Peer-reviewed paper; submitted May 2022; accepted February 2023

Odontogenic orbital cellulitis: a case report

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Abstract

Odontogenic orbital cellulitis (OOC) is inflammation of the orbital tissues secondary to dental infection. Orbital cellulitis may progress to accumulation of suppuration; as a subperiosteal abscess (SPA) or as an orbital abscess. OOC is an uncommon infection of the maxillofacial region, with an estimated prevalence of 1.3% (Blake *et al,* 2006).

We present a case of a 27-year-old pregnant female who presented with a one-day history of left sided periorbital oedema, erythema and ophthalmoplegia. She was diagnosed to have an odontogenic orbital subperiosteal abscess, which was managed acutely by a multi-disciplinary approach including maxillofacial, otorhinolaryngology and ophthalmology teams. Three weeks post-operatively, the patient showed full recovery from the abscess.

Although uncommon, OOC is an important complication of dental disease that practitioners should be aware of. This is due to the potentially severe complications including vision loss secondary to compression of the optic nerve, meningitis, cavernous sinus thrombosis, brain abscess or death (Li et al, 2020). As involvement of the orbit from dental infection is rare, there is often protracted onset of therapy increasing the risk of severe consequences. Early identification and management of dental infection by general dental practitioners can prevent these severe, potentially life-threatening complications.

Introduction

Some 2-5% of cases of orbital cellulitis (OC) are attributed to odontogenic infection (Costan *et al,* 2020). Other causes of OC include sinus disease, retention of foreign body, neoplastic disease, fungal infections and skin infection such as furunculi (Procacci *et al,* 2017).

Chandler and coworkers classified orbital cellulitis based on its location and severity in 1970. Orbital cellulitis is an extension of the inflammatory process posterior to the orbital septum (Procacci *et al,* 2017). As the process continues, an abscess with suppuration is observed (Chandler stages III/IV). The intra-ocular pressure is raised, resulting in compression and infarction of the optic nerve, leading to worsening visual symptoms (decreased visual acuity and ophthalmoplegia) (Blake *et al,* 2006. Li *et al*, 2020). Cavernous sinus thrombosis is an extension of the inflammatory process posteriorly into the cavernous sinus and is a potentially life-threatening complication, associated with cranial nerve palsy (Blake *et al,* 2006).

Chandler's Classification

Table 1. Chandler's classification of orbital cellulitis.

Stage I	Pre-septal cellulitis / Inflammatory Oedema
Stage II	Orbital cellulitis
Stage III	Subperiosteal abscess
Stage IV	Orbital abscess
Stage V	Cavernous sinus thrombosis

There are several pathways of infection from a tooth to the orbit, due to the complex anatomy of the facial bones, muscles and vasculature. The most common path however, is from the maxillary premolars/molars via the maxillary and ethmoidal sinuses (Li *et al,* 2020). Rapid and aggressive surgical and antibiotic management of a suspected odontogenic orbital abscess is required to prevent potential complications of permanent vision loss, cavernous sinus thrombosis, meningitis and death (Zawadzki *et al,* 2021). The management of the patient in this case is also complicated due to the potential risks of investigations and management to her developing foetus. When determining the best management, risks to both the patient and her developing child were considered and discussed with the patient and her whānau.

Case report

A 27-year-old pregnant female was referred by Middlemore Emergency Department to the Department of Oral & Maxillofacial Surgery (OMS) at Auckland District Health Board, Auckland, New Zealand. She presented with a one-day history of left sided periorbital oedema and erythema. She complained of an acute toothache from the upper left side three days prior to presentation. Examination noted that the visual acuity was grossly intact and pupils were equal and reactive. Lateral movement was painful in the left eye, with mild restriction (ophthalmoplegia) in vertical gaze but no diplopia. Cranial nerves V and VII were intact. Tooth 28 was acutely tender. There was no intra-oral swelling or draining sinus. Blood investigations taken at presentation showed raised inflammatory markers including; C-reactive protein (33mg/L), white blood cells (16 x E9/L) and neutrophils (13.6 x E9/L), and a positive hCG-beta.

Medically, she was at 14 weeks gestation but otherwise fit and well. Given her early stage of pregnancy, the patient was understandably concerned of the risks that her infection and its management may have on her child. Her whānau were included in all discussions about investigations, risks and benefits of all procedures.

