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Sudden Onset of Subcutaneous Air Emphysema After the Application of Air to a Maxillary Premolar Located in a Nonsurgical Field

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Clinical Relevance

Subcutaneous emphysema commonly develops when compressed air enters through a surgical site. Forced air may inadvertently enter into subcutaneous tissue through intact mucosa. Clinicians must be aware of this possibility to diagnose and manage subcutaneous emphysema during nonsurgical treatment.

SUMMARY

Although rare, subcutaneous air emphysema can occur during dental procedures such as endodontic treatment, surgical extractions, and preparing a tooth for an indirect or direct dental restoration. We report the development of a subcutaneous air emphysema that was introduced through the periodontal ligament of an untreated premolar after the use of an air syringe to dry the tooth.

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INTRODUCTION

Subcutaneous air emphysema, when air is introduced into subcutaneous tissues under forced pressure, is not a common occurrence during dental treatment. However, the use of high-speed air turbine handpieces and air syringes can lead to the introduction of air into the soft tissue spaces. Common routes for entry of air are through endodontically treated teeth, extraction sites, periodontal treatment sites, and during restorative procedures such as class V preparations and crown preparations.[1,2] Trauma to facial areas can also lead to the introduction of air into soft tissues spaces.[3] No case has yet reported the development of a subcutaneous air emphysema in which the air was introduced through a nonsurgical site, which also was not involved in any other hard or soft tissue procedure. We describe a case in which a subcutaneous air emphysema developed by the application of air to the untreated opposing dentition of a tooth being prepared for an onlay.

CASE REPORT

The following case was seen at the University of Michigan School of Dentistry. A 53-year-old man

presented for a Cerec, (Sirona Dental Systems, Inc, Long Island City, NY, USA) porcelain onlay on tooth number 19. His health history was unremarkable other than he was being treated for hypertension with lisinopril and high cholesterol with welchol and over the counter CholestOff. The patient's dentition was previously treated with four quadrants scaling and root planning and was periodontally stable except for a localized deep pocketing in the maxillary right quadrant. Flap surgery was performed on teeth numbers 2 to 5 about one week prior to being seen for onlay preparation on tooth number 19. Before the Cerec onlay preparation, the mandibular left quadrant was anesthetized by a nerve block of the left inferior alveolar nerve with 1.1 mL lidocaine with 1:100,000 epinephrine. The Cerec computer-assisted-design/computer-assisted manufacture (CAD/CAM) system allows for same-day impression and delivery of an onlay. This requires a digital impression of both the preparation and the opposing teeth to mill the onlay onsite with the CAD/CAM machine. Prior to obtaining a digital impression, it is important to evaluate the occlusion to ensure adequate occlusal reduction of the onlay preparation and to thoroughly dry the teeth. After drying the mandibular quadrant, the operator applied air to the opposing maxillary left quadrant with the air syringe, and the patient immediately reported a "lightning bolt" sensation that went from the premolars and traveled posteriorly to the maxillary molars. The patient immediately noticed a large facial swelling on the outer aspect of the left ramus. Oral Medicine was called for a consultation. At initial viewing of the patient, the left side of the patient was noticeably swollen compared with his right side (Figure 1). On examination, the swelling extended six inches in length up the ramus and was about two to three inches across. The affected tissue did not have the crepitus (crackling) feeling on palpation, but was firm to the touch. Trismus was not present with the jaw joints. The airway was not obstructed, and the patient reported that the swelling was not painful but slightly uncomfortable. Swelling was limited to the exterior portion of the ramus, and swelling was not observed on the medial aspect of the ramus. Initial diagnosis by Oral Medicine was a subcutaneous air emphysema but given the proximity to the airway, Oral Surgery was paged to evaluate the swelling. They agreed with the Oral Medicine diagnosis. At the time of the incident, probing depths in the area, the maxillary left quadrant, were unremarkable and ranged from 2 to 3 mm. Prior to scaling and root planing procedures, the probing depths on the buccal of tooth number 12 read from mesial to distal, 8, 3, and 6 mm and for number 13 read 6, 3, and 5 mm. Lingual probing depths on numbers 12 and 13 ranged from 6 to 3 mm. Initial periodontal stability had been established eight weeks after the initial scaling and root planning visit, which was more than 15 years before the development of this subcutaneous air emphysema. Five days prior to the incident, the patient had received periodontal surgery on the maxillary right quadrant for an isolated pocket that developed near tooth number 3. He was also still taking a seven-day course of 500 mg amoxicillin, three times a day, which had been prescribed at that visit; therefore, he was not placed on an additional prophylactic course of antibiotics. Later the same day, the patient was seen in the Graduate Periodontal Clinic to have sutures removed from the maxillary right quadrant. Oral Medicine followed up with the patient while he was waiting for his periodontal appointment. He reported that the swelling felt and looked smaller.

