

Tooth wear- footprints of changing oral environment: Review on etiology, diagnosis and assessment.

Swagata Deb¹, Tanmay Biswas², Surjargha Mukherjee³, Piyush Dongre³

¹Clinical Practitioner, Ganpati Enclave, Bathinda, Punjab.

²Medical officer (Dental), Shantipur State General Hospital, Nadia.

³PGT, Department of Prosthodontics and Crown & Bridge, Dr. R. Ahmed Dental College & Hospital, Kolkata.

Abstract:

Tooth wear is a general term which denotes loss of tooth surface due to causes other than dental caries. Four most common etiological factors cited to initiate tooth wear are abrasion, attrition, erosion and abfraction. These factors may cause wear alone or in combination with other factors. Congenital or developmental disorders like dentinogenesis and amelogenesis imperfecta are also associated with wear of teeth and considered as etiological factors. Due to this varied etiology, diagnosis and assessment of tooth wear is difficult. To prevent the continued process of active wear and to restore the already worn out dentition it's crucial to know the causes of wear as well as how to assess and diagnose wear. In this review paper we have placed emphasis on classifying tooth wear based on etiology, diagnosing wear based on patient history, location, extent and clinical presentations along with other investigative tools like radiographs, diagnostic mounting of articulated casts, wax mock up, salivary analysis etc.

Keywords: Tooth wear, attrition, abfraction, erosion, abrasion, tooth wear index.

Address of correspondence: Dr. Swagata Deb, Villa No.151, Ganpati Enclave, Dabwali Road Bathinda, Punjab 151001

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Introduction:

Tooth wear or Non carious loss of tooth structure denotes loss of dental hard tissues due to factors other than dental caries, trauma and developmental disorders.^[1, 2] The process of tooth wear is multifactorial. So the term 'tooth wear' was replaced by 'tooth surface loss' to accommodate all the factors that directly or indirectly initiate tooth wear process (Figure 1).^[3] The process of tooth wear is irreversible and cumulative. Due to physiologic tooth wear 20-38 micrometer enamel loss occurs per year.^[4] The process of tooth wear is called pathological when it becomes so severe that it creates an esthetic and or functional concern in the patients with or without presence of any symptoms or discomforts. In a recent prevalence study it was observed that the percentage of tooth wear loss has increased from 3% at the age of 20years to 17% at the age of 70 years and it

increases more with the progression of the age.^[5] Few studies have documented a staggering increase in the erosive tooth wear pattern among young adults and children in recent days comparatively than the other causes of tooth wear probably due to increase use of carbonated drinks and soda in that population.^[6, 7] Management of pathological tooth structure loss is not easy and straightforward process. Few aspects that complicate the management of tooth wear are, Difficulties in arriving to an accurate diagnosis

- Determining at which stage treatment has to be implemented
- Whether a treatment needs to be provided or monitoring is a better option.
- Deciding conservative treatment options for localized or generalized type of wear.

- How to restore tooth wear in the anterior region maximizing the esthetic demand as well as protecting the remaining natural tooth structure?
- How to restore the vertical space lost by opening the bite or other means like orthodontics or endodontic and crown lengthening procedures?
- Which conventional or contemporary dental materials will be suitable for a particular situation.

Etiology:

Tooth surface loss occurs mainly due to three processes attrition, abrasion and erosion. Whereas abrasion potentiates the tooth surface loss by abrasion or erosion. These processes may occur concurrently or alone.

Attrition: It occurs due to tooth to tooth contact without presence of any foreign substances. The word attrition is derived from the Latin verb “atterere” meaning action of rubbing against something.^[8] Factors contributing to attrition are parafunctional habits like bruxism, clenching, developmental defects, coarse diets and natural teeth opposed by porcelain restoration.^[9] Other contributing factors are class III incisal relationship and lack of posterior tooth contact.^[10] Wear facets due to attrition is mostly observed on occlusal or incisal surfaces though buccal and palatal surfaces of maxillary and mandibular teeth may also get involved wherein a deep bite relationship exists.^[11]

Clinical appearance of attrition: The early clinical appearance is of a small polished facet on the cusp or ridge, or there may be slight flattening of incisal edges. As the lesion progresses the reduction of the cusp height and flattening of the occlusal inclined planes occurs with concomitant dentine exposure (Figure 2). In severe cases a marked shortening of the clinical crown height is observed.

