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Research Article

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Dental Erosion, GERD, and Salivary Stimulation

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Abstract

Previously published research has linked gastro esophageal reflux disease (GERD) with tooth erosion. Additional reports suggest that saliva and salivation may mediate the effects of acid refluxed into the esophagus and mouth. This article briefly reviews GERD and presents results from a study suggesting that increasing salivation during sleep may significantly improve symptoms associated with the condition, including morning hoarseness, reflux acid taste, night time heartburn, and perceived reflux. The results also have important implications for dentists treating dental erosion resulting from GERD and offer another treatment remedy that can be combined with dental restorative care and medical intervention to manage erosion. This study demonstrates that use of an OTC dry mouth product specifically designed for use during sleep, such as OraCoat XyliMelts, may be of potential benefit in reducing stomach acid that causes dental erosion.

Introduction

Gastro esophageal reflux disease, commonly referred to as GERD, has been associated with dental problems such as tooth erosion, halitosis, mucosal pathology, and bruxism [1,2]. The erosion of dental enamel and the underlying dentine results from the acid in the gastric contents that reaches the mouth during multiple GERD episodes, especially if there is inadequate buffering by saliva [3,4]. Loss of the protective enamel covering of the teeth can lead to tooth hypersensitivity, functional impairment, caries, as well as tooth fracture, particularly if there is associated bruxism [5]. Inadequate saliva may also have an effect on the esophageal mucosa exposed to refluxed acid, resulting in subsequent thoracic symptoms including chest pain (heartburn) and voice changes (hoarseness) [6]. Significant medical symptoms include heartburn, reflux (an acid taste at the back of the throat), sleep disturbance, and reduced esophageal motility [7]. GERD is also known to cause or contribute to a number of medical problems including asthma, idiopathic pulmonary fibrosis (IPF), pre-malignant esophageal (Barrett's) metaplasia, and halitosis. All of these conditions can impair an individual's systemic and oral health and overall quality of life [8,9].

Gastro esophageal reflux disease is estimated to occur in ten to thirty percent of the population in developed countries with its frequency increasing [10]. Nocturnal GERD involves reflux of acid into the esophagus during sleep. Nocturnal GERD is more frequent than daytime GERD, presumably because gravity no longer opposes reflux when the body is horizontal. The condition is estimated to occur once a month in up to 43% of individuals and once a week in 20% of the population [11,12].

Limited reported research data related to dental erosion caused by GERD suggests that its prevalence varies considerably [13-22]. The discrepancy between studies, with prevalence estimates varying between 5% to 79 % may be related to study methodology, GERD disease duration and severity, genetic (e.g. enamel composition/density), confounding environmental variables (e.g. diet, dental care, fluoride use, etc.), and the presence of numerous salivary parameters [23]. Roesch-Ramos et al., in a prospective, observational, descriptive and comparative study of 60 healthy non-GERD and 60 GERD Mexican subjects found that 78.7% of subjects with GERD had dental erosion [24]. Prevalence data based on controlled studies of GERD related halitosis, bruxism, and mucosal pathology are not available.

The Pathophysiology of GERD

Reflux occurs when the lower esophageal sphincter (LES) relaxes and allows stomach acid to flow up into the esophagus and towards the mouth. GERD describes a condition in which this reflux is excessive and the esophagus is bathed in acid for a long enough period of time to cause symptoms. There are several 'defense' elements that help to mitigate GERD: the lower esophageal sphincter (LES) which keeps acid within the stomach, esophageal peristalsis which mechanically propels fluid (including saliva) into the stomach, and saliva flow which serves to neutralize and dilute acid that escapes the stomach [25,26]. Prolonged contact with stomach acid can lead to mucosal and tooth damage. The physiologic abnormalities that cause GERD include poor functioning of the LES, abnormal esophageal clearance, reduced salivary production, altered esophageal mucosal resistance, and delayed gastric emptying [27].

