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Case report

A multidisciplinary approach to management of extensive facial injuries resulting from the use of an angle grinder

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1. Introduction

Angle grinders utilise a rapidly rotating metal or carbon disc to cut, grind and polish metal, concrete and other hard surfaces. Improper use with disregard to safety procedures can result in serious injuries, most commonly involving the face and upper limbs. Although these injuries can be mutilating, they are rarely fatal and in most patients a good aesthetic result is achievable with meticulous debridement, reduction and fixation of any facial fractures and layered closure of the soft tissues.

We report the successful treatment of a patient with life-threatening injuries resulting from accidental trauma involving an angle grinder. The complex, penetrating and open soft tissue injury and associated fractures involving the facial skeleton, required multi-specialty intervention for maintenance of the airway, arrest of facial haemorrhage, debridement and closure of the soft tissue defect, reduction and fixation of mandibular fracture, microscopic reconstruction of the parotid and lacrimal ducts, and embolisation of the internal maxillary artery.

2. Case report

A 62-year-old male presented to the Accident and Emergency (A&E) department as a result of an injury sustained at home whilst using an angle grinder. The protective guard had been removed from the angle grinder and the patient was not wearing any facial protection. The sharp disc of the angle grinder shattered causing deep soft and hard tissue injuries extending from the left frontal bone/supra-orbital region to the left lower border of mandible (Fig. 1). In addition to the cutaneous soft tissue injuries, the left parotid duct and facial artery were severed and the left lacrimal apparatus damaged, although the globe remained grossly intact. Following initial presentation, the A&E team achieved haemodynamic stabilisation. Significant haemorrhage from the left facial artery was managed by ligation, whilst bleeding from the left maxillary and anterior ethmoid arteries were controlled by local tamponade following insertion of a Foley's catheter into the left maxillary sinus and nasal ethmoidal space, respectively. Throughout the initial presentation the patient's airway was patent but due to the significant haemorrhage a decision was made to protect the airway whilst further treatment was undertaken.

After haemorrhage arrest, endo-tracheal intubation was undertaken and the full extent of the injury determined through computed tomography (CT) examination. In addition to an avulsive soft tissue laceration, the patient had received atypical fractures of the frontal bone (involving both anterior and posterior walls), the maxilla, medial wall of the orbit, and a grossly displaced and comminuted mandibular fracture (Fig. 2). Due to the nature of the injury, a wide margin of both soft and hard tissue had been avulsed, complicating structural repair.

Urgent transfer to theatres was arranged and thorough debridement of the soft tissue wound and primary closure was carried out under general anaesthesia. Small isolated bony fragments were removed and the fracture involving the left body of the mandible reduced and fixed using a reconstruction plate (Fig. 3). The severed ends of the parotid duct were located and an epidural cannula passed in order to maintain the duct's patency; microscopic reconstruction of the parotid duct was then carried out around the cannula (Fig. 1). At the same time, repair of the partially avulsed left lacrimal apparatus was performed by the ophthalmology team. Fortunately, although the injury to the frontal sinus had avulsed a section of the posterior table the injury revealed an exposed but intact dural layer, thus negating the need for cranialisation (Fig. 2).

Prior to maxillary catheter removal, the interventional radiology team carried out internal maxillary artery embolisation (IMA). This involved the placement of particles within the distal internal maxillary artery territory using a micro-catheter introduced into the external carotid artery. To provide a more proximal ligation without compromising the distal tissues, large particle embolisation was undertaken into the parent vessels (Fig. 4). Furthermore, prevention of permanent occlusion of any potential future endovascular access by use of a permanent endovascular coil was avoided and not used in this instance in case of continued bleeding and/or subsequent formation of a focal pseudoaneurysm.

