Penetrating foreign body in the masticator space with injury to the internal maxillary artery: a surgical challenge

SSY Tan¹, MS Yeo¹, GHP Lee¹, MSY Ho¹, ML Ang¹, W Lee², EC Cheong¹

¹Department of General Surgery, Section of Plastic, Reconstructive and Aesthetic Surgery, Tan Tock Seng Hospital, Singapore

²Department of Neuroradiology, National Neuroscience Institute, Singapore

ABSTRACT

INTRODUCTION Foreign bodies (FBs) in the masticator space (MS) are a unique problem because of the difficulty of accessing this deep compartment within the head and neck. In addition, MS contents include critical structures such as the internal maxillary artery (IMA) and mandibular nerve.

CASE HISTORY A 39-year-old tradesman was involved in a construction accident whereby a metallic projectile from a machinery drill penetrated his left cheek. Computed tomography revealed a metallic object of dimension 1.9 × 1.2 cm within the MS, with concomitant fracture of left maxillary anterior and lateral walls. Surgery was indicated in view of constant pain and swelling. The FB was removed through the cheek laceration with the aid of an X-ray image intensifier. Persistent significant bleeding was observed within the wound cavity after FB removal that could not be arrested despite attempts at haemostasis with adrenaline packing and oxidised cellulose polymers. Urgent selective left external carotid angiography showed breach of a distal branch of the left internal maxillary artery with contrast extravasation. Embolisation of this branch was undertaken successfully with a liquid agent.

CONCLUSIONS This is the first time a FB within the MS with injury to the internal maxillary artery has been described.

KEYWORDS

Foreign bodies – Masticator space – Internal maxillary artery – Embolisation

Accepted 3 March 2016

CORRESPONDENCE TO

Shaun S Tan, E: shaunnietan@hotmail.com

Foreign bodies (FBs) that penetrate facial areas pose challenges to cranio-maxillofacial (CMF) surgeons because of several factors. First, FBs may be radiolucent, making detection by radiography difficult. Second, owing to the three-dimensional contour of the face and multiple overlapping bones, plain radiographs are often less useful for FB localisation than in the extremities. Third, the CMF skeleton has a high density of critical structures (vessels, nerves, muscles, tendons, viscera) and the risk of traumatic/iatrogenic injuries to these structures is high.

In particular, the masticator space (MS) is an area of the face in which removal of FBs can be difficult. Constituting one of the seven deep compartments of the head and neck, the MS is enveloped by the superficial layer of the deep cervical fascia, a dense connective tissue binding the anterior edge of the sternocleidomastoid muscle to the angle of the mandible. Here we report, for the first time, a case of penetrating FB within the MS and its complication.

Case History

A 39-year-old tradesman in a construction firm was operating machinery when a metallic drill-bit broke off and penetrated the left cheek. He presented to the emergency department on the same day complaining of pain and bleeding in the left cheek but otherwise suffered no injury to the head or eyes. A laceration of length 3 cm at the level of the nasal alar on the left cheek was noted, with no intra-oral wounds. There was a non-pulsatile swelling over his left cheek but with no active bleeding from the wound. Extra-ocular eye movements were full without diplopia, and there was paresthesia in the left infraorbital nerve.

Computed tomography (CT) of his face revealed fractures in the anterior and lateral walls of the left maxillary sinus with associated haemorrhage (Fig 1). A metallic object of dimension 1.9 × 1.2 cm was visualised in the left MS. It had penetrated the anterior and lateral walls of the left maxillary sinus. Antibiotics (i.v.), analgesics (i.v.) and tetanus

injections were administered. The patient was transported to theatre on a semi-urgent basis. The wound was explored and the FB (Fig 2) delivered through the wound using Allis forceps with the aid of an X-ray image intensifier. Upon FB removal, pulsatile haemorrhage from the cavity was noted despite attempts at haemostasis with epinephrine packs, diathermy and oxidised cellulose polymer (Surgicel®; Ethicon, Somerville, NJ, USA). Urgent and selective angiography of left external carotid territory in the angiography suite revealed breach of a distal branch of the left internal maxillary artery (IMA) with active extravasation/pooling of contrast in the left maxillary sinus (Fig 3).

Embolisation of this distal branch of the left IMA was undertaken using a liquid containing ethylene vinyl-alcohol copolymer (Onyx®18; Covidien EV3, USA). This intervention resulted in complete occlusion of the breached vessel at this site with no further extravasation as demonstrated by angiography. The patient was transferred back to theatre and the wound debrided and sutured. Our patient was observed on the ward for 48h before being discharged. He

was reviewed in the specialist outpatient clinic 1 month after the injury, and had normal clinical findings other than a small facial scar.

Discussion

The MS comprises four mastication muscles, the mandibular branch of the trigeminal nerve, infraorbital nerve, IMA and posterior mandible. MS pathology includes inflammatory conditions of odontogenic origin, lymphovascular malformations, as well as benign and malignant tumours.^{1,2} Preoperatively, IMA injuries can be recognised by clinical and radiographic means. Physical examination often reveals an expanding and pulsatile haematoma over the temporo-mandibular joint or cheek region and malocclusion with an associated history of facial trauma. Plain radiographs and CT of the face may demonstrate a subcondylar fracture or fractures in the maxillary sinus caused by a FB. Orbay and colleagues⁵ affirmed the close relationship between the IMA and mandibular subcondyle. They also established the biomechanical aetiology of haemorrhage of the maxillary artery during subcondylar fractures.