Saliva and GERD

As noted, saliva is thought to play in important role in protecting the esophageal lining, partly by diluting and partly by buffering stomach acid that enters the esophagus through reflux [28-31]. Swallowing

occurs at the rate of about once per minute during the day under normal circumstances, moving saliva, and food, into the esophagus [32,33]. Saliva at rest and during stimulation differs significantly. The normal resting, or unstimulated, whole salivary flow rate is 0.25-0.50 mL (or grams)/min. The normal, whole stimulated (by chewing paraffin) salivary flow rate is 1-3 mL (or grams)/min. As a general rule, 0.7 ml/min is the cutoff point for defining normal versus abnormal stimulated flow of whole saliva and 0.1 ml/min is the cutoff for below-normal unstimulated whole salivary flow [34].

Saliva production normally falls off during sleep. Age also plays a significant role in the production of saliva and can also disturb esophageal motility. Not only can there be a decrease in esophageal peristalsis coupled with an increase in frequency of "nonpropulsive and repetitive contractions" but saliva production in the elderly may be reduced for a variety of other reasons. For example, salivation, as well as esophageal motility and sphincter function, may be reduced by numerous medications and by conditions commonly occurring in the elderly, such as cerebrovascular disease, cardiovascular disease, pulmonary disease, diabetes mellitus, and Parkinson's disease [35,36]. The list of medications that can reduce salivary function and cause dryness is extensive and includes: anti-convulsants, anti-parkinsonian agents, anti-psychotics, anti-depressants, anti-pruritics, anti-histamines, anti-hypertensives, anxiolytics, expectorants, decongestants, diuretics, narcotics, monoamine oxidase inhibitors, sedatives, systemic bronchodilators, cardiac antiarrhythics, and skeletal muscle relaxants [37].

It has been proposed that increased salivation resulting from esophageal acidification may be mediated through an 'esophago-salivary' reflex [38]. Reflex salivation with associated bicarbonate secretion appears to be greatest when acid accumulates in the upper region of the esophagus [39]. The effect of acid infusion into the lower part of the esophagus does not appear to have the same effect on salivary flow. It has been reported that a significant increase in heartburn occurs when acid reaches the upper area of the esophagus [40,41]. In patients with reflux where stomach acid does not reach the upper area of the esophagus, a reflexive increase in saliva production may not be initiated. Hence, it has been proposed that, during sleep, individuals with a normal reduction in saliva might benefit from stimulated saliva release with its buffering capacity. Conceivably, increased salivation during sleep could also protect the teeth from erosion caused by acid reaching the oral cavity but this idea has not been tested to date [42].

Recent Research

Recently published research suggests that some symptoms of GERD occurring during sleep can be improved by salivary stimulation. The study was designed as a randomized, double-blinded, controlled trial involving two over the counter products currently on the market for use in the management of dry mouth symptoms. The product of interest was cleared by the FDA for investigation in the context of GERD on September 4, 2014 [43].

The product of interest was OraCoat XyliMelts, produced by OraHealth Corporation in Seattle, Washington. XyliMelts adhere in the mouth for safe use while sleeping and contain ingredients that are commonly used in foods. These include 550 mg xylitol for sweetness to stimulate saliva, mild mint for additional flavor, cellulose gum to slow dissolution and lubricate the mouth, acacia gum adhesive layer, a small amount of calcium carbonate to neutralize acidity of the acacia gum, and magnesium stearate. Previous research involving XyliMelts indicated that a single disc dissolved in 5 parts water resulted in a pH of 8.1 [44]. When used by subjects with dry mouth during the day, salivary pH was measured at 7.25 and use of the discs did not make saliva more basic [45]. The discs more than doubled saliva production while awake [45]. The discs slowly dissolved over six hours during sleep and the flavor was still sensed upon awakening after 8 hours of sleep [43,46].

The product used as a control was a water based gel containing cellulose hydrocolloid gums with sorbitol and xylitol sweeteners marketed as a remedy for dry mouth. As it is a soluble gel introduced prior to sleep, it was presumed to be eliminated from the oral cavity fairly quickly via salivary stimulation by the sweet flavor.

