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Review Article

Is Asthma Related to Tooth Wear- A Review

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Abstract

Tooth wear has been a major oral health issue over the past decades. Although the risk factors are well established, there hasn't been much focus on the growing concerns of respiratory diseases over tooth wear. The association of asthma over tooth wear has been investigated, however, the potential evidence is highly contentious. This article reviews asthma and tooth wear, epidemiology, risk factors, assessment and management. The review underlines the mechanisms that support the relationship between asthma and tooth wear. The first potential mechanism indicates the bidirectional relationship between asthma and GERD over tooth wear. The second mechanism illustrates the role of asthma medications over tooth wear.

Keywords: *Asthma; Tooth Wear; GERD*

Introduction

Asthma is expounded as an inflammatory based chronic condition, resulting in breathing difficulties along with excessive mucus production and constriction of airways [1]. The condition is commonly seen among adolescents and young adults [2,3]. The term tooth wear can be described as the loss of dental hard tissues, due to the interaction of teeth with other factors. Wear on a tooth caused by interaction with acidic, non-cariogenic substances is termed as erosion; that caused by mechanical interaction is termed as abrasion; and that caused by contact of one tooth over another is termed as attrition [4]. To establish a relationship between asthma and tooth wear, it is indispensable to be aware of the potential mechanism by which asthma can be associated with tooth wear. The bidirectional relationship between asthma and GERD has been recognised as one of the possible mechanism [5,6]. The other potential mechanism has been established based on asthma medications having an impact on tooth wear [7,8].

Tooth wear: There are four most common types of tooth wear. Dental erosion is a surface phenomenon, characterised by the dissolution of minerals, leading to the demineralisation of enamel [9]. Dental abrasion is a result of mechanical wear on the tooth, commonly associated with faulty or rigorous tooth brushing [10]. Besides, a V-shaped lesion is identified in the region of the labial surface and the cervical surface of canine and premolars [10,11]. Tooth attrition is accompanied by loss of structure, caused by one tooth in contact with another [12]. It is recognised with wear facets on pristine enamel, affecting occlusal and incisal surfaces [13]. Abfraction is characterised by the formation of a non-carious cervical lesion, resulting due to loading from opposite tooth cusp [14,15]. The sign and symptoms may vary among individuals and might not correlate with the severity of the condition [16]. Moreover, there is a direct impact on satisfaction level, irrespective of severity [17]. Further, the quality of life is hampered, with a psychological impact on the lives of people [18]. A common dilemma faced by subjects exposed to tooth wear is displeasing appearance with an impact on social life [16,17]. In clinical dental practice, tooth wear affects prosthetic restorations, ensuing in cases requiring full mouth rehabilitation, which increases the financial burden amongst patients [19].

Figure 1

Epidemiology of tooth wear: A systematic review has presented results for the prevalence of tooth wear involving exposed dentin ranging from 0 to 82% in primary dentition and 0 - 54% in permanent dentition [20]. However, a more updated systematic review has shown an estimated prevalence of 30.4% in permanent dentition of children and adults [21]. Studies have observed a trend of tooth wear from 3% at the age of 20 years, which escalates to 17% at 70 years [22]. The incidence of erosive tooth wear was found abundantly among the young age group with cases progressing with age [23]. Hence, the reports from studies state that tooth wear is progressive with age [3]. A common phenomenon named dentinal hypersensitivity, identified with erosive tooth wear as the predisposing factor has been accounted for high prevalence [24]. Besides, a close association between dentinal hypersensitivity and erosive tooth wear is accounted for with additional evidence from a study showing 40% of the population experienced dentinal hypersensitivity amongst the erosive tooth wear cases [25].

Risk factors for tooth wear: Acids are identified as the primary agents causing tooth erosion followed by attrition and abrasion, resulting from intense mechanical action [26]. The interaction between the processes of tooth wear is unique with a high potential for attrition and abrasion working together towards occlusal wear [27]. Studies have identified the depth of tissue loss from an existing tooth with attrition is greater compared to the acid attack on a healthy tooth [28]. Similarly, the interaction is established for eroded tooth exposed to mechanical wear showing greater loss of tissue [29]. The acids introduced in the oral cavity are the major risk factor and can be categorised into risk factors known as extrinsic and intrinsic [30].

One of the most common intrinsic component involved in the development of tooth wear is called gastroesophageal reflux disease (GERD). The condition is characterised by the movement of acid from the stomach, resulting from a defect in a lower oesophageal splinter [31]. The acid from the stomach moves to the oral cavity either through vomiting or regurgitation [32]. The regurgitation into the mouth has significant potential for teeth due to its acidic nature [33].

The extrinsic risk factors involved with tooth wear can be environmental, dietary and lifestyle [34]. Workers exposed to acid fumes in the workplace and individuals exposed to low pH level in a swimming pool are considered some of the potential environmental factors [34]. Also, exposure to agents of low and high molecular weight agents like metals, wood dust, cleaning agents have the potential to cause tooth wear. The various work environment susceptible to get exposed to the mentioned agents is health care professionals, welders, furniture makers, bakers, refinery worker [35].

