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CASE REPORT

# External penetrating laryngeal trauma caused by a metal fragment: A Case Report

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## Abstract

*BACKGROUND*

Although external penetrating laryngeal trauma is rare in the clinic, such cases often result in a high mortality rate. The early recognition of injury, protection of the airway, one-stage laryngeal reconstruction with miniplates and interdisciplinary cooperation are important in the treatment of such patients.

*CASE SUMMARY*

A 58-year-old male worker sustained a penetrating injury in the left neck. After computed tomography scanning at a local hospital, he was transferred to our hospital, where he underwent tracheotomy, neck exploration, extraction of the foreign object, debridement and repair of the thyroid cartilage using titanium miniplates. An endo laryngeal stent was inserted, which was removed 12 days later. The patient recovered well and his voice rapidly improved after surgery.

*CONCLUSION*

Penetrating laryngeal trauma is uncommon. We successfully treated a patient with early laryngeal reconstruction and management by interdisciplinary cooperation.

**Key Words:** Laryngeal trauma; Reconstructive operation; Miniplate; Multi-discipline cooperation; Computed tomography; Case report



**Core Tip:** External penetrating laryngeal trauma is rare, and is associated with a high

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mortality rate. We report a 58-year-old male worker with a penetrating injury to the left neck caused by a metal fragment. The patient underwent tracheotomy, neck exploration, extraction of the neck foreign body, debridement and repair of the thyroid cartilage with titanium miniplates and endolaryngeal stenting. The patient recovered well and his voice rapidly improved. The good recovery of this patient highlights the importance of early laryngeal reconstruction and management by interdisciplinary cooperation.

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## INTRODUCTION

External penetrating laryngeal trauma is rare, but is a potentially life-threatening injury. It is mostly caused by sharp objects or great destructive force, similar to a gunshot wound and explosion injury[1-3]. Damage to the larynx may result in severe consequences, such as massive hemorrhage, cartilage fracture and airway collapse[4, 5]. It presents with a spectrum of symptoms and signs that range from changes in voice quality to cardiopulmonary arrest due to airway obstruction[6]. Severe penetrating laryngeal trauma may be accompanied by injury to cervical great vessels, esophagus, trachea and chest[7]. Correct diagnosis and timely treatment are vital for improving patient survival and reducing the loss of organ function. When severe consequences occur, such as shock, bleeding and asphyxia, they should be treated immediately according to the general surgical principles for rescue, and tracheotomy should be performed[8-10]. In addition, early reconstruction of the larynx is important for vocal function reconstruction and recovery of patients with laryngeal cartilage fracture[7,8,11,12].

We here present a case of a 58-year-old male worker who suffered from an external penetrating laryngeal trauma and underwent timely management with one-stage laryngeal reconstruction, and achieved good functional results.

## CASE PRESENTATION

### *Chief complaints*

A 58-year-old Chinese male worker was walking in a construction site in Inner Mongolia when a metal rope suddenly broke. He was hit by a metal fragment due to the force of the metal rope. The fragment resulted in an injury to his left neck.

### *History of present illness*

Due to this serious injury and the importance of the injured area, he was immediately transferred to a tertiary hospital in Beijing with a cervical collar for spinal immobilization.

### *History of past illness*

The patient had no specific history of past illness.

### *Personal and family history*

The patient had no specific personal and family history.

### *Physical examination*

Physical examination found an irregular and dirty wound of approximately 2 cm in his left neck.

### *Laboratory examinations*

The patient had no specific laboratory examination.

### *Imaging examinations*

Upon admission, computed tomography (CT) was performed using a 64-row CT scanner (LightSpeed VCT, GE Medical Systems), with the following scanning parameters: 3.250 mm section thickness, 120 kVp, 498 mA, and 0.6 s rotation time. The patient underwent a standard diagnostic CT in the craniocaudal direction at a local hospital. CT scanning confirmed significant thyroid cartilage fracture, cervical emphysema, fracture of the C4 vertebra and right vertebral arch and a metal foreign object in front of the C4 vertebra (Figures 1A and 1B).