Those qualifying for the study were assigned to a baseline information collecting period of two weeks. Each day subjects were required to complete a short questionnaire that included the following questions:

- Did you taste refluxed stomach acid during your sleep last night (yes/no);
- How severe was the reflux (mild, moderate, severe, very severe);
- Did you have heartburn when you slept (yes/no);
- How severe was the heartburn (mild, moderate, severe, very severe);
- Did you keep water by your bedside because of dry mouth occurring during sleep (yes/no);
- Did you have uncomfortable dry mouth when you slept or upon awakening (yes/no);
- Did you experience hoarseness of your voice in the morning (yes/no);
- Did you need to take antacids during sleep (yes/no); and
- If so, how many did you take (number).

Upon completion of this first baseline phase, qualified subjects were then entered into the product phase of the study (phase two). Qualification for entry into phase two was based on having reported reflux taste on eight of the 14 days of baseline and dry mouth seven of the same mornings. Randomization was to one of two groups: treatment or control. Each subject then received by mail either the adhering discs disguised in unmarked packaging (treatment), or the sweet water based gel in an unmarked white tube (control), with printed instructions copied from the manufacturer's instructions for their method of use at bedtime. The analyzed variables of interest included reflux taste, reflux severity, heartburn sensation, heartburn severity, morning voice hoarseness and antacid use during sleep time. 53 subjects were then randomly selected to receive the disc or gel to use during sleep for two additional weeks. Comparisons were made within and between groups for all outcome variables.

Results

Subjects in the two final intervention groups were not significantly different when compared on the basis of gender, age, or prior medical diagnosis of reflux. For the symptom of heartburn, subjects using the discs demonstrated a significant reduction in reported pain of heartburn when compared with baseline (one sided U-test p value <.001). Subjects using the gel also experienced a significant reduction in pain when compared to baseline (U-test p value <.001). When these two remedies were compared via U-test, disc intervention demonstrated significantly greater improvement in heartburn pain than gel intervention (U-test p value <.01) (Figure 1).

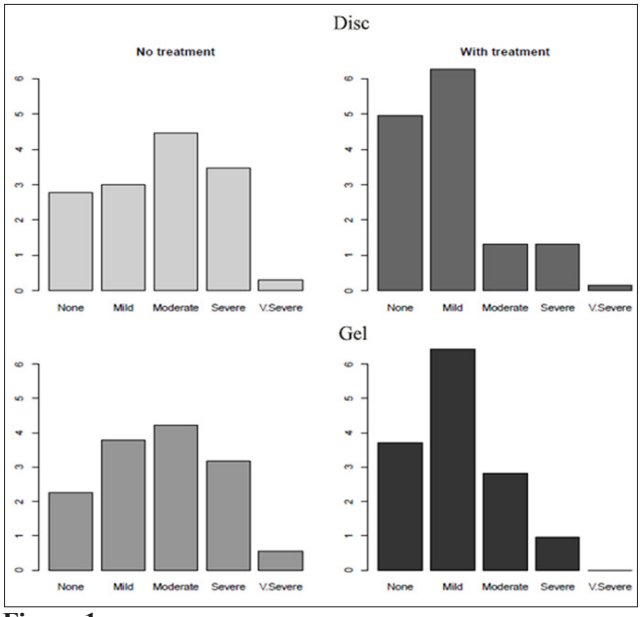

Figure 1

In terms of reflux severity, subjects using the disc intervention reported a significant reduction in reflux severity when compared with baseline (one sided U-test p value <.001) (Figure 2).

Subjects using the gel also experienced a significant reduction in reflux severity when compared to baseline values (U-test p value <.001). When the performance between the disc and gel treatments was compared, a statistically significant difference was not observed (U-test p> 0.13).