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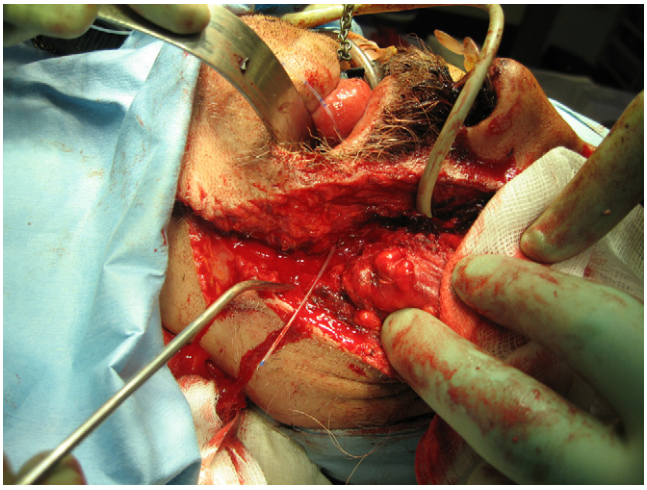

Fig. 1. Deep, linear soft and hard tissue injuries involving the left face – inflated catheters *in situ*, and parotid duct cannulated.

Following intervention the patient made good postoperative recovery. Postoperative review showed weakness of the marginal mandibular branch of the left facial nerve and cicatricial ectropion. These were however expected due to the extensive injuries (Fig. 5). Postoperative radiographic (Fig. 6) and cone-beam CT examination showed satisfactory fracture reduction. At review, normal functioning of the left parotid duct with no postoperative facial swelling was observed indicating successful reconstruction of the severed duct. The patient's facial injuries are being regularly reviewed by both the Oral and Maxillofacial and Ophthalmology teams.

3. Discussion

Machinery and/or tool related injuries during industrial or personal use are significant and the latest figures reveal that they account for approximately 87,000 injuries per annum within the UK (www.rospa.com). Within this group angle grinders are widely used and accidents involving them occur frequently.[10,16] The most

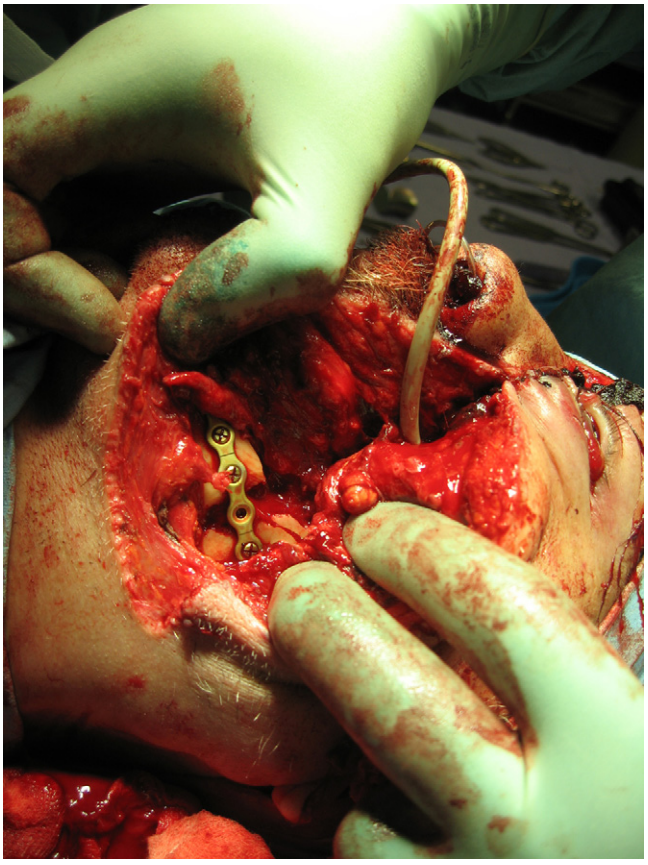

Fig. 3. Open reduction and fixation of the fracture involving the left body of mandible using a reconstruction plate to compensate for the bone loss (the width of avulsed tissue can be clearly seen). The Foley catheter in the left maxillary sinus is visible.

