrasive effect - Surface Microhardness (% SMH) tested using microhardness tester with knoop diamond under 50g load and 25g load for 5s on dentin (before and after compared) - Wear analysis determined in relation to reference surface by profilometry using profilometer (5 readings average)		