Figure 1. *Image of patient's face after onset of subcutaneous air emphysema affecting the left portion of the patient's ramus.*

This was confirmed by visual examination. Follow-ups via telephone were performed, and the patient reported that the swelling went down after two days. He has not had any further complications in the affected areas.

DISCUSSION

Subcutaneous emphysema related to dental treatment was first described by Turnbull at the beginning of the 20th century.[4] In 1995, 74 cases occurring between 1960 and 1993 were reviewed by Heyman and Babayof.[5] More recently, in 2009, McKenzie and Rosenberg published a review of an additional 32 episodes of subcutaneous emphysema occurring from 1993 to 2008.[1] Most reported cases have been associated with the use of air turbine handpieces during dental surgeries and nonsurgical restorative procedures.[1,5]

In our review of the literature, we found only two cases of subcutaneous emphysema related to the use of a dental air syringe.[2,6] In one case described by Uehara and others, the emphysema was believed to have resulted from air being directed into the gingival sulcus to dry teeth that were endodontically treated for caries.[6] Likewise, in the case described here, the subcutaneous emphysema followed the use of an air syringe in a nonsurgical field. We also believe the gingival sulcus to be the likely conduit for the entrance of the air into the subcutaneous tissue, given the fact that the maxillary teeth had not had any restorative work performed on them at the time of the emphysema.

Subcutaneous cervicofacial emphysema can be a serious and life-threatening event. The subcutaneous introduction of air into the buccal or sublingual spaces has the potential of further spread through the submandibular space and into the fascial spaces of the neck.[7] Pneumomediastinum may readily result following spread of air from the cervical spaces into the mediastinum.[3,8] The signs and symptoms of pneumomediastinum include dyspnea, chest and back pain, a crunching sound with each heartbeat known as Haman's sign, and positive radiographic findings.[9] In addition, nonspecific electrocardiographic changes in the ST-T interval may be seen. Treatment for pneumomediastinum is usually supportive, with close observation for development of further complications such as cardiac tamponade, simple and tension pneumothorax, pneumoperitoneum, mediastinitis, or airway obstruction.[9,10] The differential diagnosis must include allergic reaction along with hematoma arising as a complication of local anesthetic injection.[11] In the present case, signs of an allergic reaction, such as skin erythema and firmness to palapation, were not present. Trismus and intraoral swelling, features of an injection hematoma, were also absent. Crepitus on palpation, a feature commonly associated with subcutaneous emphysema, could not be detected. However, this feature may not be evident until several hours after introduction of the subcutaneous air.[10]

Although neither airway compromise nor cervical swelling was present in this case, patients manifesting such symptoms should be evaluated immediately via imaging to determine the extent of airway compromise and mediastinal involvement.[11-13] Subcutaneous emphysema usually resolves spontaneously over a few days, but more severe cases, especially those with airway compromise, may require hospital admission and monitoring.[13,14] The administration of antibiotics is advocated in severe cases to counter the possible introduction of bacteria along with the air into subcutaneous spaces. Oral flora being the most likely bacterial contaminants, amoxicillin or its equivalent is an appropriate choice. In the case we presented, the patient was on a seven-day course of amoxicillin for periodontal flap surgery and was on day 5 of his regimen and therefore was not prescribed an additional prophylactic antibiotic.

