

Subcutaneous emphysema related to air-powder tooth polishing: a report of three cases

V Alonso,* L García-Caballero,*‡  I Couto,† M Diniz,*‡ P Diz,*‡ J Limeres*‡

*School of Medicine and Dentistry, University of Santiago de Compostela (USC), Santiago de Compostela, Spain.

†Montecelo Hospital, Pontevedra, Spain.

‡Medical-Surgical Dentistry Research Group (OMEQUI), Health Research Institute of Santiago de Compostela (IDIS), University of Santiago de Compostela (USC), Santiago de Compostela, Spain.

ABSTRACT

Subcutaneous emphysema is a rare complication of dental procedures and can occasionally give rise to potentially life-threatening complications. We describe three cases of subcutaneous emphysema diagnosed in the same dental clinic. All cases occurred during tooth or implant cleaning using air polishing (KavoProphyflex[®]) with a sodium bicarbonate powder (Air-N-Go Classic[®]). The diagnosis was based on clinical findings and was confirmed radiologically. The cervical and facial regions were affected in all three cases, and spread to the mediastinum occurred in one case. All the episodes resolved within 3–5 days. Tooth cleaning using air polishing combined with an abrasive powder is a risk factor for subcutaneous emphysema, especially when the powder and device are from different manufacturers. Radiological assessment must be performed to rule out involvement of deep tissue planes.

Keywords: Abrasive powder, air polishing, dental prophylaxis, emphysema, tooth cleaning.

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INTRODUCTION

Subcutaneous emphysema is the appearance of swelling due to the penetration of air or other gases into the subcutaneous or submucosal tissues.¹ Cervicofacial subcutaneous emphysema develops when air is forced beneath the epithelial surface (into a surgical wound or subepithelial laceration) in the oral cavity, dissecting through the different tissue planes, usually producing unilateral facial or submandibular swelling, with crepitus detectable on palpation (crepitation is almost pathognomonic for subcutaneous emphysema). The air can spread along the fascial planes of connective tissue.^{1–4} The trapped air is often limited to the subcutaneous space in the head and neck, though it can progress deeply along the fascial planes of the neck, with potential spread into the thorax and mediastinum;⁵ these are rare but potentially life-threatening complications.³

The first case of subcutaneous emphysema related to dental treatment was reported in 1900.⁶ Since then, most cases have been associated with the use of air-driven, high-speed handpieces or air syringes during tooth extraction,^{4,7–9} restorative treatment,^{10–13} endodontic treatment^{14,15} or dental laser cooling.¹⁶

Some cases of subcutaneous emphysema related to the use of an air/abrasive powder device have been reported previously after dental plaque removal,^{2,17–20} polishing a filling¹⁹ or non-surgical therapy for peri-implantitis.²¹

Despite the striking manifestations, this is usually a benign condition, and many cases pass undiagnosed.²² Early recognition and correct treatment are very important, because the spread of large quantities of air into deeper spaces can cause serious complications.²

CASES REPORT

We describe three cases of subcutaneous emphysema diagnosed in the same dental clinic between 2013 and 2015. All cases occurred during tooth cleaning using a Kavo Prophyflex[®] air-polishing device (KaVo Dental, Biberach, Germany) with a 3.2–5-bar drag pressure and a water pressure of 0.7–0.9 Pa, combined with Air-N-Go Classic[®] polishing powder (Sat-elec; Acteon Group, Merignac, France), a sodium bicarbonate (NaHCO₃) powder with a 76-µm granulometry.

Case 1

A 73 year old woman with dental implants came to a check-up consultation in 2013. She had no periodontal disease and alveolar bone loss was normal for her age. While peri-implant cleaning was being performed to the implants in the right mandibular quadrant, sudden swelling of the face was observed, with acute pain and crepitus. Based on clinical findings and imaging studies (cone-beam computed tomography, Fig. 1), we made a diagnosis of subcutaneous emphysema with facial and cervical involvement (malar, mandibular and cervical regions). Prophylactic corticosteroid therapy (methylprednisolone, 40 mg i.m.) and antibiotic treatment (azithromycin, 500 mg/day for 3 days) were provided, and the patient was advised to rest for 72 h. The emphysema resolved within 4 days.