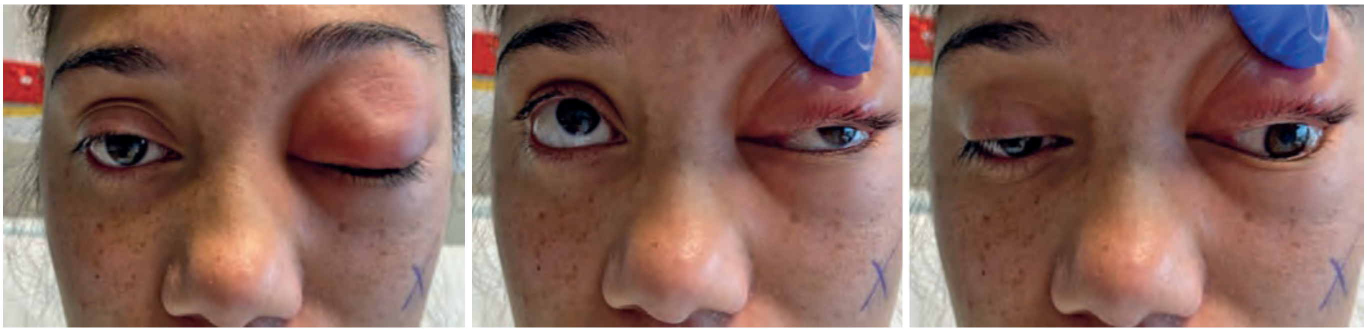
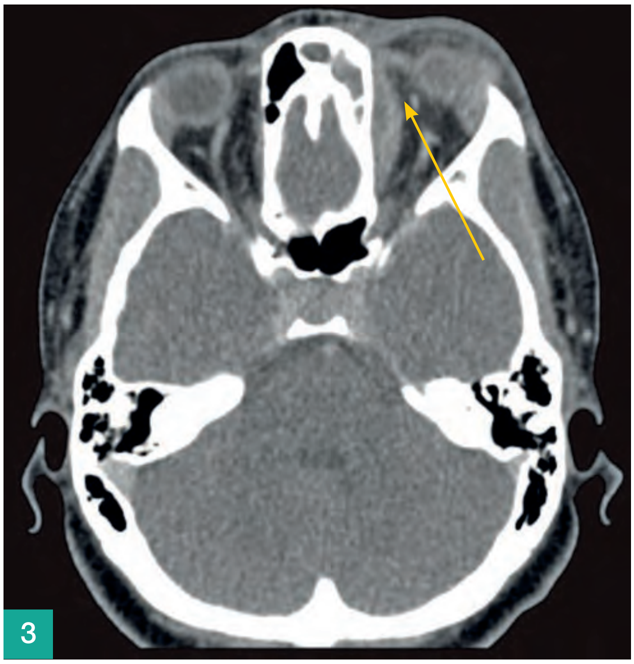
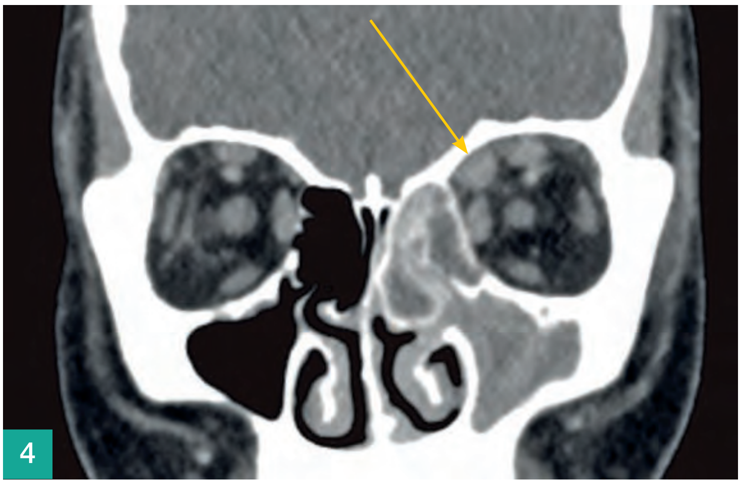


Figure 1. Pre-operative clinical photographs – significant periorbital oedema and erythema, mild restriction in vertical gaze.