Cases reported in the literature also demonstrate that the passage of air from one fascial space to another fascial space does not always follow a predictable route. Some cases reported that air forced in subcutaneously moved from mandibular spaces to maxillary spaces. For instance, Uyanik and others[15] reported on the case of a patient undergoing root canal treatment on a mandibular anterior tooth that demonstrated that an air emphysema does not necessarily localize at the site where air was introduced. During the placement of the last endodontic file on a mandibular anterior incisor, a swelling appeared in the maxillary canine fossa without compromising the airway.[1,5,15] Likewise, another endodontically treated mandibular molar developed an infraorbital swelling with the application of the air syringe.[16] In the case we presented, the air introduced in the maxilla by an air syringe moved from the canine space (also known as the infraorbital space) posteriorly through the buccal space and finally to the posterior submasseteric space.

Although the introduction of air emphysema with an air syringe is uncommon, it should be understood that it is a risk in dental treatment. It is most likely that the air syringe introduced forced air through

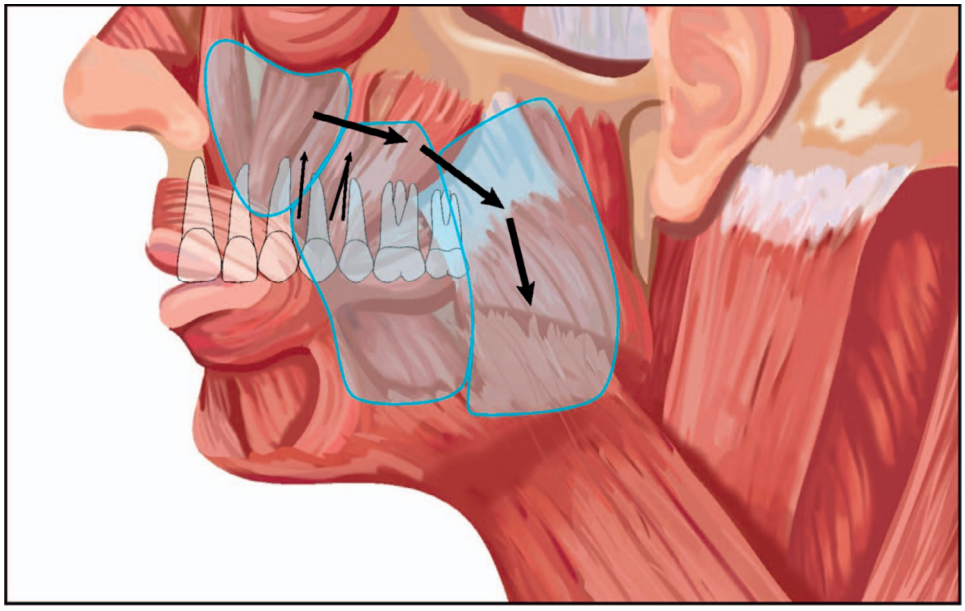

Figure 2. *Schematic of fascial spaces that the air traveled through once entering the subcutaneous tissues through the periodontal ligament of tooth number 12 or 13.*

the periodontal ligament at the site of either tooth number 12 or 13 and subsequently traveled through the canine and buccal fascial spaces before settling in the submasseteric space (Figure 2). This pathway is consistent with activation of the posterior superior alveolar nerve (and also possibly the middle superior alveolar nerve), as reported by the patient. The presence of the middle superior alveolar nerve is highly variable and mostly likely innervates the premolars by means of a nerve plexus.[17-19] The posterior superior alveolar nerve typically innervates the molars, participates in the plexus innervating the premolars, and innervates the periosteum and gingiva surrounding the premolars and molars.[20,21] Given that some cases have reported on the introduction of air emphysema via air syringes, it is important to use the air syringe sensibly to prevent such an event from happening. In the event of an iatrogenic air emphysema, it is important to recognize the risks of airway restriction and / or the presence of facial swelling. A patient with developing airway restriction should be referred to a hospital for computed tomography and further management. If only facial swelling without airway restriction is present, the patient should be followed closely for resolution with consideration given to the administration of prophylactic antibiotics.[16,22]

Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects oversight committee guidelines and policies of the University of Michigan School of Dentistry.

Conflict of Interest

The authors of this manuscript certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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