Case 2

This patient was a 43 year old man who attended the clinic in 2013 for tooth cleaning, which was performed using a jet of abrasive powder. The patient had no periodontal disease. After dental plaque removal, he reported pain radiating to the ears and described an echo when speaking. In the floor of the mouth, an erythematous area with a possible solution of continuity was observed adjacent to the right mandibular lateral incisor and canine (Fig. 2); the jet of abrasive powder had made contact with this region during cleaning. Subcutaneous emphysema with malar and temporal involvement was diagnosed based on clinical findings. The patient was referred to hospital, where imaging studies confirmed cervical involvement and limited spread into the mediastinum (Figs. 3 and 4). The patient was kept under observation for 12 h but no specific medical treatment was

administrated. The emphysema resolved spontaneously in 3–4 days.

Case 3

Our third patient was a 62 year old woman who came for tooth cleaning in 2015. She presented with chronic adult periodontitis. During the procedure, the patient reported pain on the right side of the face, associated with noticeable swelling and crepitus. The problem developed after the jet of polishing powder made contact with an area adjacent to the right mandibular second molar (Fig. 5). The diagnosis based on clinical and radiological findings (cone-beam computed tomography) was subcutaneous emphysema with cervical and facial involvement (malar region, orbit and jaw). A non-steroidal anti-inflammatory drug (ibuprofen, 600 mg/8 h for 5 days) and prophylactic antibiotic treatment (azithromycin, 500 mg/day for 3 days) were prescribed. The process resolved within 5 days (Fig. 6).

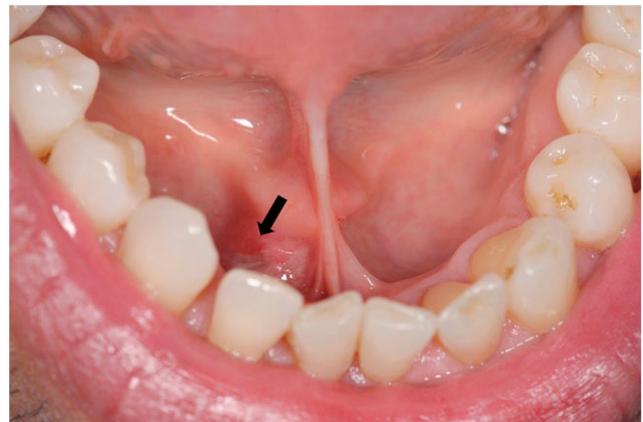


Fig. 2 Image of a possible solution of continuity on the floor of the mouth after contact with the jet of abrasive powder (arrow).

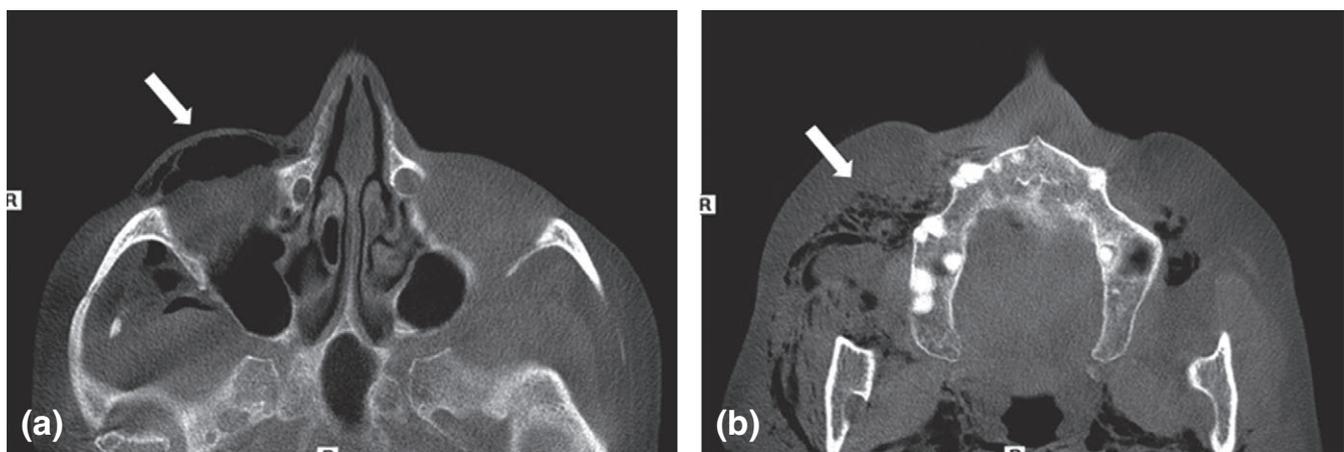


Fig. 1 Axial image of the cone-beam computed tomography showing (a) peri-orbital emphysema and (b) multiple air bubbles in the malar and masseteric regions.