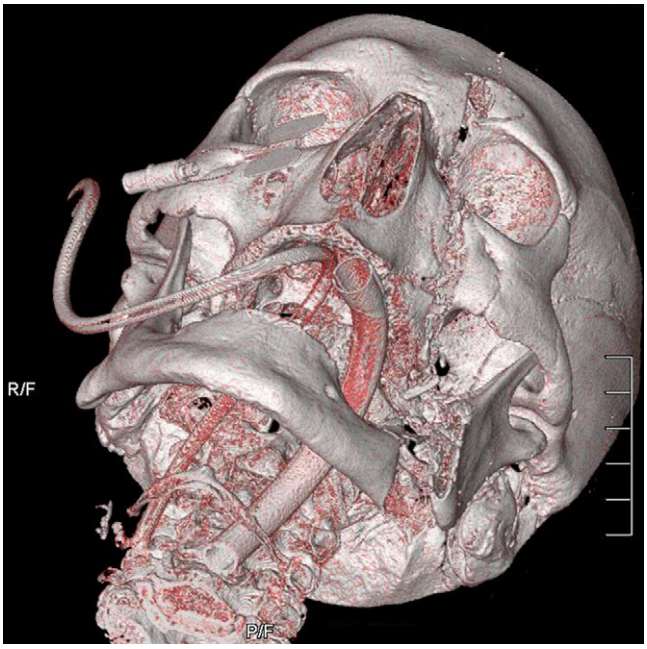

Fig. 2. 3D volumetric CT scan showing the extent of the bony injuries.

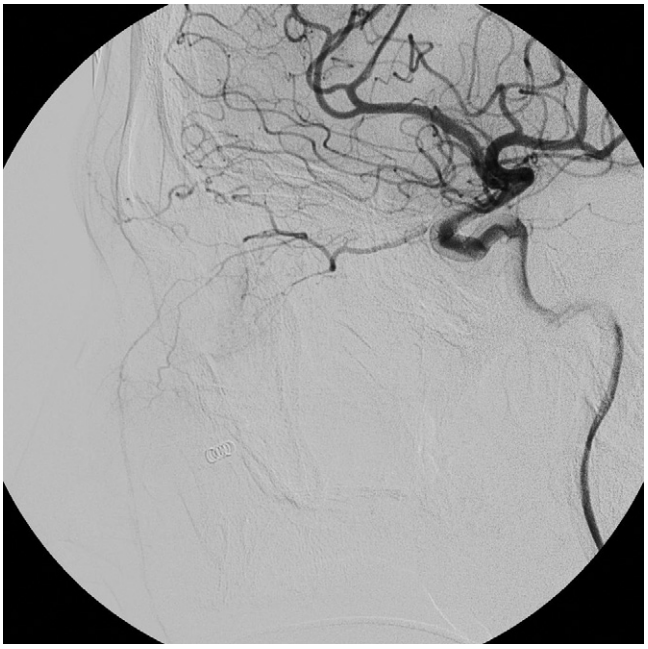

Fig. 4. The left internal maxillary artery after embolisation.

Fig. 5. Postoperative appearance at six days with weakness of the facial nerve and cicatricial ectropion.

recent data from the Home Accident Surveillance System (2000–2002) from the Royal Society for the Prevention of Accidents records document some 6400 accidents in the UK per year [HSMO 2003].[7] Fortunately, the vast majority of these injuries are not life threatening but in a significant number of patients the injuries are associated with considerable morbidity. The most common injuries are penetrating soft tissue lacerations of the face, scalp and upper limb. Others including soft tissue wounds with tissue loss and/or hard tissue involvement occur but less frequently.[10] However, when reported such wounds are usually localised and linear, conforming to the shape of the high-speed revolving disc or its fragments. Although not well documented a small number of papers do report successful reconstruction of these patients following angle grinder injuries.[10,16,17,7,3]

Our case is unusual in that the patient's facial injuries comprised extensive structural damage (to both soft and hard tissues), with compromise to the airway, life-threatening bleeding, and multi-specialty intervention with shared surgical access required for effective management, functional and aesthetic repair. Staff within the Accident and Emergency, Oral and Maxillofacial, Ophthalmology and Interventional Radiology specialties were required for immediate and acute treatment respectively, and enabled a rapid and effective treatment pathway to be instigated. In cases involving serious trauma, a methodological approach and training in relation to the traumatised patient (ABCDE's) has been shown to have a significant positive effect on patient survival/outcome,[2,12,1] and the multidisciplinary approach to acute care in the severely traumatised patient has also been shown to benefit patients as far as functional and aesthetic recovery, and general outcomes are concerned.[11,18] This case also highlights the importance of airway preservation and haemodynamic resuscitation by the first attending personnel where severe mutilating facial injuries could prove a distraction and cause unnecessary delay in life saving treatment. As stated, a methodological approach – ALS/ATLS goes some way to improve the quality and sequence of treatment received in these circumstances.[2,11]

