

## Orbital Emphysema Following Ocular Trauma and Sneezing

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Orbital emphysema is typically a benign condition that occurs following forceful injection of air into the orbital soft tissue spaces. In many cases there is a history of trauma and fracture of an orbital bone, which permits air entry. However, other mechanisms of orbital emphysema have been reported including infection, pulmonary barotrauma, injury from compressed-air hoses, and complications from surgery including dental procedures. Here, we describe a report of a teenager who suffered an isolated medial orbital wall fracture while playing basketball, and several hours later developed orbital emphysema acutely after sneezing. We will review the radiological evaluation of orbital fractures and emphysema.

### Introduction

Orbital emphysema is typically a benign condition that occurs following forceful injection of air into the orbital soft tissue spaces. In many cases there is a history of trauma and fracture of an orbital bone, which permits air entry. However, other mechanisms of orbital emphysema have been reported including infection, pulmonary

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Citation: Gauguet J-M, Lindquist PA, Shaffer K. Orbital Emphysema Following Ocular Trauma and Sneezing. *Radiology Case Reports*. [Online] 2008;3:124.

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Abbreviations: CT, computed tomography; HU, Hounsfield units; MRI, magnetic resonance imaging

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Published: January 31, 2008

DOI: 10.2484/rcr.v3i1.124

### Case Report

A 15-year-old male presented to our emergency room 24 hours after he was playing basketball and was hit in his right eye by a fellow player's knee. Following the impact the patient said that his eye was sore, but he did not experience blurry or double vision. However, several hours after the game, the patient sneezed and felt like the skin around his eye "puffed out". Following this swelling, there was no deterioration or change in his vision; he chose to present to the emergency department as there had not been resolution of the swelling over a 24-hour period. On examination, the patient denied any visual disturbance. Visual acuity was 20/60 on the left and 20/80 on the right; the patient reported this was his baseline as he normally wore corrective lenses, but did not have them with him at

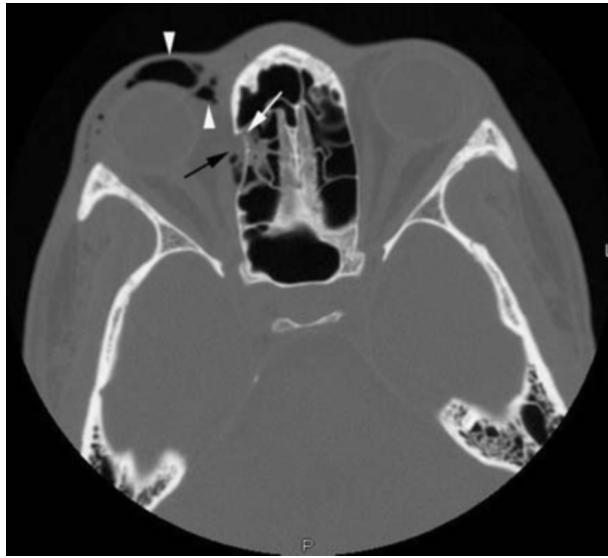


Figure 1. 15-year-old male with ocular trauma. Axial CT shows fracture of the right medial orbital wall orbital (white arrow), herniation of orbital fat through the fracture (black arrow), and orbital emphysema (arrowheads).



Figure 2. Coronally reformatted CT shows fracture of the right medial orbital wall orbital (white arrow), herniation of orbital fat through the fracture (black arrow), and orbital emphysema (arrowheads).

the time of exam. He denied headache, nausea, vomiting, dizziness, nasal congestion or bloody discharge from his nose or eye. There was mild swelling of the right upper eyelid, but no crepitus or palpable bony step-off around the orbital rim. There was no proptosis and the remainder of his optical exam was normal including extraocular motion and pupillary reflex.

