

# Diagnosis and Treatment of Multiorgan-Penetrating Injuries to the Head and Neck: Case Series

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## Abstract

Multiorgan-penetrating injuries to the head and neck are relatively uncommon, with many complications and high mortality, and the management of such injuries is often complex and nonstandardized. Here, we report our experience of treating such injuries. We retrospectively analyzed multiorgan-penetrating injuries to the head and neck in patients who were admitted to and managed in our department. We evaluated first-aid measures, imaging examination findings, operation method, and prognoses. A total of 5 patients were identified. The patients were successfully treated; two of these patients with wooden foreign bodies underwent digital subtraction angiography (DSA) of the common carotid artery. To sum up, we conclude that individualized multidisciplinary treatment according to the affected organs and manner of impalement can greatly reduce intraoperative and postoperative complications. In endoscopy-assisted removal with irregular wooden foreign bodies, we advocate intraoperative DSA of common carotid arteries as a routine procedure.

## Diagnosis and Treatment of Multiorgan-Penetrating Injuries to the Head and Neck: Case Series

**Key points:**Multiorgan-penetrating injuries to the head and neck are complex and diverse. Individualized multidisciplinary treatment according to the affected organs and manner of impalement can greatly reduce intraoperative and postoperative complications. In endoscopy-assisted removal with irregular wooden foreign bodies, we advocate intraoperative DSA of common carotid arteries as a routine procedure.

## Introduction

Multiorgan-penetrating injuries to the head and neck are relatively uncommon and are associated with a high mortality rate. Penetrating head injuries account for approximately 0.4% of all head injuries.<sup>1</sup> Penetrating neck injuries, meanwhile, account for 5-10% of all trauma cases and are associated with a significant burden of mortality (up to 6%).<sup>2</sup> Patients with injuries to important blood vessels or organs often die within a short time, while those who arrive at a hospital in time have the chance of treatment; however, often, the treatment required is quite difficult. There is currently no international consensus on the management due to its low incidence. Therefore, the case reports on multiorgan-penetrating injuries to the head and neck are valuable for proposing appropriate management strategies. In this study, we report a case series of these penetrating injuries and describe our experience of successfully treating these patients; two patients with wooden foreign bodies underwent intraoperative DSA.

## Methods

After obtaining approval from the institutional review board, a retrospective chart review of all cases of multiorgan-penetrating injuries to the head and neck between the years 2016 and 2021 was performed. The following data were collected for the analyzed cases: demographic characteristics; nature, path, and

retention time of the foreign bodies; radiologic images, surgical treatment; sequelae; outcome; and hospital stay. Below, a representative case have been described in detail.

The patients or their families provided written informed consent for the publication of their anonymized information.

This case series has been reported in line with the PROCESS Guideline.

## Representative Case Report

A 55-year-old man was brought to the emergency department with an injury to the right orbit from below the temporal side of the eyeball caused by a Chinese rose branch. He had sustained the injury 4 hours before (Figure 1A). The right eyeball was prominent and its movement was restricted. The patient had schizophrenia. Computerized tomography angiography (CTA) of the eyes and neck showed two columns of low-density foreign body shadows in the right orbit (Figure 1B), extending along the inferior orbital wall to the left and back, passing through the inner wall of the right maxillary sinus and nasal septum, and continuing to the left side of the nasopharynx. The foreign body was adjacent to the left internal carotid artery.

After the multidisciplinary team (MDT) had evaluated the patient's condition, the interventional physician performed digital subtraction angiography (DSA) of right common carotid artery and found no damage to the internal and external carotid arteries. Then, the ophthalmologist removed the foreign body (Figure 1C) and removed the residual Chinese rose branch dander and fracture fragments carefully. The wound was rinsed with hydrogen peroxide followed by gentamicin. And an otorhinolaryngologist performed transnasal endoscopic hemostasis. Finally, DSA was performed again, and it was found that the branches of carotid arteries ran naturally.

The patient was administered antifungal treatment with fluconazole and anti-infective treatment with cephalosporin for 3 days after the operation and was discharged on postoperative day 10. At the time of discharge, the depth of his right anterior chamber was good, and the pupil was round, the diameter of which was approximately 3 mm and the light reflex was good; there was no vision loss.

## Results

During the study period, 5 patients with multiorgan-penetrating injuries to the head and neck were treated at our institution. The patients' details are summarized in Table 1. The patients' mean age was 41 years. The most common cause of penetrating injury was an accident (60%), and the orbit (80%) was the most common penetrated region. These penetrating injuries were mainly caused by wooden (60%) or metallic (40%) foreign bodies. All patients underwent initial CT scans for identification of the trajectory of foreign bodies, and all of them received surgical treatment within 24 h of injury. Among the five cases, only one case underwent external approach surgery; endoscope-assisted surgery was performed in the other four cases, and of which 2 cases underwent DSA of common carotid arteries. All five patients were treated successfully, and only one patient showed visual impairment in the left eye due to the damage caused by the foreign body.