## FINAL DIAGNOSIS

The final diagnosis was external penetrating laryngeal trauma of Schaefer-Fuhrman classification group 4 (Table 1).

## TREATMENT

After an artificial airway was established by tracheotomy, the neck was explored. There was an irregular injury of approximately 2 cm in the left neck. The wound was dirty, and multiple fine black foreign objects were seen in the wound. The sinus tract formed by the trauma passed through the skin wound, the left thyroid cartilage and the pharynx to the front of the C4 vertebra. The left thyroid cartilage was broken into several fragments, while the right was largely intact. The structure of the left vocal cord, ventricular band and laryngeal ventricle was disordered, and the residual local mucosa was swollen and congested (Figure 2A). The anterior commissure, the right vocal cord, ventricular band and laryngeal ventricle were structurally clear, and the mucous membrane of the vocal cord and ventricular band was slightly swollen. A cylindrical metal foreign object of 1 cm × 1cm × 1 cm was seen which was partially lodged in the C4 vertebra (Figure 2B). The metal foreign object was removed by orthopedists (Figure 2C).

After adequate debridement, an endolaryngeal stent was inserted in order to support the laryngeal structure. The fragments of thyroid cartilage were repaired with two titanium miniplates (Figure 2D). A drainage tube was used to drain the hematocele and pneumatosis of the neck. The patient was able to breath *via* the tracheostomy cannula after surgery, and post-operative feeding was *via* a nasogastric tube. Because of the unstable C4 vertebra fracture, the orthopedist, after ensuring that there was no spinal cord injury, ordered absolute bed rest for at least one month.

## OUTCOME AND FOLLOW-UP

Post-operative radiography showed that the two plates were in a satisfactory position and no replacement was needed (Figure 3A and 3B). On the 14$^{th}$ day, fibrolaryngoscopy showed that the laryngeal structure was intact; there was hyperemia and swelling in the left vocal cord, some granulation tissues could be seen in the left vocal cord, ventricular band and laryngeal ventricle; the activity of the left vocal cord was poor, and both hyperemia and hypertrophy were observed in the right vocal cord (Figure 3C). Six months later, the patient returned for review, and dynamic laryngoscopy showed that vocal fold movement had improved and the wound had healed well without obvious laryngostenosis (Figure 3D).

## DISCUSSION

Surgery for penetrating laryngeal trauma caused by a metal fragment is worth studying to avoid death among workers in the construction industry. Although external penetrating laryngeal trauma is uncommon, attention should be paid to such injuries. The clinical treatment of the patient in this report highlights several important aspects of the management of this injury. Rapid transportation of patients is essential, and the necessary examinations and treatment should be carried out as soon as possible.

**Table 1 Schaefer-Fuhrman classification of lanryngeal trauma[4,13]**

| Group | Criteria |
|---|---|
| Group 1 | Minor endolaryngeal hematomas or lacerations; no detectable fracture |
| Group 2 | Edema, hematoma, minor mucosal disruption without exposed cartilage; nondisplaced fracture; varying degrees of airway compromise |
| Group 3 | Massive edema, large mucosal lacerations, exposed cartilage; displaced fracture(s); vocal cord immobility |
| Group 4 | Same as group 3 but more severe with: mucosal disruption; disruption of the anterior commissure; unstable fracture, two or more fracture line |
| Group 5 | Complete laryngotracheal separation |

