

Tooth Wear - A Literature Review

Abstract

The wear of teeth has become major factor limiting lifespans of dentition in mammalian population. Widely three different etiologies of tooth wear are recognized namely attrition, erosion and abrasion. Unique clinical characteristics are associated with each classification proposed. Exact prevalence data for each classification are not accessible since indices do not certainly measure one particular etiology, or the population may be belonging to various age groups and characteristics. Prevention of risk factors of tooth wear is important for the survival dentition. The management of teeth in each classification will depend on ascertaining the factors accompanying with each etiology. Severe forms of tooth wear may require specific restorative procedures, while others will not require treatment. This paper reviews the fundamental principles Classification, etiology, prevalence, prevention and management of various tooth wear patterns.

Key Words

Abrasion, Attrition Erosion, Tooth wear

Introduction

Wear can be defined as the progressive loss of material from the contacting surfaces of a body, caused by relative motion at the surface.^{[1],[2]} Wear has become a topic of interest in various branches of science such automobile engineering, mechanical engineering and in many other fields to predict the ability and life of a material. Wear has also grown into a focus of confab in the field dentistry with several epidemiological studies indicating that tooth wear is amassed into the general population.^{[3],[4]}

Tooth wear (TW), also known as tooth surface loss (TSL), is an deceptive and cumulative multifactorial process involving destruction of enamel and dentin which can threaten tooth survival and the oral health allied quality of life of affected individual.^{[5],[6]} Tooth surface loss (TSL) is a universal problem that encompasses an irreversible, multifactorial, non - carious , pathologic, or functional loss of dental hard tissues.^[7] This paper reviews the fundamental principles Classification, etiology, prevalence and management of various tooth wear patterns.

Traditionally, tooth wear patterns have been categorized as attrition, erosion, and abrasion. Attrition is defined as Attrition is defined as wear due to tooth-to-tooth contact; Erosion is a sharply defined wedge-shaped depression in the cervical area of the facial tooth surface; and abrasion refers to the loss of tooth substance induced by mechanical wear

other than that of mastication.

Various classifications have been proposed to categorize different wear patterns, however the tooth wear index proposed by Smith and Knight^[8] is the most commonly used index in the dental literature and it accounts wear on all four surfaces (buccal, cervical, lingual and incisal-occlusal), irrespective of the etiology of tooth wear (**Table 1**). Bardsley et al^[9] pioneered a new, simplified version of tooth wear index (TWI) 10 when carrying out epidemiological studies on large

Table.1 Smith And Knight Tooth Wear Index^[8]

SCORE	Criteria
0	No loss of enamel surface characteristics on buccal/lingual/occlusal/incisal surfaces. No loss of contour on cervical surface.
1	Loss of enamel surface characteristics on buccal/lingual/occlusal/incisal surfaces. Minimal loss of contour on cervical surface.
2	Loss of enamel exposing dentin for less than 1/3 of buccal/lingual/occlusal surfaces. Loss of enamel just exposing dentine on incisal surface Defect less than 1mm deep on cervical surface.
3	Loss of enamel exposing dentin for more than 1/3 of buccal/lingual/occlusal surfaces. Loss of enamel and substantial loss of dentine on incisal surface. Defect less than 1-2 mm deep cervical surface.
4	Complete enamel loss - pulp exposure - secondary dentin exposure on buccal/lingual/occlusal surfaces. Pulp exposure or exposure of secondary dentine on incisal surface Defect more than 2mm deep - pulp exposure - secondary dentine exposure on cervical surface.

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numbers of adolescents in North West England (**Table 2**).

Attrition

The term attrition is derived from the Latin verb attritum which describes the action of rubbing against something.^[11] Dental attrition is defined as the physiologic wearing of teeth resulting from tooth to tooth contact as in mastication.^{[12],[13]} Attrition engenders teeth with flattened and smooth incisal and occlusal surfaces (**Table 3**) and is conjoined with parafunctional activity^[14].

Table 2 Simplified Scoring Criteria For Tooth Wear Index^[9]

Score	Criteria
0	No wear into dentine.
1	Dentine just visible (including cupping) or dentine exposed.
2	Dentine exposure greater than 1/3 of surface.
3	Exposure of pulp or secondary dentine.