## Discussion

The management of multiorgan-penetrating injuries to the head and neck is often complex and nonstandardized. The treatment strategy employed in the cases managed by us is described in detail in Figure 2. After admission to the hospital, patients with penetrating injuries underwent CT scans through the emergency green channel. We recommend computerized tomography (CT) scans as the first option for foreign bodies. If it is a wooden foreign body, magnetic resonance imaging (MRI) can be added.<sup>3</sup> CT angiography (CTA) can also be added if vascular damage is suspected on CT scans. And relevant departments such as otorhinolaryngology, ophthalmology, neurosurgery, stomatology, vascular surgery, interventional surgery, and thoracic surgery, were contacted for consultation according to the injury site, and the departments for treatment were selected according to the examination results. Subsequently emergency surgical treatment was next performed by MDT.

In the management of multiorgan-penetrating injuries to the head and neck, the involvement of an MDT is of paramount importance. Because of the complications caused by multiorgan injuries, a single department is often unable to optimally complete the treatment. The management of major multiorgan-penetrating injuries invariably requires the simultaneous involvement of many different disciplines and surgical subspecialties. An appropriate MDT can expedite the preoperative disease assessment, create conditions for the early and safe completion of surgery to a large extent, and reduce intraoperative risks and the incidence of postoperative complications.<sup>4</sup> Careful anamnesis, physical examination, and inspection of preoperative imaging data along with an MDT consultation are of high importance for optimal emergent surgical planning and execution. In this study, multidisciplinary consultations involving an ophthalmologist, an otorhinolaryngologist, an anesthesiologist, a thoracic surgeon, an interventional radiologist, and other involved department physicians was rapidly initiated after emergency admission.

The surgical procedures include surgical approaches, foreign body removal, wound exploration, irrigation, and suturing. The surgical approaches reported in previous cases were divided into external approach and endoscopy-assisted surgery. An individualized surgical approach should be performed under safe conditions. Through the literature review, we found DSA can help the surgeon to stop bleeding quickly by controlling the common carotid artery, besides, it can help to find the integrity of the vessels before and after the removal of foreign bodies.

DSA is the “gold standard” for examining potential vascular injury, and it can also help optimize vascular control through balloon occlusion.<sup>5</sup> According to statistics, the edge of wooden foreign bodies is more irregular or bifurcation appears in the process of entering. Removal of these foreign bodies, especially with endoscope-assisted surgery, may induce a secondary injury to the blood vessels and lead to a disastrous ending. Therefore, for these penetrating injuries with irregular wooden foreign bodies, we advocate routine intraoperative DSA of common carotid arteries in endoscopy-assisted surgery. In this case, endoscopy-assisted surgery was chosen to remove the foreign body directly to minimize injury. CTA scans showed that the foreign body was closely related to the left internal carotid artery. Since the foreign body was a Chinese rose branch, the local sharpness was not clear. Then, DSA of right common carotid artery was performed to provide immediate support for potential vascular injuries. It confirmed that the foreign body did not involve blood vessels before and after its removal. The same treatment was given to case 2. However, for those far from blood vessels and not adjacent to vital tissues, the foreign bodies can be removed directly.

Infection is a common complication following contamination of foreign bodies and is also associated with significant mortality. We suggest that preoperative broad-spectrum antibiotics may be used in cases with a long preoperative duration. If the patient can be operated on within a short time after admission, the use of postoperative antibiotics is sufficient. If foreign bodies were metallic, effective antibiotics were administered postoperatively; if foreign bodies were wooden, antibiotics and antifungal agents were used in combination; if other types, broad-spectrum antibiotics were administered first, and fungal infection would be considered if subsequent infection worsened. Fungal infections are rare but should be considered, especially in cases of injuries from foreign bodies such as thorns and branches.<sup>6</sup> Besides, the patient should be injected with tetanus globulin if the penetrating injuries were deep and heavily polluted.

In conclusion, we report cases in which multiorgan-penetrating injuries to the head and neck were successfully treated. Depending on the characteristics of the foreign bodies and the anatomic locations of penetrating injuries, MDT across different specialties, including otolaryngology, ophthalmology, interventional radiology, and other involved departments is pivotal in the management of such cases. Preoperative imaging studies, including CTA if indicated, combined with early surgical exploration is essential for good recovery and favorable outcomes. In endoscopy-assisted removal with irregular wooden foreign bodies, we advocate intraoperative DSA of common carotid arteries as a routine surgical procedure.