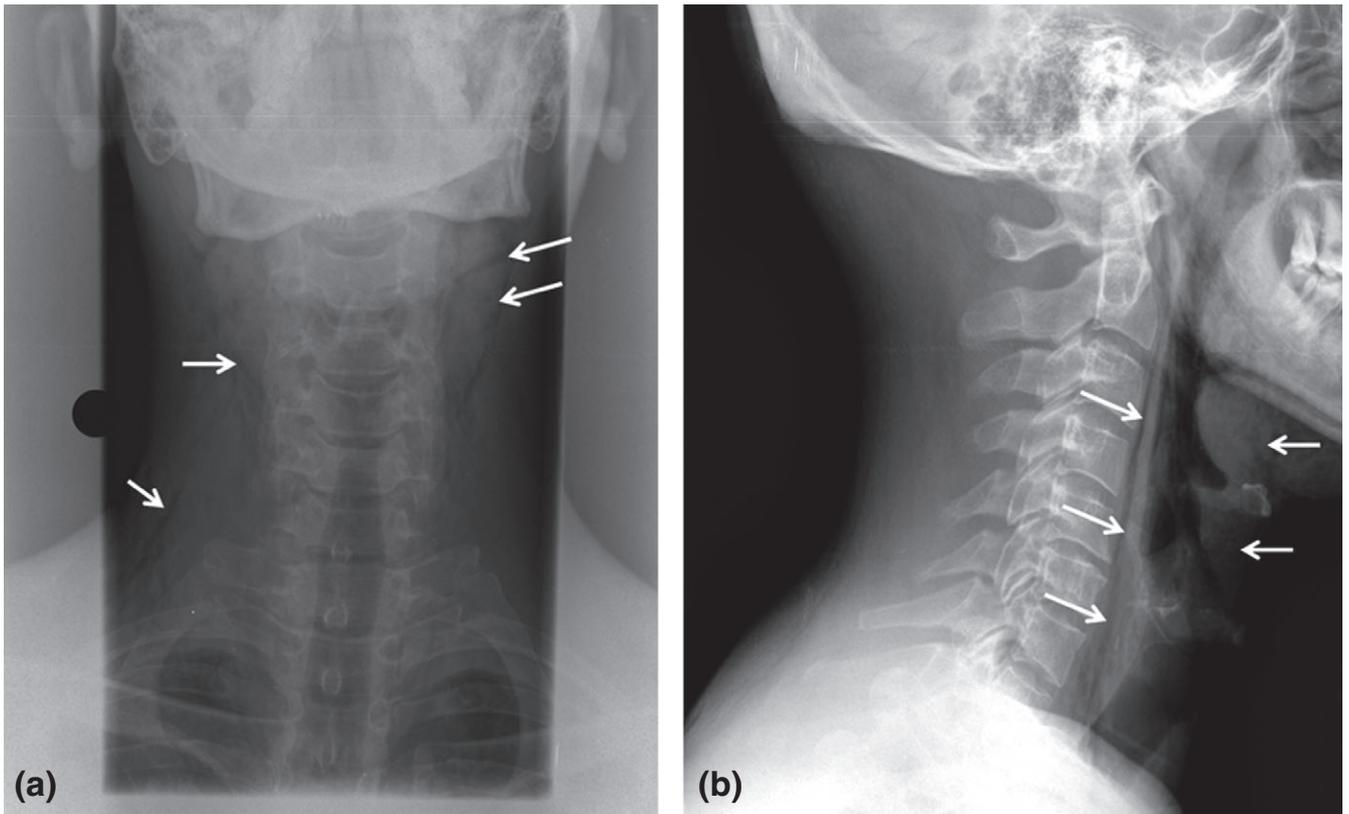


Fig. 3 (a) Anteroposterior and (b) lateral X-rays of the neck showing cervical spread of the subcutaneous emphysema (arrows).