Abrasion: Abrasion is derived from the Latin word ‘abradere’ which means to scrape off. It is the pathological wear of dental hard tissues via mechanical process that involves presence of foreign objects. Abrasion is usually influenced by brushing technique, frequency of brushing, force applied during brushing, stiffness of the tooth brush bristles and abrasives present in dentifrices. Notching of the incisal edges on maxillary central incisor teeth is seen when habits such as the biting of tacks, nails, pins, threads, a pipe stem, hair pins or a wind instrument is present (Figure 3a).

Clinical appearance of abrasion: The typical abrasion lesions are a ‘v’ shaped defect (Figure 3b) seen on the buccal/labial surfaces in the region of cement enamel junction. Cervical abrasion due to tooth brushing is usually found on canines and first premolars due to presence of thin buccal plates.

Erosion: Erosion is loss of dental hard tissues by non bacteriogenic acid substances. Erosion can be due to intrinsic and extrinsic causes. Intrinsic causes are gastric reflux and include vomiting in case of anorexia, bulimia nervosa, and rumination.^[12] The term Perimolysis describes the classical lesions seen in chronic vomiting. Extrinsic causes include use of acidic soft drinks, citrus fruit juices.^[13] Medications like vitamin C, iron preparations, aspirin, mood improving drugs may also cause greater risk of erosion.^[14,15]

Clinical appearance of erosive lesions: Erosive lesions usually appear as concave defects without any chalkiness or roughness which is normally associated with carious lesions. In the early stages, erosion affects the enamel layer only which results in a shallow, smooth, glazed surface without any developmental ridges and stain lines (Figure 4).^[16] As the lesion progresses, dentine exposure occur and the lesion has a rather dulled appearance. In more severe situations ‘cupping’ of the occlusal surface of posterior

teeth and the incisal edges of anterior teeth occurs. Extrinsic erosion is usually seen on the labial surfaces of maxillary anterior teeth, with a typical 'scooped out' depressions, whereas lesions occurring due to intrinsic acid sources are mostly seen on the palatal surfaces of the maxillary anterior teeth, having a concave depression on the entire palatal surface.

Abfraction

The term abfraction, derived from the Latin verb *frangere* (to break), means a wedge-shaped defect.^[17] Its defined as the loss of hard tissue from eccentric occlusal loading which causes compressive and tensile stresses at the cervical fulcrum area.^[18] These lesions are also termed as 'cervical stress lesions.'^[19] They have a typical wedge shaped defect with sharp margins at the cemento-enamel junction and are often associated with recurrently failing cervical restorations (Figure 5).

Assessment of tooth wear:

For successful management of tooth wear cases accurate diagnosis, a clear concept of occlusion, knowledge of properties of different available biomaterials and techniques is important.

Patient history: Treatment planning is a complex procedure in patients with tooth surface loss due to its multifactorial etiology and varied range of tooth structure loss from mild to extremely severe. History and clinical examination plays a vital role in establishing this goal. Most common complaints that patients present with in these cases usually are compromised esthetics due to fractured, worn out or discoloured teeth, loss of lip and cheek support, functional difficulties such as inefficient mastication, pain and sensitivity of tooth due to loss of dentin and pulp involvement. A detailed history of medications used must be noted. Asthma inhalers which contain steroids predisposes

to erosive lesions.^[20] The pH values of common inhalers have been found to be in the range of 4.3-9.30. Other medications such as aspirin (salicylic acid) and chewable vitamin C preparations (ascorbic acid), iron preparations have also been associated with erosion.^[21] History of a gastro-oesophageal reflux in patients diagnosed with anorexia nervosa, bulimia nervosa or hiatus hernia, sphincter incompetence, oesophagitis, or increased gastric pressure (and volume) is associated with considerable erosive wear.^[22]

Female patients are usually more affected by eating disorders more than males at a ratio of 10:1.5.^[23] Pregnancy is also a risk factor for developing erosive tooth wear, as they are predisposed to regurgitation due to increase in abdominal pressure. Morning sickness with frequent vomiting episodes commonly observed in pregnant women further exacerbates the situation.^[24] A history of Gastric reflux is also associated with esophageal carcinoma. Erosive tooth wear also has been commonly observed in frequent swimmers as they are exposed to chlorine in pool water. Habits such as excessive alcohol consumption, smoking and other dietary habits should also be evaluated.