Management of an industrial-type penetrating FB within the pterygomaxillary fossa is outlined here, but the management principles are similar to those for gunshot injuries to the face. As described by Kaufman and colleagues, the extent of injury relates to the structural character, kinetic energy, and interaction with surrounding tissue of the projectile.⁴ Ballistics as velocities (expressed in feet/s) can be classified as 'low' (<1200), 'medium' (1200–2000) or 'high' (>2000). The FB in this case has similar properties to that of a low-velocity projectile with the propensity to deflect soft tissue, fracture bone and injure vessels. Victims of high-

velocity ballistic projectiles such as rifle bullets rarely survive the injury. Nevertheless, IMA injuries with resultant pseudoaneurysms secondary to gunshot injuries have been reported and managed using endovascular methods.^{5,6} A FB in the MS is particularly difficult to manage because the MS is not a true 'space' but instead a tightly confined cavity bounded by dense connective tissue of the superficial layer of deep cervical fascia. A projectile entering the MS must possess significant force for it to traverse soft tissue, buccal space and maxillary bone. Within the MS, there is little capacity for critical anatomical structures such as the IMA to be displaced. Thus, the artery is likely to be 'trapped' between the projectile and mandible and to carry a high risk of laceration. After laceration, minimal bleeding may be manifested because the projectile acts as a tamponade to prevent formation of an obvious haematoma. The injury may be manifested only if the FB is removed.

Various methods to address intractable bleeding from the IMA have been described. Yeo and colleagues⁷ outlined direct pressure, packing and topical haemostatic agents as the first steps for attempting haemostasis. Failure of these measures may prompt surgical ligation of the origin of the maxillary artery. The other option is selective angioembolisation, or an ipsilateral neck incision and placement of an external carotid artery sling followed by direct surgical ligation of the maxillary artery. Evidence from a systemic review by Khanna and coworkers⁸ supports the modality of transcatheter arterial embolisation (TAE) haemostasis for life-threatening haemorrhage in maxillofacial surgery. TAE is becoming the 'gold standard' because it obviates the need for surgical incisions and allows flexibility in reaching sites inaccessible to surgical ligation. Moreover, it can also be used to detect arteriovenous malformations or false aneurysms. TAE can arrest bleeding in $\leq 96\%$ of patients and carries a prevalence of major complications of 3% .⁸ Such complications may include injury to cranial nerves, cerebrovascular accidents, or skin/mucosal necrosis. Gui and colleagues showed that operative time may be reduced significantly in institutions with ready access to surgical navigational systems.⁹ By using computed tomography and digital subtraction angiography preoperatively, the authors could create three-dimensional views of complex FBs embedded deep within the maxillofacial region. Thereafter, they defined their spatial locations using an image-guided

navigational system, resulting in successful minimally invasive retrieval of FBs.

Learning points

FBs within the MS must be approached with caution due to its close anatomical relationship with the IMA and its propensity for traumatic or iatrogenic injuries in such cases. Traumatic injuries to the IMA may be masqueraded by tamponade by the FB or the resulting haematoma within the tight confines of the MS, and may become only apparent after FB removal. Iatrogenic injuries to the IMA during FB removal may occur, so provisions must be made by discussion with the anaesthesiologist regarding fluid management and availability of blood products, as well as ensuring the availability of prompt angiography/angioembolisation services if required. Image-guided surgical navigation, if available, may be considered to facilitate the removal of radio-opaque foreign bodies in the maxillofacial regions. However, the surgeon should be aware of the strengths and limitations of these systems in such cases.

References

1. Fernandes T, Lobo JC, Castro R *et al.* Anatomy and pathology of the masticator space. *Insights Imaging* 2013; **4**: 605–616.
2. Wei Y, Xiao J, Zou L. Masticator space: CT and MRI of secondary tumor spread. *Am J Roentgenol* 2007; **189**: 488–497.
3. Orbay H, Kerem M, Unlu RE *et al.* Maxillary artery: anatomical landmarks and relationship with the mandibular subcondyle. *Plast Reconstr Surg* 2007; **120**: 1,865–1,870.
4. Kaufman Y, Cole P, Hollier LH. Facial gunshot wounds: trends in management. *Craniofac Trauma Reconstr* 2009; **2**: 85–90.
5. dos Santos Pereira R, de Souza Guimaraes VC, Timóteo CA *et al.* Internal maxillary artery pseudoaneurysm subsequent gunshot wound in a teenager. *J Craniofac Surg* 2014; **25**: 1,125–1,126.
6. Krishnan DG, Marashi A, Malik A. Pseudoaneurysm of internal maxillary artery secondary to gunshot wound managed by endovascular technique. *J Oral Maxillofac Surg* 2004; **62**: 500–502.
7. Yeo MS, Goh TL, Nallathamby V *et al.* Maxillary artery injury associated with subcondylar mandible fractures: a novel treatment algorithm. *Craniofac Trauma Reconstr* 2012; **5**: 83–88.
8. Khanna S, Dagum AB. A critical review of the literature and an evidence-based approach for life-threatening hemorrhage in maxillofacial surgery. *Ann Plast Surg* 2012; **69**: 474–478.
9. Gui H, Yang H, Shen SG *et al.* Image-guided surgical navigation for removal of foreign bodies in the deep maxillofacial region. *J Oral Maxillofac Surg* 2013; **71**: 1,563–1,571.