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An Overview of the Impact of Lifestyle Behaviors on the Operative Dentistry

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Abstract

Objective: This review provides important insights into how the personal lifestyle behaviors may affect the oral health, especially with respect the Operative Dentistry field. Thus, the effect of lifestyle behavior on the dental hard tissues and restorative materials was explored, aiming to assess preventive and restorative strategies.

Materials and Methods: Studies focusing on the potential effects of lifestyle behaviors on the restorative dentistry were used as a resource data. The collected literature was based on the original scientific full-papers from peer-reviewed journals in PubMed database.

Results: Lifestyle behaviors may lead to changes in the appearance of dental tissue and dental restorations. The frequent consumption of coffee, tea, red wine and tobacco can lead to discoloration of tooth and resin-based materials. In addition, cigarette smoke may hinder the adhesive bonding mechanism and also may affect the physical properties of restorative materials. Occupational exposure to acid environment, addicted to acid drinks and regular/competitive swimmers should be aware of the potential risk for dental erosion. Moreover, since sports injuries can seriously lead to tooth and facial damage, the use of protective devices during sports activities should be emphasized, especially for athletes and regular practitioners of high-risk activities.

Conclusion: Lifestyle behaviors may jeopardize the dental tissues and accelerate the aging process of aesthetic dental restorations. Thus, the widespread knowledge of this potential risks on the oral health and restorative dentistry is beneficial for targeting educational health care programs, preventive and reparative therapies.

Keywords: Oral health; Teeth; Cigarette; Erosion; Tooth discoloration; Occupational exposure; Sports

Introduction

The excellence in clinical performance of aesthetic dental restorations depends on several factors, including the characteristics of the restorative materials, the bonding technique and operator experience. Although the physical and mechanical properties of dental materials are indicators that can help to predict the outcomes of adhesive restorations, other aspects, such as the individual's behavioral patterns must be also taken into account.

A better understanding of the influence of how personal lifestyle behaviors (i. e. dietary habits, smoking) can affect the dental hard tissues and dental restorations can provide important evidence for preventive and restorative strategies. In this sense, efforts have been made to improve the overall quality of dental restorative materials, and also to increase the patient knowledge and its participation in their oral care practice.

This review focuses to discuss the influence of individual lifestyle behaviors on the integrity and aesthetics of the dental hard tissue and adhesive restorations by summarizing the previously published information over the last 30 years. The collected literature was based on peer-reviewed journals from PubMed database by two examiners. The search was conducted using one of the following keywords: behavior, tooth, enamel, dentin, erosion, acids, drink, lifestyle, behavior, occupational exposure, smoke, cigarette, athletes, sports, activities, bonding, stain, bleaching, color, aesthetic, restoration and composite. Appropriate titles and abstracts that fit the main purpose of this review were identified and evaluated for subject relevance.

Approaches of Behavioral and Lifestyle Effects on Dental Tissue and Aesthetic Restorations

Diet

The effects of food components and beverages on the characteristics of dental tissue and resin-based dental materials have been extensively studied in restorative dentistry. Currently, a particular interest is related to the role of diet in the discoloration of tooth and direct/indirect restorative materials [1-5]. Falkensammer et al. [1] evaluated the impact of different storage solutions (red wine, black tea, chlorhexidine, sodium fluoride, tea tree oil, and distilled water as a control group) on the color stability of composite resin materials. The authors demonstrated that the discoloration of composite resin was influenced by the storage solution, and the most severe discoloration, categorized as clinically unacceptable, was noted for red wine. In accordance with this finding, studies reported that the highest level of discoloration was observed for resin-based materials when immersed

in red wine [2]. Moreover, the bleached enamel was also more vulnerable to red wine than coffee staining [5].

Villalta et al. [4] evaluated the effect of three bleaching systems and two staining solutions (coffee or red wine) on the color changes of two composite resins (Filtek Supreme and Esthet X) using a spectrophotometer. The authors demonstrated that the effect of staining solutions on color changes of composite resins was material dependent; Filtek Supreme was more susceptible to color changes than Esthet X, and it seems likely due to its composition such as the resin and/or filler type. However, both materials returned to the original color after bleaching, and the three different concentrations of carbamide peroxide (16%, 18% and 35%) apparently showed clinically similar effects in removing the superficial staining from resin-based materials. However, the bleached composite resin may not match the surrounding bleached tooth structure and hence the restoration replacement may be required for aesthetic reasons. Moreover, bleaching agents can increase the surface roughness of composite resins and may accelerate the stain incorporation over time [6,7]. Thus, since discoloration is one of the main reasons for replacement of resin-based composite restorations [8], the color stability of resin-based materials is an important characteristic that clinicians should take in account during the selection of restorative materials.

