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Dental Erosion and Tea: A Systematic Review

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Abstract: ***Introduction:*** ***Tooth erosion is a growing oral health problem. Practitioners and other healthcare professionals should be aware of which drinks can cause erosion and what can safely be recommended to patients. Tea is a popular beverage greatly consumed around the world. The objective of this study was to explore the relationship between tea and dental erosion through a systematic review.*** ***Methods:*** ***A systematic review was carried out by 5 dentists and a scientist. The research was conducted in July 2012 on Medline from PubMed interface using the boolean equation ("Tooth Erosion"[Mesh]) AND "Tea"[Mesh]. After selection of articles, data were extracted and analyzed.*** ***Results:*** ***8 articles were selected including one cross-sectional epidemiological study and 7 laboratory studies. The non-erosive effect was observed with green tea and black tea in sugar-free infusion. The erosive effect was confirmed for the fruity tea, the herbal tea (ginger and vanilla), Ice tea and sugary tea. No study has been conducted on oolong tea so far.*** ***Conclusions:*** ***Dental erosion is related to the consumption of certain types of tea or when tea is sweetened. The dentist may authorize the use of unsweetened tea for its non-erosive effect.***

Keywords: Tooth Erosion- Tea - Dietary Carbohydrates - Systematic Review

1. Introduction

Tooth erosion is a growing oral health problem. This pathology consists in the loss of hard surface tissues caused by chemical processes that do not involve bacteria [1]. The aetiology of erosive tooth wear could be attributed either to intrinsic or extrinsic long-term exposure to acids.

To increase awareness about dental erosion and to elaborate good preventive councelling, practitioners and other healthcare professionals should be aware of which drinks can cause erosion and what can safely be recommended to patients.

Tea is a popular beverage of great consumption around the world. It consists in dried leaves of the *Camellia sinensis* species of the *Theaceae* family. Multiple lines of evidence, mostly from population-based studies, suggest that green tea consumption is associated with a reduced risk of several human pathologies [2]. The relationship between the tooth and tea is often associated with discoloration or the remineralization process due to its fluoride contents [3], but little is known about its involvement in the pathological process of tooth demineralization.

The objective of this study was to explore the relationship between tea and dental erosion through a systematic review.

2. Material and methods

The working group included 5 dentists and a scientist. The study required a commitment from the working group members for a critical reading of articles, extracting and synthesizing data independently. Conclusions were confirmed under a well coordinated predefined grid. In case of disagreement, a discussion between the group members was necessary. In some cases, a contact with the authors of the articles was needed to obtain more information.

2.1. Literature search

The research for articles was conducted on MEDLINE using PubMed interface. Indexing language based on MeSH terms was used. The following keywords were used: "Tooth Erosion" [Mesh] and "Tea" [Mesh]. Using the Boolean operator "AND", the following Boolean equation was formulated: "Tooth Erosion" [Mesh] AND "Tea" [Mesh]. The search for this equation stopped on July 2012 and it identified 13 articles.

2.2. Study Selection

Epidemiological articles such as cohort, case control or laboratory studies were included. Article search was limited to the ones published between 2000 and 2012. Both human and animal species were considered in this study. The articles that were not published in French or English were excluded from the study. Papers were also excluded if they do not deal with the relationship between dental erosion and tea.

All the papers were read in full text. The relevant information found in the articles included in this study were extracted according to a predefined reading grid. This grid developed by the working group included details concerning: the authors, the paper study design, the type of tea, the adjunction of sugar or not, and the erosive effect of tea. The extracted data were presented in a summary table for a better analysis.

3. Results

3.1 Articles

The MEDLINE search identified 13 articles. During the screening phase, two of these articles were excluded on the basis of the exclusion criteria on the original language and date. After reading the articles, three were excluded given the other exclusion criteria adopted in the study. Among the 8 selected articles, 7 articles corresponded to laboratory studies and only one was an epidemiological study of transversal pattern. The pattern of article selection is summarized in figure 1.