Table 3 Attrition Index^{[20],[21]}

Score	Criteria
0	No wear
1	Minimal wear
2	Noticable flattening parallel to occlusal planes
3	Flattening of cusps or grooves
4	Total loss of contour and /or dentin exposure when identifiable

Table.4 Classification Of Dental Erosion^[29]

CLASS I	Superficial lesions involving enamel only
CLASS II	Localized lesions involving dentin for less than one third of the surface
CLASS III	Generalized lesions involving dentin for more than one third of the surfaces <ul style="list-style-type: none"> • Facial surfaces • Lingual and palatal surfaces • Incisal and occlusal surfaces • Severe multisurface involvement

Table.5 Erosion Index^{[29],[30]}

Surface	Score	Criteria
Facial	0	No erosion Surface with a smooth, silky glazed appearance, possible absence of developmental ridges
	1	Loss of surface enamel. Intact enamel cervical to the erosive lesion; concavity enamel where breadth clearly exceeds depth, thus distinguishing it from tooth brush abrasion. Undulating borders of the lesion are possible and Dentin is not involved.
	2	Involvement of dentin for less than half of tooth surface
	3	Involvement of dentin for more than half of tooth surface
Occlusal / lingual	0	No erosion. Surface with a smooth, silky glazed appearance, possible absence of developmental ridges
	1	Slight erosion, rounded cusps, edges of restorations rising above the level of adjacent tooth surface, grooves on occlusal aspects. Loss of surface enamel. Dentin is not involved
	2	Severe erosions, more pronounced signs than in grade 1. Dentin is involved

Etiology

Tooth wear occurs at an ultrastructure level and can be caused by direct contact between surfaces or the action of an intervening slurry.^[15] Attrition may be accelerated by a coarse diet and abrasive dust. Some para functional habits like bruxism and clenching may also contribute to attrition.^{[16],[17],[18]}

Radiographic characteristics of attrition includes shortened crown image, sclerosis of root canals and pulp chambers due to secondary dentine deposition along with periodontal ligament space widening, hypercementosis and loss of alveolar bone.^[2]

Erosion

The term erosion is derived from the Latin verb erosum (to corrode) which describes the process of gradual destruction of a surface, usually by a chemical or electrolytic process.^[12] The term “erosion” generally is assumed and believed by most patients and clinicians; however, there are some who choose the

term “corrosion.” Erosion occurs on smooth (facial, lingual, palatal), occlusal and incisal tooth surfaces (**Table.4 & 5**). Initially appears as “silky-glazed” dull enamel surfaces, with loss of enamel characterization such as perikymata.^[22]

Etiology

The distribution and wear pattern of erosion is markedly associated with the basis of the acid and the location of the head when the acid is existing.^{[23],[24]} The extrinsic etiology of diet has been comprehensively studied, but the tangible evidence connecting a specific acidic food or beverage as the primary reason is limited. Collectively, however, the evidence stalwartly supports the role of acidic foods and beverages as a contributing factor in dental erosion.^[25]

The sources of acid generally are intrinsic or extrinsic.^{[25],[26]} Extrinsic sources commonly are found in the diet; for example, citrus fruits and citrus drinks.^[27]

Dental erosion from intrinsic factors is instigated mainly by gastric acid contacting the dentition and oral cavity recurrently and unswervingly. This may be a result of chronic vomiting, persistent gastro esophageal reflux, regurgitation or rumination.^[28] Erosion seen in gastrointestinal reflux are presented as concave depressions on the palatal and occlusal surfaces of maxillary teeth, as well as buccal and occlusal surfaces of mandibular posterior teeth (**Table.4 & 5**), and have been termed perimolysis or perimylolysis.^{[8],[12]}

Radiographic view shows diffused or well defined radiolucency on the crown margins.^[8]

Abrasion

Abrasion is derived from the Latin verb abrasum (to scrape off), which describes the wearing away of a substance or structure through mechanical process. The site and pattern of abrasion wear can be diagnostic as different foreign objects produce different patterns of abrasion wear.^[31]

Etiology

Few forms of abrasion may be concomitant with habit or occupation, such as a rounded ditch on the cervical aspects of teeth due to vigorous horizontal tooth brushing or incisal notching caused by pipe smoking or nail biting^{[17],[18],[32]} or improper use of tooth picks and dental floss, etc. The most common cause of dental abrasion found

in the cervical areas is tooth brushing and the severity and distribution of tooth brushing. Abrasion wear may be related to brushing technique, time, frequency, bristle design and the abrasiveness of the dentifrice. This wear pattern usually presents with V-shaped or wedge shaped notches at the cervical margins.

