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Severe enamel abrasion due to misuse of an air polishing device

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Abstract: *Objectives:* In this case report, a 28-year-old male patient who severely injured the enamel tissue of his upper incisors due to excessive self-performed air polishing has been presented. Air polishing devices are frequently used in initial or supportive periodontal therapy to remove supragingival plaque and dental stains. Enamel tissue is minimally affected by air polishing when appropriately performed by a professional. However, excessive air polishing may have detrimental effects even on the intact enamel. The aim of this case report is to present a patient who severely injured the enamel surfaces of his upper incisors due to excessive self-performed air polishing. *Methods:* A case of severe enamel abrasions in a 28-year-old male patient who injured the enamel surfaces of his upper incisors following several self-performed air polishing sessions has been presented. *Results:* Severely abraded enamel surfaces of the upper incisors were present and during the course of therapy restored by composite restorations to establish a satisfactory clinical appearance. *Conclusions:* In clinical practice, air polishing can be performed rather safely on intact enamel and is a beneficial procedure in initial and supportive periodontal therapy when performed by a professional under recommended operating conditions. However, review of the literature reveals that air polishing may be harmful on tooth and surrounding structures unless carried out cautiously. Furthermore, excessive use of air polishing devices, especially by unauthorized personnel may be damaging and lead to severe abrasion of enamel tissue.

Key words: air polishing; air polishing devices; enamel abrasion

Introduction

Air polishing devices (APDs) have been introduced in early 1980s as useful aids in removing supragingival plaque and dental stains. APDs mainly operate on the basis of pulverization of abrasive slurry containing water, sodium bicarbonate (NaHCO3) powder and pressurized air, by which the removal of accretions on tooth surface is achieved through mechanical action of accelerated particles (1, 2). The efficacy of the system depends on factors such as velocity of water and abrasive particles, distance between the nozzle tip and the tooth surface being treated, shape and size of abrasive particles (2–5), duration of air polishing (6) and amount of powder in powder chamber (7). APDs can rapidly and effectively remove soft deposits from tooth surfaces, especially in areas of difficult accessibility such as pits and fissures (2, 3), furcations (2) and root flutings (8). Nevertheless, air polishing may lead to clinically relevant loss of tooth substance when applied on denuded root surfaces or dentin (2, 6, 9–11). Although it is generally considered that the enamel is minimally affected by air polishing (1, 4, 11–13), APDs may cause enamel abrasion (4), localized gingival trauma (11, 14–16) and surface roughness on composite restorations even following short application periods (17). Our aim in this case report is to present a case of enamel abrasions in a patient who severely injured the enamel surfaces of his upper incisors due to excessive self-performed air polishing.

Case description and results

A 28-year-old male presented to our clinic complaining of yellowish discolorations on his upper incisors. Dental examination revealed severe enamel abrasions on the buccal aspect of all upper incisors most severely on the right upper central incisor. Poor fitting and abraded composite restorations were also present (Fig. 1). Gingival margins were inflamed to a certain degree as a sign of marginal gingivitis and poor oral hygiene. Thorough anamnesis revealed that the patient was a dental technician. According to his statement, he discovered the 'whitening' effect of an APD in his workplace. Initially almost a year ago, he air polished the buccal surfaces of his own upper front teeth, including composite restorations, for at least 3 min until they 'whitened'. As his front teeth and composite restorations took yellowish appearance with time, he repeated this procedure for five times approximately in 1-year period in order to 'whiten' them again. However, the patient could not give precise information relating to exact type of the APD and the abrasive media that he (mis)used.

Following initial periodontal therapy including oral hygiene procedures and scaling, defective restorations and abraded areas on the buccal surfaces of all upper incisors were restored by composite restorations (Fig. 2).

Discussion

Air polishing devices, useful aids in periodontal maintenance, remove 2.5 times less root substance than that of curettes (3), are as efficient as rotary instruments and curettes in plaque and stain removal (10, 12) and comparably time saving than these instruments (3, 10, 15), especially in orthodontic patients (6, 18). General opinion is that the enamel is minimally affected by air polishing when performed in accordance with the recommendations of APD manufacturers (1, 4, 11–13).

Early studies on air abrasive techniques showed that aluminium oxide and magnesium calcium carbonate (dolomite) powders were highly erosive on tooth structure (19, 20). Sodium bicarbonate is the commonly used air abrasive in today's APDs, however, it should not be used in patients on sodium-restricted diet (14). A novel low-abrasive air polishing powder has been examined and found to be more functional with regards to more bacterial plaque and less tooth substance removal (21–23).

Fig 1. Clinical appearance of severe enamel abrasions on right upper central incisor and contiguous to poor-fitting composite restorations.

Fig 2. Clinical appearance of upper incisors 21 days following treatment. Note the persistent marginal inflammation.