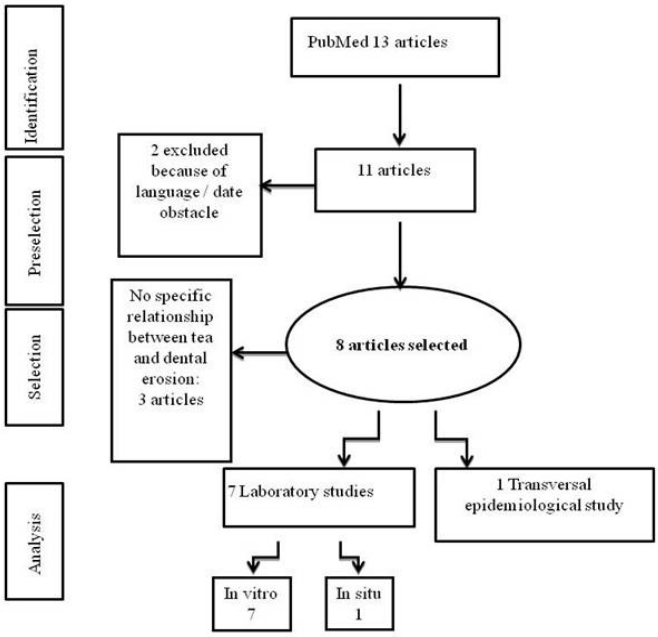

Figure1 : Pattern of articles selection

3.2 Excluded Articles

Five articles were excluded. The first article was in German language [4]; the second paper dated back to 1973 [5]. The third paper did not mention the erosive potential of tea but only the relationship between taking tea and the decline in pH [6]. The fourth paper was excluded because of confusion between abrasion and erosion [7]. The fifth paper was excluded because the relation between erosion and tea was not established [8]. A summary of the excluded articles is presented in table 1.

Table 1: excluded articles

Authors	*Study design*	*Reason for exclusion*
Van Nieuw Amerongen et al., 2004		German language
Isa, 1973		Date
Simpson et al., 2001	in situ study	Did not mention the erosive potential of tea but only the relationship between taking tea and the decline in pH
Krikken et al., 2008	in vitro study	confusing abrasion as erosion
Al-Majed et al., 2002	transversal descriptive study	The relation between erosion and tea was not established

3.3. Articles selected

Among the 8 selected articles, seven articles corresponded to manuscripts of laboratory study type, and one article [9] was a cross-sectional epidemiological study. The relevant data identified in reading grids are summarized in table 2.

Table 2: Articles selected in the study

Authors	*Study design*	*Type of tea*	*The erosive effect of tea*
Huew et al., 2011	Cross-sectional observational study	Other	Erosive effect
FUJII et al., 2011	Laboratory study: an in vitro study	Green tea	Non-erosive effect
KATO et al., 2009	Laboratory study : an in situ study	Green tea	Non-erosive effect
Bassiouny et al., 2007	Laboratory study : an in vitro study	Green tea Black tea	Non-erosive effect
Rees et al., 2006	Laboratory study an in vitro study	Ice tea	erosive effect
Jain et al., 2007	Laboratory study an in vitro study	Fruit tea	Erosive effect
Brunton et al., 2001	Laboratory study: an in vitro study	Black tea Herbal tea	Non-erosive effect Erosive effect
Lussi et al., 2000	Laboratory study: an in vitro study	Ice tea	Erosive effect

3.4 Data of articles

The non-erosive effect of tea on dental tissues was observed with green tea and black tea in sugar-free infusion [10, 11, 12,13]. The erosive effect was found in fruity tea [14], herbal tea, particularly ginger and vanilla [10], Ice tea [15, 16] and sugary tea [9]. No article was interested in oolong tea. In all the cases, sugary drinks have an acidic pH, making them erosive.

4. Discussion

There are few studies exploring the relationship between tea and erosion [17, 18]. In fact, our research found only 13 articles which reflects the lack of investigation in this subject. Yet, data research was performed on the MEDLINE database that is a bibliographic database reference for clinicians usually used for systematic reviews [19]. The choice of the period from 2000 to 2012 as a criterion for inclusion of articles was also aligned with other systematic reviews [19]. However, the number of articles was further reduced, since after reading, only eight articles were selected.