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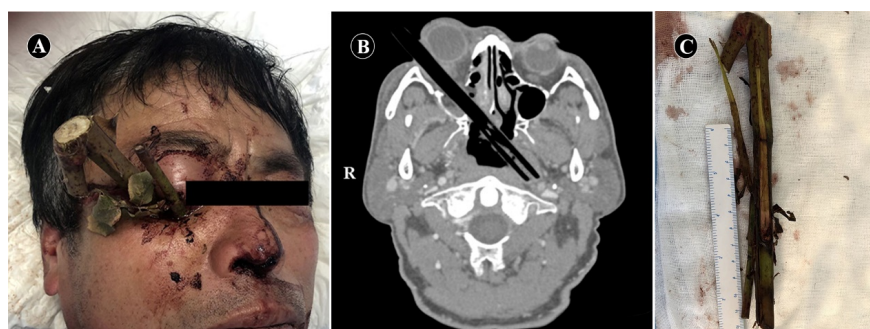


Figure 1. Imaging findings in case 1

(A), A Chinese rose branch was inserted into the right orbit from the temporal side of the orbit in the patient. (B), An axial CT showed two columns of low-density foreign bodies penetrating from the temporal side of the right orbit, passing through the inner wall of the right maxillary sinus and the posterior of the nasal septum, and extending to the left side of the nasopharynx. (C), Approximately 12 cm of the foreign body was inserted into the body.

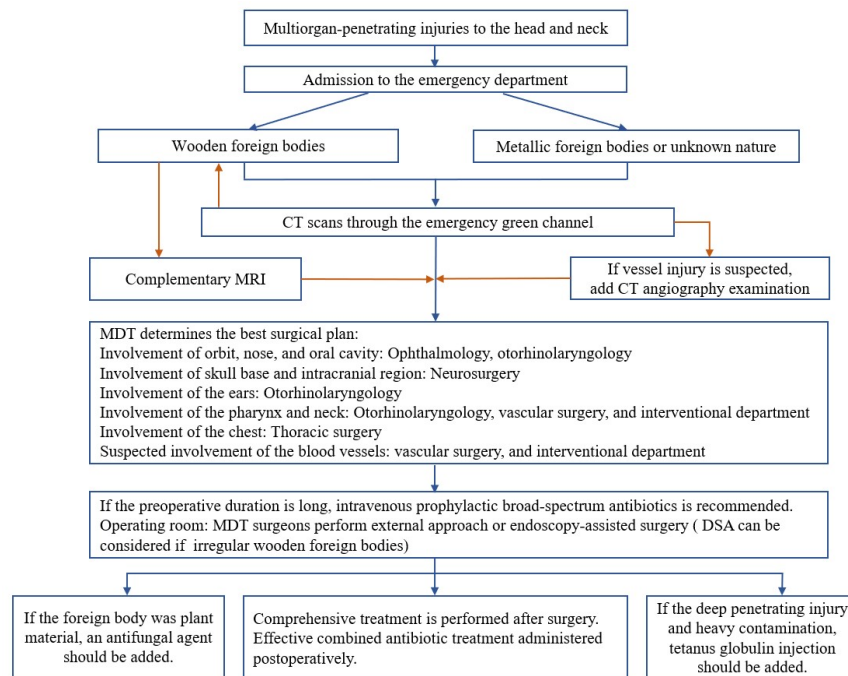
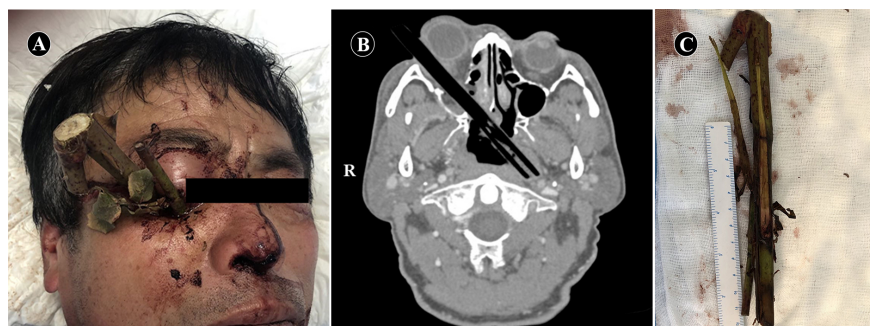


Figure 2. Flow diagram of multiorgan-penetrating injuries to the head and neck.

Table 1 The details of five patients with multiorgan-penetrating injuries to the head and neck

Characteristics	Case 1
Sex	Male
Age (years)	55
Cause	Suicide
Nature of the foreign bodies	Chinese rose branch
Parts involved	Right eye, right maxillary sinus, nasal septum, left nasopharyngeal wall
Time from injury to medical treatment	4 hours
Length of preoperative hospitalization	10 hours
Operation method	DSA of right common carotid artery; removal of a right intraorbital foreign body
Multidisciplinary team	Ophthalmology, otolaryngology, interventional department
Sequela	No
Outcome	Recovery



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