In light of the mechanism of injury and the abrupt onset of orbital swelling after the patient sneezed, there was a high suspicion for an orbital fracture with concomitant orbital emphysema. Computed tomography (CT) of the facial bones including the orbits was performed with contiguous axial imaging (Figure 1); coronal and sagittal reformatted images were generated (Figures 2,3). There was a right medial orbital wall (lamina papyracea) fracture, which was depressed by approximately 3 mm. A small amount of retro-orbital fat herniated into the adjacent right ethmoid air cells without entrapment of the medial rectus. There was gas between the right medial rectus and the medial orbital wall extending anteriorly into the periorbital soft tissues and superiorly into the supraorbital fat. While the patient's symptom of orbital swelling after sneezing suggest that orbital emphysema occurred after the sneeze, as no imaging was obtained prior to the patient's sneeze we are unable to formally exclude the possibility

that there was orbital emphysema before the sneeze.

The patient was discharged from the emergency department in stable condition with a follow-up appointment with an ophthalmologist, a course of oral antibiotics, and instructions to use nasal decongestants and avoid blowing his nose. Surgical repair and decompression were not performed, and several weeks later the patient was doing well without sequela.

## Discussion

Orbital emphysema typically results from forceful entry of air into the orbital soft tissue spaces following an orbital fracture; however, other mechanisms including infection, pulmonary barotrauma, injury from compressed-air hoses, complications from surgery, sneezing, airplane travel, and Boerhaave's syndrome (esophageal rupture) have been reported [1, 2]. Fractures typically occur at the thinnest portions of the orbital wall including the medial or inferior orbital wall permitting air entry from the ethmoid and maxillary sinuses, respectively. Although the medial wall (lamina papyracea) is thinner (approximately 0.25 mm thick) than the orbital floor (approximately 0.5 mm thick), fractures of the orbital floor are most common, while isolated medial wall fractures occur in approximately

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10-30% of cases of orbital trauma [3-5]. In children, the more flexible bones of the orbit are less prone to fracture and shattering, but rather they fracture and function as a trap door which results in a higher incidence of muscle entrapment following orbital wall fractures [6, 7]. Air is trapped in the periorbital spaces when the orbital soft tissue acts as a ball valve and presses back the fracture fragment or herniates into the sinus cavity [3, 8]. With orbital emphysema there may be complications with a range of severity including proptosis, loss of vision, increased intraocular pressure, and central retinal artery occlusion, with the more severe complications caused by orbital compartment syndrome [3]. In two dramatic cases, one patient developed subcutaneous emphysema and pneumomediastinum following a medial orbital wall fracture, while another developed pneumomediastinum after blowing her nose without prior evidence of ocular trauma [9, 10].

CT is effective in identifying the presence and anatomical location of air when orbital emphysema is suspected [11]. Subcutaneous air restricted to the eyelid is classified as palpebral emphysema, and is a rare event arising from disruption of the lacrimal sac and bone [1]. In true orbital emphysema, air is located behind an intact orbital septum, which occurs following fracture of an orbital wall and tearing of the sinus mucosa. A further distinction is made between intraconal (bounded by the medial and lateral rectus muscles) and extraconal orbital emphysema. Air enters into the orbital soft tissue spaces when intranasal pressure



Figure 3. Sagittally reformatted CT shows orbital emphysema (arrows).

increases during coughing, sneezing, or nose blowing [1]. Orbitalpalpebral emphysema occurs when orbital pressure increases beyond the mechanical strength of the orbital septum and air passes freely from the orbit into the eyelid. The presence of orbitalpalpebral emphysema effectively rules out any risk of orbital compartment syndrome, which arises when the pressure of orbital air is sufficient to cause vascular compromise to orbital structures including the retina and the optic nerve. One pitfall in using CT to evaluate the presence of air after orbital trauma is that a wooden foreign body can mimic the presence of orbital emphysema, and the management of these two scenarios is entirely different [12]. There is a wide range of attenuation of wood on CT ranging from air density (-984 HU) to soft tissue/fluid density (+23 HU), which depends upon the type of wood and how much fluid it has absorbed after entering the tissue [5]. In such cases, a careful history is helpful in making the correct diagnosis.