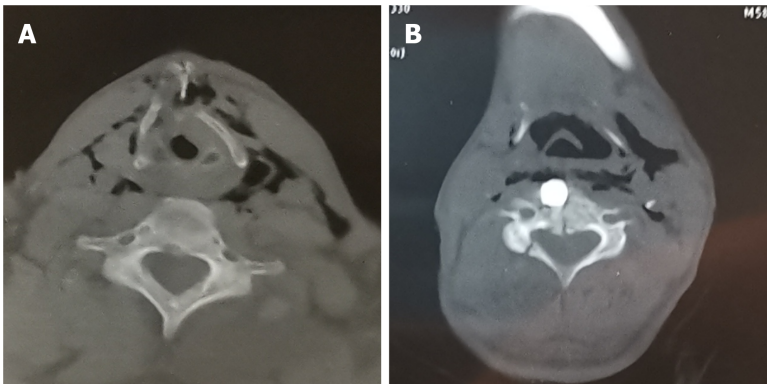


**Figure 1 Axial computed tomography scan of the neck.** A: Laryngeal injury; B: Metal fragment.

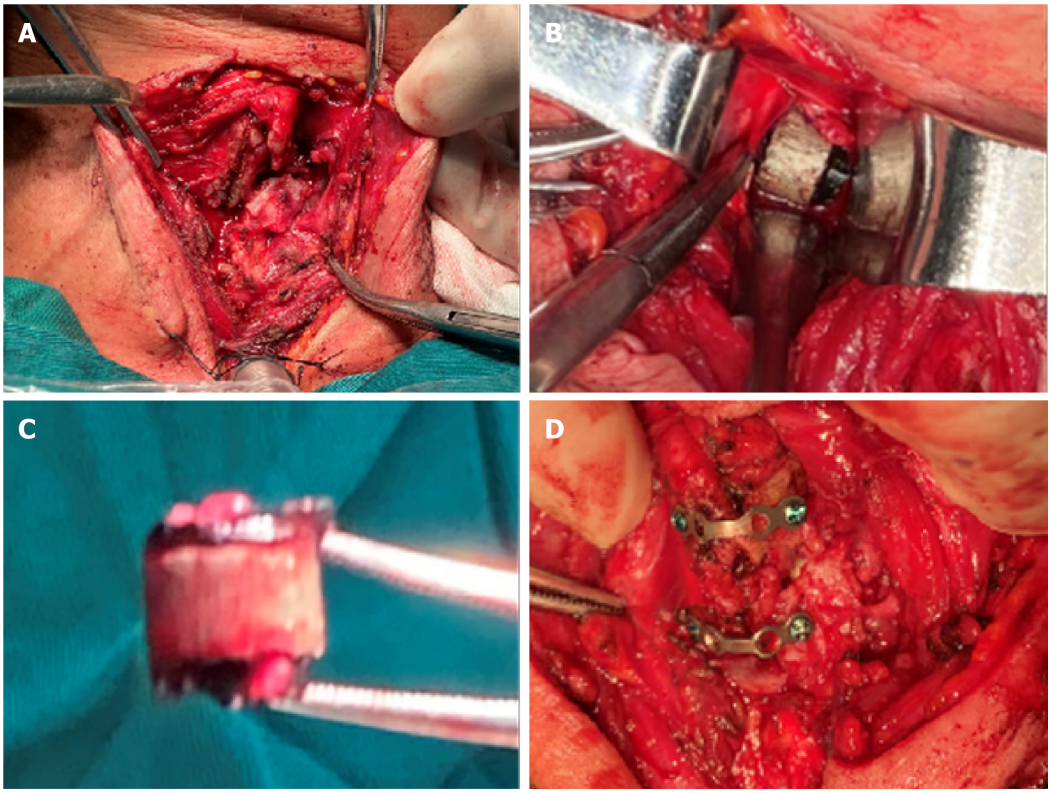


**Figure 2 Intra-operative images.** A: Laryngeal injury; B: Fragment lodged in the C4 vertebra; C: Fragment was removed; D: Miniplate fixation.

Laryngeal trauma was classified into four groups by Schaefer[4]. In 1990, Fuhrman added a fifth group (Table 1)[13]. The case described here was classified into group 4.