As far as the literature reveals there are no definite indices for abrasion however, Michael et al in his study surveyed 15,000 extracted permanent anterior teeth and were examined at the cervical region under illumination of 2 x magnifications. The main categories of cervical lesions developed from this study were “shallow”, “concave”, “wedge-shaped”, “notched”, and “irregular”.^[33]

Radiographic findings include radiolucent defect at the cervical level of tooth and full or partial sclerosis of pulp chambers in case of tooth brush injury narrow semilunar grooves in the interproximal surfaces of the teeth near the cervical third in case of dental floss injuries.^[19]

Abfraction

Abfraction derived from Latin words ab meaning away and functio meaning breaking, that describes loss of hard tooth substance in the cervical region as a result of crack formation during tooth flexure.^{[7],[34]} Bader et al^[35] concluded that factors such as brushing, diet, and tooth flexure may act autonomously or at different points in the initiation and progression of cervical lesions. Occluding forces that concentrate produce abfractions especially in the cervical areas.^{[36],[37],[38]} Theoretically it involves flexure and distortion of the tooth at the cervical margin, which predisposes the area to erosion or abrasion.^[37]

Prevalence

Tooth wear is a common condition with a prevalence rate several fold that of caries. It may begin in the primary dentition and may persist to involve the permanent dentition in adulthood. In a cross-sectional study Smith and Robb observed that tooth wear is common in adults, with up to 97% of the study population experiencing some tooth wear.^[39] In a systematic review by Vantspiker et al^[9] on prevalence of tooth wear in adults reported that the expected percentage of adults presenting with severe tooth wear increases from 3% at age 20 years to 17%

at age 70 years, indicating a tendency for accumulative wear with age. The exact prevalence of tooth wear is uncertain, primarily due to different valuation criteria, but has been estimated to range from 13% to 98%.^{[7],[40],[41]}

Ayers et al. conducted a cross-sectional study to investigate the prevalence and severity of tooth wear in the primary dentition of New Zealand school children aged between 5 and 8. A high percentage (82%) of children had at least one primary tooth with dentine exposure,^[41] since tooth wear is part of the normal aging process, it is not surprising to find that older individuals have more tooth wear.

In a study steered by Smith and Robb they put forward that the proportion of pathological wear in people 65 years and older was more than three times greater than that observed in people aged 26 to 35 years.^[39] Some para functional habits (bruxism and clenching) may also contribute to attrition while the prevalence of bruxism is unclear, studies report between 5% to 96% of the population may be affected.^[17] It is also difficult to compare prevalence studies because of different indices and different sampled teeth.^[43]

Azzopardi et al^[44] reviewed techniques to measure tooth wear and erosion. They clinched that in vitro techniques may have little direct clinical relevance, but they may lead to innovative and accurate methods. In a study^[45] it has been reported that professional wine tasters had an associated increased risk of tooth erosion due to the frequent exposure to wines with erosive potential (pH range of 3.0 to 3.6). A study conducted by Zero et al^[25] on competitive swimmers at gas-chlorinated pools have shown increased prevalence of dental erosion.