Although radiography has long been the standard for imaging orbital trauma and detecting fractures, it has a high false negative rate (50%) and non-diagnostic rate (30%), which greatly limits its utility [13]. Rather, initial radiological evaluation of orbital fractures is best performed with CT as it can effectively identify bony defects [4, 6]. Images in the axial plane permit sensitive examination of medial and lateral orbital walls, while coronal images, which can be obtained directly or through reformatting axial images, are useful in evaluating fractures of the orbital floor and roof. Helical scanning is superior to conventional scanning in the detection of metallic foreign bodies, and when coronal reformats are generated from axial helical scans, imaging time and radiation dose are significantly reduced compared to obtaining direct scans in the axial and coronal planes [4, 5]. The reduced scan time and radiation dose are particularly important when evaluating the pediatric population, who are more radiosensitive and may be less cooperative during a scan. In addition to identifying foreign bodies and fractures, it is important for the radiologist to recognize entrapment of extraocular muscles or herniation of periorbital fat into the sinus cavities. Indirect signs of muscle entrapment include kinking or rounding of the rectus [5, 14, 15]. The presence of orbital emphysema in the absence of an apparent orbital wall fracture suggests an occult fracture of the orbit [16], and a study by Hunts demonstrated that the location of the orbital emphysema correlates with the fracture location [3]. There is a limited role for MRI in the evaluation of orbital trauma as it has limited sensitivity for detection of fractures and is contraindicated until the absence of a metallic foreign body

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in the eye has been documented by CT. However, MRI may be useful in further evaluating soft tissue pathology of the rectus muscles, the optic nerve and the brain, and in evaluating vascular damage [5]. Ultrasound is helpful in diagnosing globe defects including foreign bodies, vitreous hemorrhage, lens dislocation, retinal detachment, or globe rupture [6]. Care must be taken; however, to prevent infection or cause unnecessary pain and discomfort when applying the transducer to an orbital wound.

The management of orbital fractures and orbital emphysema depends largely on the clinical presentation and imaging findings. Clinical findings associated with orbital fractures and orbital emphysema include orbital pain, hypoesthesia, restriction of ocular motion, proptosis or enophthalmos (posterior displacement of the globe into the orbit), diplopia, and vision loss. If there is suspicion for orbital compartment syndrome, emergent decompression is necessary and is typically performed by either canthotomy/cantholysis or needle aspiration of trapped air, which can lead to rapid decompression and resolution of symptoms [8]. Otherwise, orbital emphysema will resolve on its own as the air is absorbed. Surgical repair of orbital fractures within two weeks is indicated in patients with diplopia and CT evidence of entrapped muscle or periorbital tissue, large fractures (>50% of the wall), and enophthalmos that does not resolve. Entrapment of soft tissue may stimulate the oculocardiac reflex, which may stimulate strong vagal responses including bradycardia, nausea, vomiting, syncope and heart block. In these scenarios, rapid repair and release of entrapped soft tissues is recommended [17]. Conservative management is generally reserved for patients with minimal diplopia, preserved ocular motility and the absence of marked enophthalmos [5].

There have not been clinical trials to adequately assess the importance of antibiotics in the management of orbital fractures and this remains an area of controversy. A survey of maxillofacial surgeons reported that 47% prescribed antibiotics at the time of orbital fracture diagnosis; however, another report suggested that antibiotics are only indicated in the setting of an open fracture, concomitant or recent sinus infection, or an immunocompromised state [5, 18].

Our case is a presentation of orbitalpalpebral emphysema caused by sneezing and preceded by fracture of the medial orbital wall. Similar cases have been reported in the adult population, and there has been one other report in the pediatric population of trauma and orbital emphysema resulting from a snowboarding accident followed by nose blowing [19, 20]. Interestingly, there have been several reports of orbital emphysema after sneezing or nose blowing without history of trauma, or many months after orbital

trauma [1, 21-24]. Direct trauma to the orbit; however, followed by forceful air entry into the soft tissues spaces during nose blowing, sneezing, or coughing, is the most common cause of orbital emphysema.

In our patient, other than orbital swelling and tenderness, there were no complications from the isolated medial wall orbital fracture and orbitalpalpebral emphysema, which was diagnosed by CT. In the absence of any ocular symptoms and no CT evidence of muscle entrapment, there was no indication for surgical repair. He was prescribed a course of antibiotics and the patient recovered well with conservative management.

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