The clinical presentation of periorbital oedema and ophthalmoplegia was deemed to warrant a computed tomography (CT) scan. The risks of a CT of the head and neck during pregnancy were discussed with the patient. When balancing the risks of imaging during pregnancy, versus the potential risks an unmanaged OOC, the patient opted to proceed with imaging.

The CT showed complete opacification of the left maxillary sinus, anterior ethmoid air cells and partial opacification of the left frontal sinus. There was an elongated extraconal collection in the left orbit, located on the superomedial orbital wall (measuring 30 x 4 x 6 mm). There was displacement of the superior oblique muscle and mild left sided proptosis. An apical radiolucency was





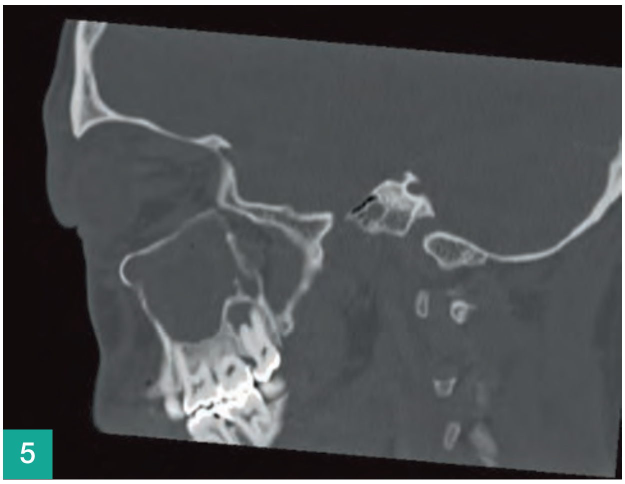


Figure 2. Axial slice of CT indicating proptosis of the left globe.
Figure 3. Axial slice of CT – medial wall collection arrowed.
Figure 4. Coronal slice of soft tissue CT – opacification of sinuses and superomedial SPA (arrowed).
Figure 5. Sagittal view of CT – apical lucency of 28.

noted on tooth 28. There was no radiographic evidence of cavernous sinus thrombosis.

Given the acute presentation, spread of infection and risk of vision loss, the decision was made for urgent surgical intervention. The patient was taken to acute theatre for an incision and drainage of left orbital, maxillary sinus and buccal collections and extraction of tooth 28 under general anaesthestic. To gain access to the intra-orbital space, a retroseptal transconjunctival approach was used. The orbital contents were explored and an estimated 5 mL of frank pus drained. Aspirated pus cultures later grew mixed anaerobes and *Prevotella baroniae.* Interrupted closure of the transconjunctival approach was completed using 6.0 chromic gut sutures. Intraorally, tooth 28 was extracted. There was no pus encountered in the socket. A full thickness mucoperiosteal flap was raised to expose the maxillary sinus antral wall. Copious frank pus (approximately 20 mL) was encountered immediately following antrostomy. The sinus was irrigated with 1L sterile normal saline. A Penrose drain was secured into the left maxillary sinus using silk sutures. Following an uneventful extubation, the patient was transferred to the ward for ongoing monitoring and IV augmentin (1.2 g three times daily).

The patient was reviewed daily by the OMS and Ophthalmology teams. Ophthalmological assessment included measurements of visual acuity, intra-ocular pressure, eye movements, globe positioning (using Hertel's exophthalmometer), colour vision and brightness perception. It was hoped the initial drainage and removal of the offending source would facilitate improvement, however two days post-operatively, the patient's visual symptoms had not improved and her proptosis had mildly worsened. Following discussion with radiology and the patient, a decision was made for a repeat CT. The CT found persistent opacification of the left maxillary sinus, left anterior ethmoid sinus and left frontal sinus; which had mildly improved compared to pre-operative imaging.

Discussion between OMS and Otorhinolayrngology (ORL) teams determined that the patient may need further endoscopic drainage, addressing the ethmoid sinuses. The patient was kindly accepted for care by our colleagues in ORL at Auckland City Hospital. She was taken that day for acute endoscopic transnasal drainage under general anaesthetic. Following a stable post-operative recovery, she was admitted to the ward for IV ceftriaxone and metronidazole. Day one post-operatively she had resolving proptosis and improved ocular motility. Five days following her second surgery, the patient was discharged. On review in OMS outpatient clinic two weeks later, she had free eye movements with no pain and her clinical proptosis had resolved.