In addition, higher mineral loss of enamel was observed by the percentage of hardness reduction during home bleaching combined with acidic drinks (cola soft drink/pH 2.6 and red wine/pH 3.6). As a result, the intake of acidic food/drinks can modify the enamel surface and reduce staining resistance after bleaching [3]. It is noteworthy to mention that the dental erosion is theirreversible loss of dental hard tissue due to a chemical process (acid exposure) without bacterial involvement, and it is not directly associated with mechanical factors or dental caries [9-12].

Dental erosion is a multifactorial condition characterized by smooth silky-glazed appearance of tooth surface, intact enamel along the gingival margin, grooving on occlusal surfaces, absence of perikymata and may lead to dentin hypersensitivity [10-13]. The erosive mechanism involves protons of the acidic agent attacking the components of hydroxyapatite such as carbonate, phosphate and hydroxyl ions, which results in hydroxyapatite crystal dissolution with a subsequent release of calcium ions [14]. Chemical, biological and behavioral factors are involved in this process. Some biological factors (i.e. acquired pellicle, salivary flow and buffering capacity, tooth structure and itsposition in relation to soft tissues) can help to explain individual differences [10,12]. In addition, the erosive potential of food and acidic drinks is also influenced by chemical factors such as pH value, titratable acidity (the buffering capacity), mineral content and the calcium-chelation properties [10,12].

Nowadays, changes in the nutritional habits and early dietary exposure to acid foods and acid drinks increased the prevalence of dental erosion, especially in younger age groups [15]. The consumption of soft drinks, sport drinks and acid juices can decrease the pH of oral environment below the critical pH of 5.5 and subsequently lead to enamel and dentin demineralization [13,16,17]. Blacker and Chadwick [18] assessed the erosive potential of different fruit smoothies by surface microhardness measurement and surface profile determination of tooth specimen. According to the authors, kiwi, apple and lime smoothie produced the most depth loss of tooth substance. Curiously, Brown [19] evaluated the erosive potential of flavoured sparkling water using an in vitro dissolution assay with hydroxyapatite powder and electron microscopic examination of surface enamel. Flavoured sparkling water, which is often considered as a healthy alternative to carbonated drinks, demonstrated erosive potential similar to or greater than pure orange juice [19]. Overall, the amount and intake frequency of acidic drinks, the method of drinking and keeping in the mouth are also important factors related to dental erosion [20].

Based on these findings, improve the patient's and health professional's knowledge about tooth staining and erosive potential of foods and beverages may positively impact in their dietary choices and consumption frequency. Therefore, the replacement of aesthetic restorations due to discoloration may decrease as well the risk of developing dental erosion. In addition, the early diagnosis of dental erosion is important to prevent further progression and, thus, regular dental check-up visits play an essential role as a conservative approach.

Environmental occupational exposure

As mentioned before, extrinsic factors such as acid beverages may lead to dental erosion. Bearing this in mind, wine tasters and winemakers are considered high-risk occupation groups for dental erosion [21,22]. The variety of wine produced in the world has different acid levels, phosphate and fluoride content and these changes can imply in different erosion potential. Therefore, regular oral hygiene using topical fluoride rinses, fluoride dentifrice and the use of paste containing casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) may reduce enamel solubility and then protect the teeth against erosion [21,23,24].

Dental erosion can also be pointed out as an occupational hazard in work environments where acid gases act directly on the toothsurface. Environmental erosion has been reported in workers exposed to sulfuric acid and hydrochloric acid in battery and galvanizing industries [25-27]. Wiegand and Attin [14] concluded in their review that the higher risk of occupational dental erosion is associated to factory´s workers, predominately battery forming and charging workers as well as galvanizing, pickling, plating and chemical manufacturers, who are exposed to those aforementioned strong acids. In addition, studies also demonstrated that, in general, dental erosion induced by inhalation of acidic fumes was mostly confined to aesthetic areas, such as the labial and incisal surfaces of the anterior teeth [14,27,28].

The increased risk of dental erosion due to the presence of acids also highlights the degradation mechanism of restorative materials. The wear process of dental composites is complex by the fact that filler content and matrix resin consist of fundamentally different materials, which distinct concentration and composition may affect the mechanical properties of resin-based materials [29]. Wear of dental composites includes diverse phenomena as adhesion, abrasion, attrition, chemical degradation, and fatigue [30]. Intriguingly, the chemical environment is one aspect of the oral environment, which could have an appreciable influence on in vivo degradation of composite resins. Moreover, certain chemicals agents, such as acid gases, may lead the composite polymer to collapse since the resin matrix can be softened by the contact with these agents and fillers can be leached out, resulting in filler-polymer matrix debonding [31]. The BisGMA (bisphenol-A-glycidyl methacrylate) resin compound is susceptible to chemical softening, which reduces the surface hardness of the composites and enhances the material´s wear rate [32]. All these effects may deteriorate the mechanical properties of the composite resin and reduce the clinical longevity of composite resin restorations [33].