Epidemiologic studies have focused mainly on toothbrush abrasions, or cervical abrasions attributed to tooth brushing and interrelated factors. The prevalence of toothbrush abrasions varies from 5% to 85%, depending on the population studied. According to most of the studies tooth wear depends on the alignment of teeth in arch and which hand is holding the tooth brush, more abrasions observed on the left side of a right-handed person and vice versa.^[46]

Sangnes and Gjermo conducted a study on prevalence of oral soft tissues and hard tissue lesions related to mechanical tooth cleansing and found that 32% of their youngest age group and 50% of subjects

over 30 years with at least one tooth with wedge-shaped defects.^[47]

Prevention

Prevention plays a key role in maintaining the integrity of the dentition. A clinical indicator for active tooth wear is the beginning of worn teeth. Even when the intensities of tooth wear are less severe, clinicians should reminisce that the progression of tooth wears often inevitable. Attrition and abrasion are the lesions that are individual-based. Para functional habits like bruxism, clenching of teeth if perceived in the initial stages can be vetoed by appropriate patient counselling and providing occlusal night guards to prevent further loss of tooth structure. As most common cause for cervical abrasions is due to faulty tooth brushing techniques, educating and motivating every patient visiting dental clinics about correct brushing methods downgrades the prevalence of cervical abrasion in populations. The pervasiveness of erosion can be reduced by plummeting the frequency of tooth contact with acidic foods and beverages which is an utmost effective advice.^{[48],[49]} At the same time subsequent comanagement with the patient's physician should be considered if erosion by gastric acid is alleged.^{[48],[49],[50]} Dietary advice and oral therapy may be performed to increase the protective properties of saliva and alter consumption of potentially harmful foods.

Management

Accurate diagnosis is necessary for the proper management of various tooth wear processes. A sound deliberate principle must be followed for a successful restoration and rehabilitation. Considering the multifactorial nature of the tooth wear process, a detailed clinical examination which includes medical and dental history, occupation, diet and parafunctional habit is critical for diagnosis and treatment planning.^[18] Primary management includes counselling and educating the patients towards controlling risk factors as well as addressing any disproportions in oral environment. The main objectives of biologically utilitarian management includethe safeguarding the remaining tooth tissue, a pragmatic improvement in aesthetics and restoration of patient confidence.^[51]

Physiological attrition demands no

treatment since formation of secondary dentin and the eruption process keep the wear process in balance. Severely attrited teeth up to gingival margin may require restoration of the vertical dimension to improve function and esthetics along with occlusal adjustment and splint therapy.^{[13],[19]} Other treatment options include extraction of affected teeth and substitution with conventional dentures, overlay prosthesis, overdentures, amalgam or composite buildups, and fixed or removable prostheses.^[52] Studies which were conducted on the use of dentine bonding agents as a management policy have found that the coating was retained for a short period of time only.^[53] In recent days modern restorative materials are pondered expendable, repairable, and renewable, the traditional full mouth rehabilitation methodology as a rationale for refurbishing a worn dentition must now change and focus instead on guarding the remaining sound tooth structure.

Cervical lesions existing in a variety of forms depending on type and severity of the etiologic factor and not all these lesions necessitate restorations.^[54]

Decision to restore non carious cervical lesions include: fortification the tooth and reducing the hypothetical stress concentration and flexure, modifying oral hygiene maintenance, preventing hypersensitivity and pulp involvement and enlightening the esthetics.

In the management of erosion primarily the etiological factors should be identified and brought under control. Direct composites used to restore worn anterior teeth have provided a reasonable longevity of about three to five years.^{[20],[21]} On the other hand restorative therapies includes glass ionomers, resin composites, composite or porcelain veneers, and placement of crowns and bridges. Sensitive teeth may be treated with desensitizing agents and dentifrices. Unless the etiology of erosive lesions is jettisoned, restorations that are abrasive to the antagonistic teeth, such as porcelain, should not be used.^{[55],[56],[57],[58]}

Conclusion

Tooth wear is an increasing clinical problem as life expectancy increases and teeth are retained for longer period. Prevention of risk factors of tooth wear is an important aspect to the survival of teeth. Dentinal hypersensitivity is a relatively common problem experienced due to loss of enamel or opening up of

dental tubules via attrition, abrasion, erosion or abfractions.^[59] Therefore, perfect diagnosis and accurate treatment plan can increase the longevity of the affected dentition. Hence, the main focus of the clinicians should always be to correctly spot the signs of tooth wear, eliminating the risk factors and apposite management of the same. The clinician's choice to restore worn teeth depends on the patient's needs and the status of the dentition and supporting tissues.

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