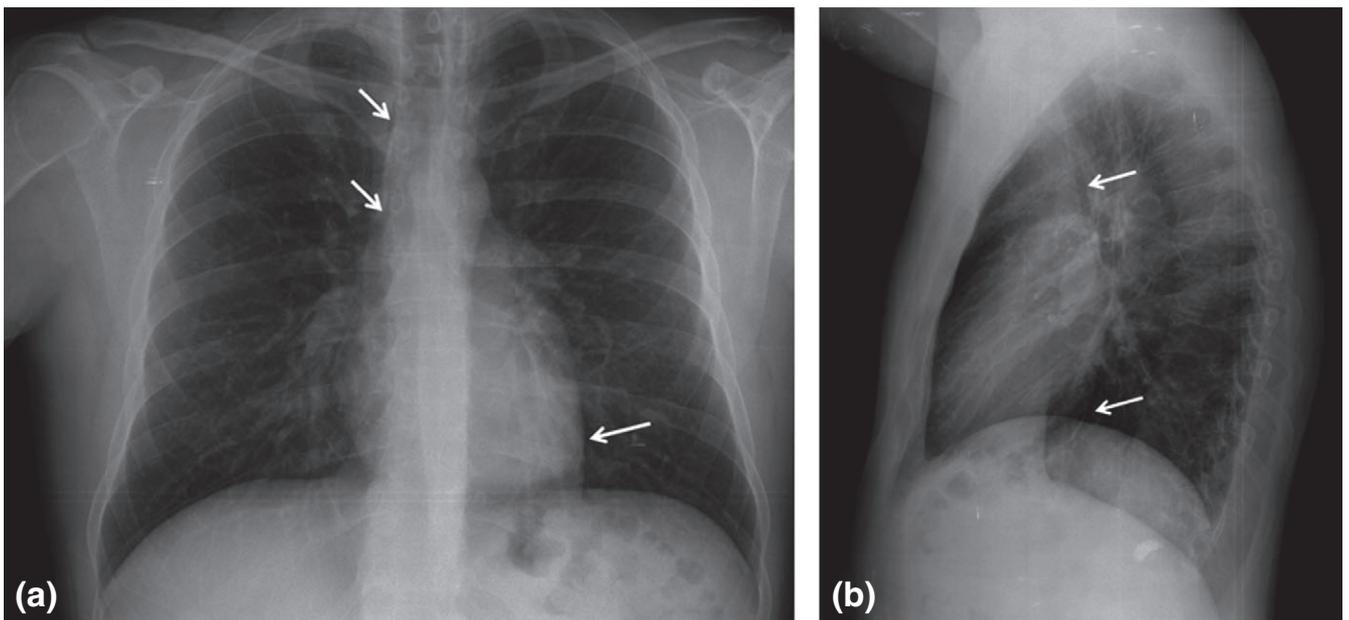


Fig. 4 (a) Anteroposterior and (b) lateral chest X-rays showing slight mediastinal emphysema (arrows).

DISCUSSION

Although the use of an air syringe, high-speed handpieces or a combination of these devices has been

reported in most cases of emphysema resulting from dental treatment,²² there are also some cases of emphysema related to the use of air polishing.^{2,17-20} It has been suggested that the air pressure employed



Fig. 5 Gingival recession around the right mandibular second molar and mucosal dehiscence detected after using the jet of abrasive powder (arrow).

by air-polishing systems exceeds that of other dental instruments, such as the air/water syringe or the air turbine.¹⁷

As in the present series, the most commonly involved sites are the malar, orbital and periorbital regions; the mediastinum is rarely affected.^{2,17-20}

During a dental procedure, the appearance of sudden soft-tissue swelling associated with crepitus should raise a suspicion of subcutaneous emphysema,³ especially in the absence of erythema, oedema, significant tenderness or lymphadenopathy.²³ The most important differential diagnoses are angioedema, haematoma and infection.² Emphysema may go undetected or be misdiagnosed,¹⁴ and the diagnosis is best established radiologically.²⁴ Chest radiographs and computed tomography are recommended to rule out mediastinal involvement as they offer a more precise assessment of the topographic spread and volume of the gas in the tissues.²⁵