Examination of the patient: A meticulous intra oral and extra oral examination should be conducted at the beginning which should include,

- i. Assessment of TMJ and associated muscles
- ii. Bilateral palpation of muscle and joint
- iii. Presence of clicking, crepitations, mandibular deviation on opening or closing
- iv. Maximum jaw opening (less than 40mm is considered restricted)
- v. Presence of parotid gland enlargement (seen in bulimic patients)

- vi. Facial vertical dimension: Vertical dimension at rest (VDR) and occlusal vertical dimension (VDO)
- vii. Amount of available freeway space
- viii. Smile line and lip line
- ix. Intraoral soft tissue assessment to check for buccal keratoses, scalloping of tongue, signs of xerostomia (as saliva is a protective factor in prevention of enamel erosion), level of oral hygiene and a basic periodontal assessment.

A dental chart must include the following

- a. Presence or absence of teeth
- b. Dental caries
- c. Restorations
- d. Failed restorations
- e. Fractures
- f. Abrasions, erosions
- g. Teeth alignment (crowding, rotations, tilting, drifting, spacing, over eruption, mobility)
- h. Amount of overbite and overjet
- i. Presence of a stable centric contact
- j. Tooth contact in maximum intercuspal (ICP) position
- k. Whether easy manipulation of mandible in Centric relation is possible or not. Muscle deprogramming is advised with Lucia jig, splints or other such devices in cases wherever required.
- l. Presence of any slide from Centric relation (CR) to centric contact (CO)
- m. The direction of CR-CO slide whether horizontal and vertical to be noted as a greater amount of horizontal slide may be an issue during creating space for restorative materials.
- n. The type of occlusion present canine guided or group function
- o. Presence of Working or non-working interferences
- p. Fit of a existing removable prosthesis and denture bearing area need to be inspected

Investigations:

Radiographs: Good quality periapical radiograph are important to detect,

1. Alveolar bone loss,
2. Status of pre-existing endodontic treatment
3. Presence of dental caries
4. Widening/disturbance of the lamina dura
5. Crown: root ratio
6. Presence of retained roots

Articulated study casts: Articulated study casts help in assessment of the occlusion without soft tissue and muscular interferences. The exact amount of supra eruption of teeth also can be estimated. It helps the clinician to decide,

- a. Presence of occlusal interferences in CR, lateral and protrusive movements.
- b. Articulating the mandible in CR help in estimating the available restorative space.
- c. The amount of vertical height increase required for restoration.
- d. Planning of crown lengthening procedure on the cast
- e. Occlusal adjustment and correction

Diagnostic mock ups: They form a visual aid and communication tool for the dentist with the final occlusal scheme and esthetic modification (Figure 6). They assist in evaluation of tooth shape, length, inclinations and esthetics. This same wax up can be duplicated and used for fabrication of a splint, a tooth reduction guide, a template for constructing provisionals and for making a silicone index. A definitive restoration with direct composite can also be made.

Other diagnostic aids that are frequently used are pulp vitality tests, salivary analysis tests; to detect flow and amount of saliva, intra oral and extra oral photographs that includes occlusal, profile photo, left and right occlusals, smile in rest and in wide smile.

Measurement of tooth wear: There are various indices available to measure tooth wear but the most widely used index is the Tooth Wear Index by Smith and Knight.^[25] This index can help in comparing wear rates and monitoring the progression of wear for the concerned patient. Though the shortcoming of this index is it is unable to

correlate the etiology of the tooth wear to its outcome. Another index has been introduced by Vialati and Belser and its called Anterior Clinical Erosive Classification (ACEC) (Table 2).^[26] This index not only assesses the severity of tooth structure loss but also proposes a treatment guide for the clinician on how to restore them.