Discussion

There are several potential pathways of infection from the tooth to the orbit. As per Grodinsky & Holoyke (1938), the fascial planes create spaces that pathogens use to follow the path of least resistance. This path is dictated by the relation of the tooth root with the adjacent muscles, bone, periosteum and fascial planes (Eltayeb *et al*, 2019).

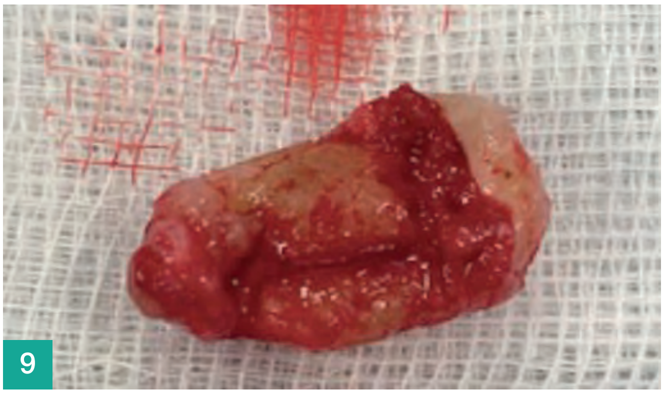


Figure 6. Intra-operative clinical photograph (showing the transconjunctival approach.
Figure 7. Clinical photograph of maxillary antrostomy access (Caldwell–Luc approach).
Figure 8. Clinical photograph of maxillary sinus drain in situ.
Figure 9. Clinical photograph of tooth 28 with visible periapical granuloma.

Figure 10. Post-operative review – free range of eye movement, improved swelling and resolved erythema.

The pathogenesis and potential complications of an OOC is related to the specific anatomy of the orbit. The bones forming the walls of the orbit are predominantly thin walled, some of which house pneumatized sinuses (Blake *et al,* 2006). The periorbita (periosteum of the orbit) surrounds the entire orbit and separates hard from soft tissue; housing the eye, optic nerve, muscle and nervous tissue (Blake *et al,* 2006).

The most common path of infection in OOC is from the maxillary molars and premolars into the maxillary sinus (Li *et al,* 2020). The roots of these teeth lie in close proximity, if not within, the sinus. The inflammatory process then spreads through to the orbit either via the ethmoid sinuses, bony erosion of the orbital floor or through the infraorbital canal (Procacci *et al*, 2017). A study by Mills & Kartush (1985) studied the thickness of the borders of the orbit on 93 human skulls. They found that lateral wall of the ethmoidal labyrinth orbit is the thinnest boundary of the orbit. They deduced that orbital abscess most often occur in the medial orbit, as pus in the ethmoid sinuses are in constant contact with the very thin wall of the lamina papyracea. The lamina papyracea also contains natural dehiscences, increasing the risk of spread of infection to the orbit (Geusens *et al*, 2020).

As in the present case, infection from tooth 28 root apices eroded into the maxillary sinus. Accumulating infection then spread into the ethmoid and frontal sinus. Infection eroded through the thin ethmoid lamina wall, accumulating as an OOC in the superomedial wall of the orbit.

The "closed box" anatomy of the orbit predisposes it to serious sequelae during infection. If not managed in a prompt and appropriate manner, an orbital abscess can result in permanent and severe vision loss (Geusens *et al,* 2020). The incidence of worsened visual acuity secondary to OOC was found to be 45.8% by Youssef *et al,* (2008). Severe initial vision loss is associated with poorer long term visual prognosis. Orbital compartment syndrome, vascular occlusion of ophthalmic arteries and damage to the optic nerve are the main mechanisms attributed to vision loss secondary to orbital infections (Youssef *et al,* 2008). Haematological dissemination via the ophthalmic veins into the cavernous sinus can lead to septic cavernous sinus thrombosis. This involves obstruction of the venous drainage from the sinus and compression of the cranial nerves located in the sinus (Caranfa and Yoon, 2021). As a result, the patient presents with periorbital oedema, proptosis, chemosis, ophthalmoplegia, reduced eye movements, diplopia, loss of vision and hyper/hypoaesthesia of the ophthalmic and maxillary branches of trigeminal nerve (Caranfa and Yoon, 2021). Prior to the advent of antibiotic therapies, septic cavernous sinus thrombosis was associated with mortality rates of 80-100% (Caranfa & Yoon, 2021). Other potential outcomes can include meningitis, brain abscess and subdural empyema (Zawadzki *et al,* 2021).