Among the selected articles, seven were laboratory studies and only one a transversal epidemiological study. This observation also demonstrates the lack of epidemiological studies in this field.

Tooth erosion is increasing, as today's lifestyle changes are usually associated with an increase in the consumption of acidic beverages, which induces a greater prevalence of dental erosion around the world ranging from 30% to 68% [20]. Several factors could cause or prevent tooth erosion, like the pH value, calcium, phosphate and the fluoride content of

a drink or foodstuff [1]. On this basis, a common beverage like tea was explored in this study in order to evaluate its erosive or protective effect on teeth.

Black, green, and oolong tea are the 3 main categories of tea consumed around the world. They are produced from *Camellia sinensis* and have proven to be beneficial for health [17]. In fact, there is solid evidence that tea enhances innate immunity, protects against cancers in experimental animals [17] and increases bone density [21]. Tea consumption may also reduce tooth decay and cavities as described in a cross-sectional study [22]. This effect could be related to the antibacterial effect of tea against Streptococcus mutans bacteria [23], its anti-plaque properties [24], its preservation of pH neutrality of saliva [16] or its action on mineralized tissues [21].

Regarding the erosive effect of tea on dental mineralized tissues, our study revealed that sugar-free green and black tea have a non-erosive effect [10, 11, 12, 13], while fruity, herbal, ice and sugary tea have erosive effects [16, 10, 14, 15] (table 2). The difference observed here should be attributed not only to the pH, but also to the differences between the components of each type of tea. Indeed, many studies have revealed that pH is a good predicator of dental erosion. In fact, when the pH of a product decreases under the value of 4.5, the enamel begins to erode [25]. The pH of black tea and green tea are respectively about 5.7 [26] and 6.3 [16], suggesting that they are non-erosive. However, the other types of tea have an acidic pH. In fact, fruity tea are based on fruits with a high citric acid content [27] and their acid pH ranges from 2.98 to 3.95 [17]. The pH of the herbal tea is about 3.2 [13] and many of them were even found to be more erosive than orange juice [26]. Ice tea has an erosive effect as their pH is assessed at 3.00. These types of tea also decrease the pH of the oral fluids to a level that they become erosive [19].

Concerning their components, green, black and oolong tea are rich sources of flavonoids and antioxidants, unlike fruity tea and herbal tea. Antioxidants could inhibit salivary oxidation proteins related to tooth decay [28] but their action against tooth erosion is still unknown. Green tea polyphenols were also found to have a distinct inhibitory activity against matrix metalloproteinase-2 and -9 that are enzymes able to degrade dentin matrix components [29], justifying the supplementation of green tea extract to soft drinks that reduces their erosive effect against dentin [18]. However, these polyphenols need more exploration to assess their protective effect on dentine erosion.

The erosive effect of sugary tea is explained by the presence of carbohydrates that have been shown to have an erosive effect by declining pH. In fact, sugars are metabolized by microorganisms to generate organic acids. Interestingly, the modification of such beverages by adding ions like calcium and phosphate reduces this effect. The amount of ions varies for each type of tea. Fung's study particularly showed that black tea had higher aluminium and fluoride concentrations than green tea [30]. There is an increasing knowledge about the erosion inhibiting potential of fluorides but salivary proteins play an additional role in the solubility of CaF_2-like layers, making the precipitates less stable on the dentine than the enamel [26]. Further studies should also be conducted on oolong teas.

Based on these results, it was concluded that black or green tea might be beneficial in reducing tooth wear provided that there is no sugar added. A recent study demonstrated that green tea has the less erosion effect compared with other tea varieties (citrus tea, fruity tea, black tea and floral tea) [31]. The anti-erosion effect of black or green tea could be enhanced by adding calcium source like milk but their action could be different regarding the enamel or the dentine.

5. Acknowledgements

None

6. Statement of Authorship

All authors contributed to the conception, the reading of the papers, the analysis of data and the writing of the article. They also have reviewed the final paper prior to its submission.

7. Declaration of Interests

The authors have no conflict of interest

8. Funding Sources

None

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