Measuring tooth wear: One of the first approaches established to identify tooth wear quantitatively, irrespective of the cause, was the Tooth Wear Index (TWI). The TWI is characterised by examination on surfaces of buccal, incisor and lingual in anterior teeth followed by occlusal region in the first molars [36]. The index proved to be an essential tool for identifying and measuring tooth wear evolved by multiple factors [37].

The mentioned indexes proposed over the years were determined based on their valid use and flaws involved within the index [38]. The Basic Erosive Wear Examination (BEWE) was established for measuring erosion [39]. The former index is established on a scoring system that addresses partial examination of the tooth surfaces, affected severely in a given sextant [39]. It is classified as 0 (no erosive tooth wear), 1 (initial loss of surface texture) (Hard tissue loss with a distinct defect affecting < 50% of the surface) and 3 (Loss of hard tissue affecting ≥50% of the surface area) [39]. The overall goal behind BEWE is to form an elementary structure, which is standardised and validated worldwide [39]. Studies have reported high sensitivity and specificity but moderate inter-and intra-examiner reliability score [40]. BEWE is considered a comprehensive index but lacks in reproducibility [41].

Asthma: Asthma can be defined as an inflammatory condition, which is chronic in nature. characterised by constriction of airways due to excessive mucus production, resulting in difficulties with breathing [1]. In clinical terms, it is recognised with recurrent occurrences

of coughing, wheezing, tightness in the chest and compression of breath [42]. It is regarded to be as an interaction that is complex in nature between gene and environment, following with airway obstruction [43]. The airway obstruction varies in duration and is reversible, either with treatment or spontaneously [1]. The classification of asthma was first proposed as allergic and intrinsic [44]. Later, steps were taken to propose a new classification based on the severity of clinical features. The Global Initiative for Asthma (GINA) classifies asthma- Intermittent, Mild persistent, Moderate persistent and Severe persistent [45,46].

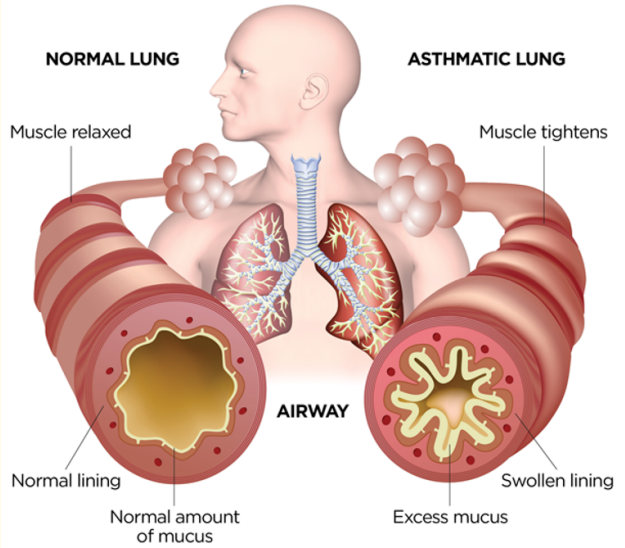

Figure 2

Epidemiology of asthma: The global prevalence of asthma cases is estimated to be 300 million worldwide along with an expected rise of 100 million cases by 2025 [47]. The increased prevalence of the disease is due to atopic sensitisation with increases in disorders like rhinitis and eczema. The number of disability-adjusted life years (DALY) lost due to asthma is estimated to be 15 million per year with 1 death in every 250 deaths worldwide [48]. Asthma is more common in developed countries, however, developing countries are at a peak in an increased number of cases due to the rapid urbanisation of communities [49]. United States holds the highest prevalence of asthmatic cases amongst the age group of 5 - 14 years and the most prevalent race/ethnic group affected are African Americans [50]. Epidemiological studies have noted asthma symptoms disappeared in 30 - 50% of children, however, symptoms tend to reappear in adulthood with altered lung functions [51]. Among adults, the symptoms of asthma overlap with other diseases such as COPD and cardiovascular disease [52].

Clinical assessment of asthma: There are numerous ways to measure asthma with the absence of a definite gold standard test to measure the disease [53]. The most common lung function tests are spirometry and peak expiratory flow. The spirometry test demonstrates airway limitation by a reduction in the volume of air expired forcefully in 1 second to the forced vital capacity (FEV1/FVC) ratio [54]. Variability is an important aspect of asthma test and is demonstrated in spirometry [55]. Furthermore, peak expiratory flow is an important assessment that demonstrates the variability in expiratory airway limitation. Children diagnosed with a marker of > 13% in diurnal variation is suggestive of asthma [56]. Other tests are also available, which include bronchodilator responsiveness (BDR) and bronchial hyperresponsiveness (BHR) as lung function test. Besides, markers for inflammation of airways, test for allergy and index for predicting asthma (API) are available to predict the outcome [55].