In our first case, we believe the gas entered through the peri-implant area, where the mucosal seal is less resistant than the seal provided by periodontal connective tissue fibers.²¹ In the other two cases, the procedure provoked a macroscopic solution of continuity in a previously intact oral mucosa. When analyzing the possible origin of emphysema in the present series, we should take into account the dentist's experience, the air pressure of the polishing device and the abrasive powder employed. The procedures were all performed by the same dentist, who had 24 years' professional experience and had already performed tooth cleaning using this device (Kavo Prophylflex) on many occasions, with no incidents recorded over many years. After the first case of emphysema occurred, a technical assessment of device pressure was performed, confirming correct calibration and



Fig. 6 Clinical course of subcutaneous emphysema affecting the right side of the face. From left to right, appearance of the patient on days 1, 2, 4 and 5 after onset of the condition.

pressure values. Sodium bicarbonate air polishing has been shown to be safe for removal of the supragingival plaque biofilm and stains from intact enamel surfaces and more efficient than conventional scaling and rubber-cup polishing.²⁶ Although damage to enamel has not been reported, the potentially negative effects of sodium bicarbonate polishing systems do include abrasion of cementum and dentine, patient discomfort, epithelial abrasion of the gums and even the appearance of subcutaneous emphysema.²⁷ Manufacturers of glycine, calcium sodium phosphosilicate and calcium carbonate claim these powders are less abrasive than traditional sodium bicarbonate-based powders, but there are no studies published on these air-polishing powders to verify their safety and efficacy.²⁸ Air-N-Go Classic powder is composed mainly of ultrafine crystals of sodium bicarbonate with a non-aggressive geometry, specially designed to reduce pain and bleeding; particles are rounded to minimize their abrasive potential and their hardness is 2.5 on the Mohs scale to avoid damage to the enamel surface.

We have not been able to establish a common cause for these three cases of subcutaneous emphysema. However, we believe strongly that the combination of an air-polishing device with an abrasive powder from a distinct manufacturer may alter the speed and/or trajectory of the bicarbonate microparticles, increasing the abrasive potential of their impact not only in the peridental/peri-implant area but also on the adjacent intact mucosa. It is important to follow the manufacturer's recommendations to prevent complications, as some working parameters affect efficacy of the air-polishing devices: stand-off distance between nozzle and surface, angulation of central beam, instrumentation time and type of surface treated.²⁸ During supragingival debridement, parts of the jet stream of the abrasive water jet device will inevitably impact on the soft tissues surrounding the tooth.²⁸ Optimal angulation and distance of the air-polishing nozzle from the tooth surface will avoid facial and tissue emphysema and other gingival trauma. Air-polishing devices should be used for no more than 5–10 s per tooth surface, performing overlapping strokes to minimize the extent of epithelial erosion.²⁹

The management of subcutaneous and mediastinal emphysema is usually conservative. In mild and moderate cases, treatment consists of observation and patient reassurance.²⁵ Although the appearance of infection related to subcutaneous emphysema is rare, the introduction of non-sterile air, water and abrasive powder could potentially lead to serious complications, and some authors therefore recommend the prophylactic administration of a broad-spectrum antibiotic,¹⁶ particularly in cases of mediastinal involvement, in order to minimize the risk of mediastinitis.^{20,30,31} Although

subcutaneous emphysema is not always painful, some authors do recommend analgesia.^{30,31} In the majority of cases, the condition improves within 2–3 days and, as in the three cases presented, resolution occurs within 5–10 days.^{32,33}

CONCLUSIONS

The use of abrasive powder with air polishing for tooth and implant cleaning is a risk factor for subcutaneous emphysema. Precautions should be maximized when performing these procedures, verifying the manufacturer's specifications and applying an appropriate technique.

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Address for correspondence:
Dr Lucía García-Caballero
School of Medicine and Dentistry
University of Santiago de Compostela
c/ Entrerriós, sn. 15782
Santiago de Compostela, Spain
Email: lucia.garcia.caballero@usc.es