Rapid, accurate diagnosis is critical for management of OOC. Panoramic dental radiography can aid in assessing the dentition. CT is considered the gold standard in orbital infections as it is helpful in identifying sinus involvement, location of the abscess, determining if there are any cerebral complications and to assess the extent of the disease (Kim *et al*, 2007). Magnetic resonance imaging aids in review of soft tissues and structures related to the eye, in particular in evaluating the retromaxillary soft tissues and the cavernous sinus (Yousef *et al,* 2008).

Management of OOC must involve surgical drainage of the abscess, IV antibiotic therapy and eradication of the primary source (Blake *et al,* 2006). The patient must be admitted acutely for medical and surgical treatment. Management is often multidisciplinary, including acute ophthalmology and otorhinolaryngology input. Some authors suggest that the use of corticosteroids (such as dexamethasone) in acute sinusitis can have a protective effect against mucosal oedema and scarring, in addition to improving periorbital swelling, proptosis and ocular movements (Procacci *et al,* 2017).

Surgical intervention is indicated in cases of significant sinus disease, evidence of SPA or orbital abscess (Chandlers III/IV) (Procacci *et al,* 2017). The surgical approach to drainage is determined by the maxillofacial surgeon based on the location of the abscess on the CT (Procacci *et al,* 2017). The likelihood of complete visual recovery is increased when surgical intervention is early (within 24 hours of presentation) (Procacci *et al,* 2017). Endoscopic drainage of the SPA can be performed for medial/inferomedial SPA, via removal of the ethmoid lamina papiracea (Procacci *et al*, 2017). The maxillary sinus may also be approached endoscopically, or using the intraoral antrostomy via the Caldwell-Luc approach (Procacci *et al,* 2017). In the present case, the OMS team utilized a transconjunctival approach to drain the superomedial SPA. The Caldwell-Luc approach and antrostomy was used to drain and irrigate the maxillary sinus. Persistent infection in the ethmoids and frontal sinus further required ethmoidectomy and exploration of the frontal sinus via a transnasal endoscopic approach.

Consideration of the impact of investigations and management to the developing foetus had to be made in this case. CT imaging produces ionizing radiation, a potential teratogen (Ladkany & Layman, 2017). It has been found that CT imaging of the head and neck produces minimal scatter radiation to the foetus (Ladkany & Layman, 2017). The potential risks of exposure must be discussed with the patient. These risks should not prevent appropriate management, where the risks to maternal safety outweigh the potential risks to the foetus (Shetty & Paspulati, 2021) Non-obstetric general anaesthetic during pregnancy can place the patient and her child at increased risk of pre-term birth, low birth weight and caesarian delivery (Devroe *et al*, 2019). Dental practitioners are often apprehensive of dental treatment during pregnancy. Appropriate and early management of dental infection in this case would have prevented the patient being exposed to potentially more harmful general anaesthetic drugs and a higher radiation dose (via CT imaging).

Conclusion

Odontogenic orbital cellulitis is the inflammation of orbit tissues, secondary to dental infection. If not managed promptly and effectively, there are potentially significant complications of an OOC including complete loss of vision, cavernous sinus thrombosis and intracranial abscess. If the OOC has progressed to a subperiosteal abscess or intraorbital abscess, management must include surgical drainage, removal of the dental cause, appropriate empirical antibiotic therapy and medical support. Although rare, dentists must be aware of OOC to allow early intervention and treatment. Early management of dental infection is the cornerstone of prevention.

Acknowledgements

Thank you to our patient for agreeing for this case report to be written for the New Zealand Dental Journal. Consent was obtained from the patient to write this case report and to include clinical images (including face forward images).

Conflicting interests

The authors declare that there is no conflict of interest.