TABLE 1: Tooth wear Index by Smith and Knight

Grade	Criteria
0	No loss of enamel surface characteristics
1	Loss of enamel surface characteristics
2	Buccal, lingual and occlusal loss of enamel, exposing dentine for less than one third of the surface Incisal loss of enamel Minimal dentine exposure
3	Buccal, lingual and occlusal loss of enamel, exposing dentine for more than one third of the surface Incisal loss of enamel Substantial loss of dentine
4	Buccal, lingual and occlusal complete loss of enamel, pulp exposure or exposure of secondary dentine Incisal pulp exposure or exposure of secondary dentine

Table 2: ACEC Classification by Vialati and Belser

Class	Palatal enamel	Palatal dentine	Incisal edge length	Facial enamel	Pulp vitality	Suggested therapy
I	Reduced	Non exposed	Preserved	Preserved	preserved	No restorative treatment- Prevention only
II	Lost in contact areas	Minimally exposed	Preserved	preserved	Preserved	Palatal composites
III	Lost	Distinctly exposed	Lost < 2mm	Preserved	Preserved	Palatal onlays
IV	Lost	Exposed	Lost greater than 2mm	Preserved	Preserved	Sandwich approach
V	Lost	Extensively exposed	Lost greater than 2mm	Distinctly reduced or lost	Preserved	Sandwich approach (experimental)
VI	Lost	Extensively exposed	Lost greater than 2mm	Lost	Lost	Sandwich approach (highly experimental)

The ‘sandwich approach’ as mentioned in Table 2 refers to the application of a resin-based material, followed by the application of a labial/ facial ceramic veneer to treat palatal surface wear.

Consequences of tooth wear and its clinical implication on restorative management:

Tooth wear alters tooth anatomy causing loss of function and esthetics. The loss in vertical dimension gives a fallen appearance to face.

With the loss of vertical height; the position of smile line, the horizontal plane of occlusion, and the incisal position change. Loss of anterior guidance and canine protection increases stress on the posterior occlusion and may induce fracture of existing restorations. Depending on whether the wear is localized or generalized, mild or severe, whether the patient is fully or partially dentate restorative plan varies. In case of localized anterior tooth loss it becomes imperative to find out whether there would be sufficient space to place restoration either in intercuspal position (CO) or when the mandible is positioned in centric relation. As along with the wear process there is a compensatory dentoalveolar eruption of the worn out segment which is the main reason of lack of space for placement of restoration. This scarcity of freeway space causes tongue biting and cheek biting in patients. Depending on the availability of freeway space Turner and Missirilian proposed a classification for generalized tooth wear.^[27] They divided generalized tooth wear into three categories:

- i. Category 1 – Excessive wear with loss of vertical dimension of occlusion, sufficient freeway space available
- ii. Category 2 – Excessive wear without loss of vertical dimension of occlusion, but space is available
- iii. Category 3 – Excessive wear without loss of vertical dimension and with limited space.

When the wear rate is slow, the secondary dentoalveolar compensation by supra eruption of the teeth matches the rate of wear causing an inadequacy of space for restoration, as seen in category 2 and 3. So deciding a most conservative treatment plan yet maximizing the outcome with the knowledge of current dental biomaterials is vital for effective management of tooth wear.

Conclusion:

As more number of elderly population retain their teeth for a longer duration there is a significant increase in detecting patients with worn out dentition. But since the etiology is complex it becomes vital to accurately assess and diagnose tooth wear. The pattern of wear lesions may provide critical clues like footprints, for diagnosis. So this paper places a considerable emphasis on etiology, differential diagnosis and assessment of tooth wear as without a clear understanding of those early detection, prevention and proper management is difficult.

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Figures:



Figure 1



Figure 2



Figure 3



Figure 4



Figure 5



Figure 6



Figure 7



Figure 8



Figure 9



Figure 10