Up to now, however, there are no studies on the effect of acid gases on restorative materials, which could be helpful for prevention of occupational composite resin degradation. Overall, authors focus their research on the effect of other types of erosive challenges, such as acid drinks and acidic medicines, on restorative materials [34-38]. These studies have shown that erosive conditions might have only little impact on behavior of tooth-colored restorative materials, such as composites, and that dentin sealants also seem to be rather resistant against erosive conditions.

Wegehaupt et al. [39] evaluated different sealants to prevent erosive tooth wear caused by extrinsic and intrinsic acids under long-term exposition. The authors concluded that resin based surface sealant was able to significantly reduce the demineralization of enamel caused by acids. The protective effect of this material has the advantage of being independent of the patient´s compliance due to the fact that many preventive measures concerning erosion prevention depend on patient ´s behavior changes, so the chance that the measure fail to prevent erosive tooth wear is still high. Notably, mouth rinsing with drinking water during working hours, wearing of protective masks and rest periods are considered to be effective approaches for removal of intra-oral sulfuric acid [40]. In addition, educational programs about occupational hazards, positive worksite oral health promotion and training for standardized behaviors such as wearing respiratory protective equipment and gargling during/after working are also considered as preventive strategies to decrease occupational tooth and composite restoration erosion [41].

Mouth rinses selection criteria

Although some dietary choices may produce perceptible discoloration oftooth and resin-based materials, other extrinsic factors have been investigated such as the use of mouth rinses. It is widely known about the potential antiplaque biofilm activity and anti-gingivitis effects of different types of antiseptic mouthwash [42,43]; however, mouth rinses containing chlorhexidine showed potential to produce tooth and tongue staining [44,45].

Falkensammer et al. [1] demonstrated that colored mouth rinses (i. e. chlorhexidine, sodium fluoride and tea tree oil) produced minor perceptible color changes in the majority of composite resins after 4 weeks [1]. It has been found that mouthrinses solutions can reduce the surface roughness of a nanofilled composite resin when combined with tooth brushing [46]. In addition, low-pH mouth rinses with higher alcohol content may affect some physical-mechanical properties of resin composite, increasing the water sorption and solubility and producing softening of restorative materials which impairs in the long-term clinical performance of aesthetic restorations [47]. On the other hand, Gürdal et al. [48] did not observe any effect of the mouth rinses on the micro hardness and color changes of restorative materials. The authors highlighted the importance of routine assessment of the effect of mouth rinses on aesthetic restorations due to the in vivo variability, and also emphasizes that more data evaluating this association should be considered in further studies.

Sports

Physical activity stimulates children's growth and improve the physical and emotional health; however, sports practice may result in dental and jaw injuries. It is especially associated with high-risk sports such as inline skating, mountain biking, skateboarding, comb at and contact team sports [49-51]. Hersberger et al. [52] interviewed 415 players of water polo, which is classified as medium risk activity, and 44.6% of athletes have already witnesses a dental injury. In addition, Hecova et al. [53] investigated pre-injury risk factors to permanent teeth in 384 patients and the most common cause of injury was due to sports activity (26%), followed by bicycling (19.5%) and playing (17.4%). These finding suggests a potential dental injury risk in medium- and low-risk activities, which is also linked to the age group [52-54].

The consequences of dental trauma involve enamel or enamel-dentin fracture, fracture with exposed pulp and also tooth avulsion [53]. To protect tissues against injuries, equipment devices such as helmet, knee or elbow pads are well known, however the use of mouth guards remain a concern[49,50,54]. Muller et al. [50] evaluated the wearing habits of mouth guards in mountain biking athletes. Even though most of them knew about the importance of mouth guards (71.9%), only 4.4% athletes wore mouth guards during activity. Overall, athletes showed different reasons for not wearing a mouthguard, including breathing difficulties, hinder effective communication, poor aesthetics, poor retention and also some athletes believe that the use of mouthguard is not necessary [49,50,54]. It appears that an educational and motivational program focused on amateurs and professionals sporting participants is essential to achieve reduced level of oral and facial injury. In addition, considering the limited knowledge of sports participants regarding dental emergency management and the potential risk of tooth avulsion in some sport activities[50,54,55], practitioners and professional team should be aware of the importance of tooth drying prevention and the use of storage media (i.e. saline, milk or saliva) prior to tooth replantation.