Author contributions

All authors contributed to the work, revision of the article, and final approval of the version to be published.

References

Blake F, Siegert J, Wedl J, Gbara A, Schelzle R. (2006) The Acute Orbit: Etiology, Diagnosis, and Therapy. *Journal of Oral and Maxillofacial Surgery*. 64(1) 87-93.

Caranfa J, Yoon M. (2021. Septic cavernous sinus thrombosis: A review. *Survey of Opthalmology*. 66(6) 1021-1030.

Costan V, Bogdanici C, Gheorghe L, Obada O, Budacu C, Grigoras C, Adronic D, Niagu I. (2020) Odontogenic Orbital Inflammation. *Romanian Journal of Ophthalmology.* 64(2) 116-121.

Chandler JR, Langenbrunner DJ, Stevens ER. (1970) The pathogenesis of orbital complications in acute sinusitis. *The Laryngoscope.* 80(9) 1412-1428.

Devroe S, Bleeser T, Van de Velde T, Verbrugge L, De Buck F, Deprest J, Devlieger R, Rex S. (2019). Anaesthesia for non-obstetric surgery during pregnancy in a tertiary referral center: a 16-year retrospective, matched case-control, cohort study. *International Journal of Obstetric Anaesthesia.* 39; 74-81.

Eltayeb AS, Karrar MA, Elbeshir EI. (2019) Orbital Subperiosteal Abscess Associated with Mandibular Wisdom Tooth Infection: A Case Report. *Journal of Maxillofacial & Oral Surgery.* 18(1) 30-33.

Geusens J, Dubron K, Meeus J, Spaey Y, Politis C. (2020) Subperiosteal orbital abscess from odontogenic origin: A case report. *International Journal of Surgery Case Reports.* 73; 263-267.

Grodinsky M, Holyoke E. (1938) The fasciae and facial spaces of the head, neck and adjacent regions. *American Journal of Anatomy.* 63(3) 367-408.

Kim IK, Kim JR, Jang KS, Moon YS, Park SW. (2007) Orbital abscess from an odontogenic infection. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology & Endodontics*. 103(1) 1-6.

Ladkany D, Layman K. Imaging Considerations in Pregnancy. In Bohart J (Editor). From Emergency Department Management of Obstetric Complications. Cham: Springer 2017; p159-168.

Li J, Huang J, Qui Y, Lin L. (2020) Orbital Apex Syndrome Causing Blindness Secondary to a Vertical Root Fracture of a Tooth. *Journal of Craniofacial Surgery.* 31(4) 378-380.

Favero V, Bacci C, Volpato A, Bandiera M, Favero L, Zanette G. (2021) Pregnancy and Dentistry: A Literature Review on Risk Management during Dental Surgical Procedures. *Dent J.* 9(4) 46.

Mills RP, Kartush JM. (1985) Orbital wall thickness and the spread of infection from the paranasal sinuses. *Clinical Otolaryngology and Allied Sciences*. 10(4) 209-216.

Munteanu G, Bertestanu S, Mitran D, Condeescu M. (2018) Orbital complications of acute rhinosinusitis. *International Bulletin of Otorhinolaryngology.* 14(3) 5.

Procacci P, Zangani A, Rossetto A, Rizzini A, Zanette G. (2017) Odontogenic orbital abscess: a case report and a review of the literature. *Oral and Maxillofacial Surgery*. 21(2) 271-279.

Shetty MK, Paspulati RM. Non-obstetric Complications in Pregnancy: Role of Imaging. In Shetty MK (Editor). From Breast & Gynecological Diseases Role of Imaging in the Management. Cham: Springer 2021; p289-326.

Yeh S, Foroozan R. (2004) Orbital apex syndrome. *Current opinion in ophthalmology.* 15(6) 490-498.

Youssef O, Stefanyszyn M, Bilyk J. (2008) Odontogenic Orbital Cellulitis. *Ophthalmic Plastic & Reconstructive Surgery*. 2008(1) 29-35.

Zawadzki T, Komisarek O, Pawloski J, Wojtera B, Bilska-Stoklosa J, Osmola K. (2021) Orbital Abscess- Two Case Reports with Review. *Indian Journal of Otolaryngology and Head & Neck Surgery.* 1; 1-10.

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