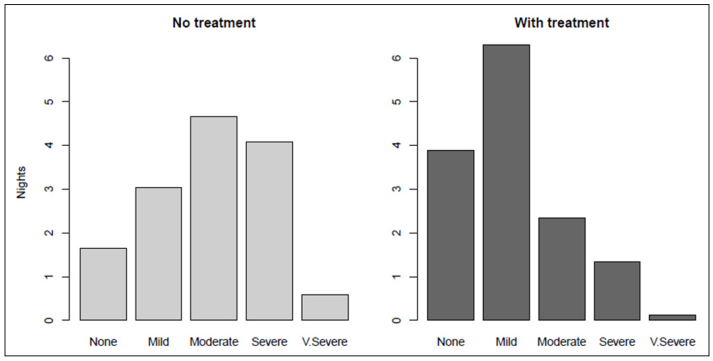

Figure 2

Hoarseness was also significantly reduced with disc and gel treatment (p <.001) with comparison between the two products not statistically significant (p = 0.41) (Figure 3). The disc treatment resulted in a 60% reduction in antacid use while the gel intervention demonstrated a 45% reduction. Values were significantly different for both treatments. A T-test comparing the two treatments did not show a significant difference (p = 0.89) (Figure 3).

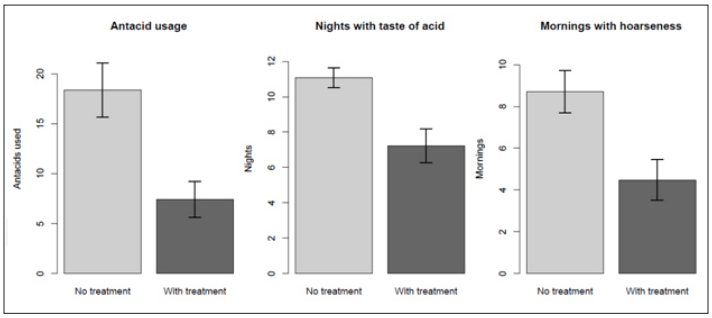

Figure 3

Discussion

Nightly use of both adhering discs and gel dry mouth remedies that stimulate saliva via flavor significantly reduced symptoms associated with GERD, including morning hoarseness, reflux acid taste, night time heartburn, and perceived reflux. Subjects who used the discs and gel for two weeks also demonstrated a significant reduction in antacid use during the night in comparison to two weeks of baseline use. The discs were found to be generally more effective in reducing symptoms than the gel, although most of the differences were not statistically significant. The exception was heartburn, where improvement was found to be significantly better for subjects using the discs than the gel. Significant side effects were not reported in either group during product use.

These results have important implications for the management of dental erosion thought to be related to GERD. If the symptoms of this condition are significantly reduced in the morning by increasing salivation during sleep, then, in addition to the many day-time strategies that are potentially useful for reducing acid reflux dissolution of tooth structure, there is now a possible strategy for reducing erosion occurring at night. Further research is needed to verify this effect, but, in the interim, this study suggests that it might be prudent to incorporate nocturnal salivary stimulation into the mix of treatments already recommended to reduce dental erosion resulting from GERD.

Conclusion

This reviewed study suggests that two available OTC products used to manage dry mouth during sleep may provide an effective adjunctive remedy for reducing reflux and heartburn symptoms in patients with concomitant xerostomia. The adhering discs and the gel were well tolerated and not associated with adverse reactions during use. Further, the data appear to support the hypothesis that an increase in salivation during sleep may be the reason for symptom reduction. The findings of this study are novel and potentially medically and dentally important. For physicians treating GERD, provide additional therapeutic benefit. For dentists treating tooth erosion thought to be the result of nocturnal GERD, this offers another remedy that can be offered along with appropriate dental treatment to patients. These findings are particularly salient for individuals with dental erosion who have been assessed by testing as having dry mouth and nocturnal GERD. Use of an OTC dry mouth product specifically designed for use during sleep, such as OraCoat XyliMelts, may be of potential benefit in reducing stomach acid that causes dental erosion.

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