Recent studies have demonstrated a cause-and-effect association between prolonged exposure to gas-chlorinated swimming pool water and dental erosion, and the competitive swimmers is considered to be the higher risk group[56-59]. Curiously, a few case reports showed severe and rapid loss of enamel by regular swimmers as a result of long time spent in inadequately maintained pools [56,57]. Chlorine is the most common agent used to keep swimming pools free of bacterial and other microorganisms, and the cyanuric acid is usually added to stabilize this agent [52,57]. However, if the pH water conditions became inadequately buffered and the pH remains lower than expected (7.2 to 8.0), there is a potential risk of tooth demineralization and the facial surfaces of anterior teeth are mostly affected [56,58-60]. Interestingly, changes in the salivary parameters (i. e. reduction of salivary secretion and phosphate level, and increased levels of calcium and fluoride) were observed in competitive swimmers after 2-hour swimming practice in a properly maintained gas-chlorinated swimming pool (i.e. average pH 7.5, calcium chloride=1.5 $mg.L^{-1}$) [60]. In summary, these observations highlighted the importance of dental professionals, regular swimmers, coaches and athletes being aware of the potential risk of dental erosion, and the importance of regular dental attendance to early diagnosis and preventive approaches (i.e. supervised use of fluorides).

Cigarette smoke

Although the number of smoking-attributable death starts to reduce, the cigarette smoking remains a leading cause of preventable mortality in the world [61,62]. The potential health hazards associated with cigarette smoking are widely documented, including cancer, cardiac dysfunction, chronic obstructive pulmonary disease, periodontal disease and adverse effects on reproductive function

[63-66]. Huang and Gregory [67] demonstrated that nicotine enhanced biofilm formation and biofilm metabolism of S. mutans. In addition, lower concentration of salivary secretory immunoglobulin A (sIgA), which plays an important role in mucosal immunity, wasobserved in smokers [68]. Based on these findings, smoking behavior seems affect the caries development; however, more studies should accurately evaluate this association since both behavioral and biological factors may influence the caries development [67,69-71].

Regarding the aesthetic dentistry, smoking and chewing tobacco may lead to extrinsic staining of tooth structure and restorative materials. Bazzi et al. [72] investigated the stain removal ability of tooth bleaching (at-home bleaching) and simulated tooth brushing after coffee and cigarette smoke staining in enamel surface. The authors showed that both chemical and mechanical treatments were effective to eliminate cigarette smoke staining, which appears to be superficial and easy to remove. However, only peroxide at-home bleaching was effective in removing stains caused by coffee. Limited information is available concerning the color alterations due to cigarette smoke in dentin surface, especially concerning the clinical areas exposed to oral environment (i.e. non-carious cervical lesions, root surface). Thus, further investigations should evaluate the potential correlation between the intensity of dental staining and the type, amount and frequency of cigarette smoking.

The color alterations of resin-based aesthetic materials due to cigarette smoke staining have been well documented [73-76]. Surprisingly, an intense discoloration onthe resin composite was observed when cigarette smoke was combined with colored beverages (coffee and red wine), and repolishing procedures with aluminum oxide abrasive discs can merely minimize the superficial staining [73,76].

The complexity and dynamic process of cigarette smoke formation involves a wide variety of compounds such as nicotine, carbon monoxide, acetaldehyde, formaldehyde, acetone and benzene [77,78]. Cigarette smoke particles (i.e. cadmium, arsenic and lead) were identified in dental structures and resin composite surface using energy-dispersive X-ray analysis [75]. It seems that the cigarette smoke compounds may impair the contact between dentin and adhesive systems and lead to lower values of dentin bond strength [79].

Although the potential effect of cigarette combustion in oral environment remains unclear, high temperatures (55°C) can increase the kinetics of water diffusion, water sorption and solubility of dental adhesive resins [80]. Recently, Vitória et al. [81] evaluated the water sorption and solubility of different adhesive systems when exposure or not to cigarette smoking. Specimens were placed in a cigarette smoking machine and daily exposed to 10 cigarettes per 8 min, twice a day. After 21 days, higher values of water sorption and solubility were observed for self-etching adhesive system after cigarette smoking. In addition, Mathias et al. [82] showed increased of water sorption when composite resins were exposed to cigarette smoking simulation; however, no differences were observed for solubility, except by the microfilled composite (Durafill). According to the authors, tar particles were easily observed in all composites and Durafill specimens were the one that more incorporated cigarette staining. Thus, it appears that the tar particles were incorporated during cigarette smoking exposure, and it may also have affected the release of composite compounds during the solubility assay. In summary, the cigarette smoking exposure canaffect the aesthetic and mechanical/physical properties of resin-based materials. Therefore, the frequency of cigarette smoking may also affect potential of staining and may impair the longevity of adhesive restorations due to aesthetic reasons or increased polymer degradation.

Conclusions

Within the limitations of this review, it can be concluded that the lifestyle behavior scan affect the dental tissues and may accelerate the aging process of aesthetic restorations. This knowledge is an important approach in preventive and restorative strategies.

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