This case also demonstrates the key role played by interventional radiologists. Whilst many injuries, including those involving the face and facial skeleton can lead to damage of blood vessels and persistent haemorrhage, most can be managed by either applying direct pressure or ligating and suturing those vessels involved. In this specific case the bleeding originated from the post nasal space and although was profuse, ligation and suturing of the vessels involved was not possible as they were inaccessible. Therefore, indirect pressure was applied using Foley catheters inserted into the maxillary, nasal and ethmoidal air spaces (Fig. 3). Whilst reports have shown that electrocautery, packing with Merocel packs and the use of inflatable catheters can be effective controlling epistaxis and post-nasal bleeding,[15] the haemorrhage could only be controlled on a temporary basis whilst the catheters were inflated. Repeated deflation of the catheters and exploration of these spaces failed to identify the vessels responsible and so endovascular embolisation was requested in order to prevent further blood loss. The use of endovascular embolisation has been shown to be extremely effective in managing refractory craniofacial haemorrhage where conventional methods of control have failed,[9,4] and was successful in this case. Several methods can be

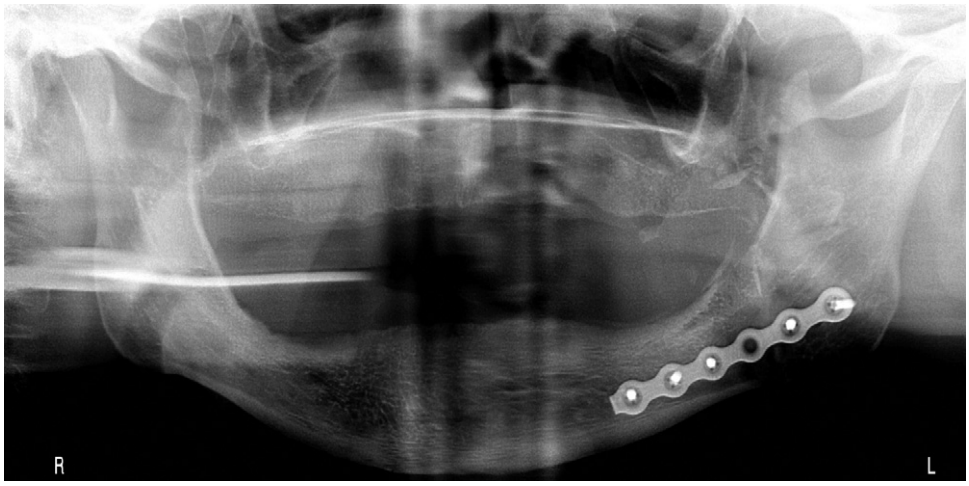

Fig. 6. Postoperative OPT showing good reduction of the fracture involving the left body of the mandible.

employed when undertaking transarterial embolisation – Gelfoam pledgets, polyvinyl beads/particles, trans-arterial glue or platinum wire coils. In this case large particle embolisation was undertaken in order to reduce the risk of permanent occlusion of the vessels involved and thus prevent further attempts if required.

Finally, this case highlights the need and benefit of early intervention when managing facial injuries. It is largely accepted and been documented that when managing facial soft and hard tissue injuries–lacerations, facial fractures, orbital, nerve and salivary gland/duct injuries, early intervention will lead to optimal recovery and reduce the incidence of long term morbidity, aesthetic deformity or functional deficiency.[5,14,13,8,6]

4. Conclusion

This case of severe and life-threatening facial trauma following the use of an angle grinder shows the importance of a multi-specialty approach to treatment and the value of ATLS procedures as well as advanced imaging and surgical techniques to achieve initial airway protection, haemostatic control and satisfactory long-term functional and aesthetic outcome.

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