Sound enamel is resistant to air polishing (11, 13) depending on the orientation of enamel prisms in relation to the tooth surface (13). The resistance of enamel to air abrasives closely depend on mineralization density and hardness of enamel, and presence of enamel discontinuities (10, 13). Enamel is selectively attacked by air abrasive particles and lost at enamel discontinuities (13). Similar or even less amount of enamel is removed by air polishing when compared to that of polishing pastes. However, according to optical profilometry results, some devices may remove considerable amount of enamel that rules out the use of these devices (4).

Cementum and dentin removal increase in a linear correlation with the time of exposure to air abrasive powder (6, 11, 13). Exposure of denuded root surfaces and dentin to air abrasives is damaging, may lead to surface cavitation and should be avoided (2, 6, 9–11). If a pit-like depression is created on the dentin by abrasive particles, it tends to widen and deepen with ongoing air polishing (6) and this may lead to undermining of enamel at enamel–dentin junction (13). Although dentinal tubules on exposed dentin are obliterated by abrasive powder (2, 11), it is not known whether this prevents hypersensitivity permanently (12).

The manufacturers of different APDs recommend different angles of spray stream for various tooth surfaces, however, it is difficult to maintain a constant angle in clinical practice (4). Additionally, no significant difference in the amount of tooth substance loss has been established following 45° and 90° angulations of the nozzle tip towards the treated surface (24). It has been recommended to disclose the plaque before prophylaxis (4) and move the nozzle tip with overlapping strokes (12) to avoid undesired effects. Subcutaneous facial emphysema owing to the use of an APD has been reported (25) and this incident reinforces to angle the nozzle tip at 80°–90° to tooth surface, especially at sites contiguous to deep periodontal pockets (12).

Sodium bicarbonate (17) and aluminium trihydroxide (26) particles may remove organic matrix of composite restorations just in 5 s, creating surface roughness. On the other hand, it has been shown that air polishing does not lead to loss of marginal integrity of Class V composite restorations (27).

In this case, the patient air polished only his upper incisors for five times almost in 1-year time period. In each session, he used the device for 'whitening' his teeth for at least 3 min, which means approximately 45 s of application per incisor. This is quite prolonged exposure of enamel to the abrasive particles, as 5.5 ± 3.6 min is adequate to clean half of the teeth in totally dentate subjects (15). Patient's statement of so-called 'whitening' most probably refers to the etching of enamel that can be achieved by APDs in 15–30 s per tooth. However, the degree of erosion linearly increases with time (13). In this case, the surface roughness created on enamel surfaces and composite restorations by the patient probably led to increased plaque and stain retention. This can explain why the patient felt that his teeth discolored with time and he air polished them for several times. Air polishing may induce localized trauma on healthy gingiva (10, 14–16) and oral mucosa (11) characterized by abrasion of epithelial cell layers. It has been suggested that localized gingival trauma could heal in 6–12 days following air polishing (14–16), but in fact this can cause bleeding, sensitivity and difficulty in tooth brushing (10). Most recently, it has been demonstrated that the exposure of healthy gingival margin to abrasive slurry for 5 s might result in epithelial erosion and ongoing application up to 20 s led to denudation of gingival connective tissue. Therefore, it has been recommended to cover the gingiva with an aluminium foil prior to air polishing (16). The patients at risk require antibiotic cover because bacteraemia may occur after air polishing (28).

The severely abraded areas and poor-fitting fillings were present on the upper incisors and restored during the course of therapy by new composite restorations. However, 21 days following initial treatment, persistent inflammation of the marginal gingiva was evident that might be owing to abrasive particles deeply embedded into connective tissue (Fig. 2). This is probable, since implantation of birefringent particles leading to surgical emphysema following application of APDs has been demonstrated (11). The embedded particles may become encapsulated and constitute potential microfoci of infection, as it is not known whether these particles are biodegradable (11). As mentioned earlier, prolonged exposure of patient's front teeth to abrasive slurry for 45 s per tooth increases the probability of embedment of abrasive particles into the depths of soft tissue, because complete plaque removal from tooth surface can be achieved in 5–20 s of air polishing (3, 22–24).

In this case it is apparent that the patient, as a dental technician, did not know about the possible harmful effects of APDs that may arise due to excessive use of these devices and that is why he unintentionally injured the enamel tissue of his upper central incisors. It is unthinkable that air polishing would be performed in this manner by a hygienist or a dentist.

In clinical practice, air polishing can be performed rather safely on intact enamel. APDs are useful aids in initial and supportive periodontal therapy and have no adverse effects on the teeth and surrounding structures as long as used cautiously by a professional under manufacturer's recommendations. On the other hand, this case is a striking example of how APDs

can be detrimental to the enamel tissue when used by unauthorized personnel in the environment of dental clinic.

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