Management of asthma: Management of asthma is dependent upon medications that are further classified under 2 main types (Table 1): Long-term asthma control and quick-relief asthma medications [57,58]. Long-term medications are responsible to reduce the inflammation present in the airways while quick-relief medications work rapidly towards opening up the swollen airways. The classification of asthma medications are as follows.

Figure 3

Type	Sub-type	Drug	Market name
Long-term asthma control	Inhaled corticosteroids	Fluticasone	Flonase, Flovent HFA
		Budesonide	Pulmicort Flex haler, Rhinocort
		Flunisolide	Aerospan HFA
		Ciclesonide	Alvesco, Omnaris, Zetonna
		Beclomethasone	Qnasl, Qvar
		Mometasone	Asmanex
		Fluticasone furote	Arnuity Ellipta
	Leukotriene modifiers	Montelukast	Singulair
		Zafirlukast	Accolate
		Zileuton	Zyflo
	Long-acting beta-agonist	Salmeterol	Serevent
		Formoterol	Foradil, Perforomist
	Combination inhalers	Fluticasone- salmeterol	Advair Diskus
		Budesonide-formoterol	Symbicort
		Formoterol- mometasone	Dulera
	Methylxanthines	Theophylline	Theo24, Elixophyllin
Quick-relief asthma medication	Short-acting beta-agonist	Albuterol	Pro Air HFA, Ventolin HFA
		Levalbuterol	Xopenex
	Ipratropium	Atrovent	
	Oral and inhaled corticosteroid	Prednisone	
		Methylprednisolone	

Table 1

Potential mechanisms linking asthma to tooth wear: The bidirectional relationship between asthma and GERD has been foundational in deriving an association between asthma and tooth wear. However, the direction of the association is still unclear [5].

The pathophysiological connection between GERD and asthma was first recognised with a theory- asthma attacks result due to irritated bronchial mucosa, induced indirectly from the stomach reflex [59]. Later, the interplay was further investigated and presented comprehensively; the micro aspiration of gastric contents during an episode of GERD damages the airway linings, making them reactive to irritants and consequently causing asthma [60,61]. Also, the distal oesophagus generates acid stimuli which trigger bronchial symptoms via vagally mediated reflex owing to the similar embryological origin and neural innervation of the oesophagus and bronchial tree [61,62]. The foregoing theory is coined as "reflex theory" [63]. Similarly, direct micro aspiration of gastric contents damages the pulmonary tree and is referred to as "reflux theory" [62]. In contrast, asthma and its medications can also trigger GERD. Asthmatic patients struggle with lung hyperinflation caused due to increased breathing, resulting in increased pressure gradient between abdomen and thorax. The aforementioned events cause the gastroesophageal sphincter to herniate and exacerbates acid reflux [64]. Further, asthma medications such as long-acting beta-agonist and meth xanthine bronchodilators are known to relax the lower oesophageal sphincter, acid reflex ensues as a result [64,65].

The second potential mechanism is based on asthma medication causing tooth wear. Inhalers administered by asthmatic patients to mitigate breathing difficulties have been found to drop intraoral pH [66]. Any medication with low pH, coming in contact

with a tooth has the potential to cause tooth wear [67]. The dry powder inhalers, compared to metered-dose inhalers, are recognised as a low pH medication, with the potential to dissolve enamel hydroxyapatite [7,8]. Apart from alteration in pH and salivary flow rate, studies have observed decreased output in total proteins, amylase, hexosamine, salivary peroxidase during exposure to asthmatic medication [68]. On the other hand, the reduced salivary flow induced by asthmatic medication might result in increased consumption of drinks to compensate. In most instances, people are exposed to drinks low in pH and highly acidic in nature [69].

Figure 4

Summary

Asthma is expounded as an inflammatory based chronic condition. It is commonly seen in adolescents and young adults. The global prevalence of asthma cases are high and cases are expected to rise exponentially in the future. There is no definite gold standard way to measure the disease, however, spirometry and peak expiratory flow are the most common lung function test. Asthma can be managed using long term asthma medication and quick-relief medication. Tooth wear can be attributed to loss of dental hard tissue due to the interaction of teeth with other factors. The four types of tooth wear; attrition, abrasion, erosion and abfraction. Tooth wear is seen to be progressing with age. Risk factors associated with tooth wear are divided into intrinsic and extrinsic. The most common way of measuring tooth wear is using indices. BEWE (basic erosive wear examination) is the most common amongst the indices. The potential mechanism between asthma and tooth wear has been established in studies. The bidirectional relationship between asthma and GERD has been formulated in many studies along with impact of asthma medication on tooth wear. The present findings have implications on the role of asthmatic medications and future research. Dental professionals should be aware of a possible association between both conditions and should look for evidence of tooth wear among asthmatic patients or vice-versa.

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