The choice of examination is important for diagnosing injuries and optimal treatment planning. In this case, CT findings helped us make the primary diagnosis and determine the surgical plan. CT is more sensitive than flexible laryngoscopy for

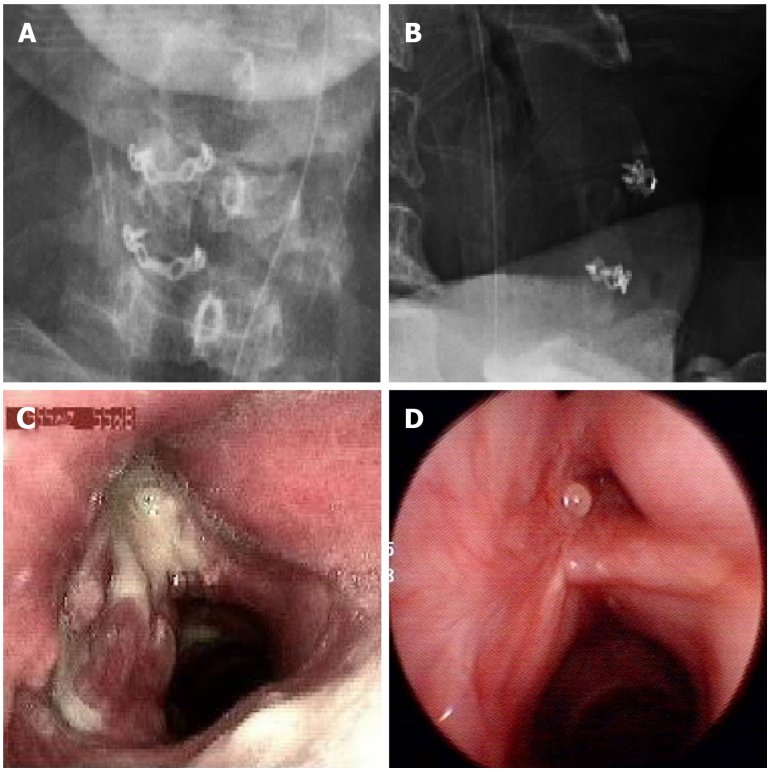


**Figure 3 Post-operative findings.** A: Antero-posterior radiograph, demonstrating good position of the miniplates; B: Lateral radiograph, demonstrating good position of the miniplates; C: Fibrolaryngoscopy on the 14th day after surgery, demonstrating the condition of the endolarynx; D: Dynamic laryngoscopy 6 mo after surgery, demonstrating good recovery of the larynx.

identifying laryngeal injury because it can show minimal cartilage fracture and other details[14,15]. In addition, distorted anatomy, bleeding and poor visualization may result in difficulties in laryngoscopy[7]. When plain CT cannot show radiological signs of potential vascular injuries, which may delay patients' diagnoses, contrast-enhanced CT is more sensitive for vascular injuries[16]. In an emergency, contrast-enhanced CT is helpful in revealing details regarding the vessels and surrounding structures, such as angiorrhexis and hematoma[17,18]. In a retrospective study of 67 patients with penetrating neck injuries, combining clinical signs and radiological evidence improved the accuracy of exploration of injured vessels to 97.7%[19]. Therefore, contrast-enhanced CT is an essential examination for the diagnosis of injuries because of its high sensitivity in evaluating soft tissues, specifically vascular structures, in addition to fractures.

In patients with laryngeal trauma, the overriding priority is to maintain airway patency. Endotracheal intubation and tracheotomy have been recommended to establish a safe airway. However, intubating patients who have laryngeal injuries may be difficult or can fail, due to disordered anatomy, limited visualization and poor condition of the patients[8,9,10,20]. In our case, in order to avoid worsening the situation, we chose tracheotomy but not endotracheal intubation because of the severe laryngeal cartilage fracture with displacement of fragments and the unstable C4 vertebra fracture. Other reports have also shown that cricothyroidotomy may be a helpful temporary measure in emergency situations[20,21].

The optimal method and timing of surgery are controversial. A review of 77 patients revealed that expeditious repair of laryngeal injuries within 48 h could reduce the incidence of poor voice and/or airway outcomes[8]. In some retrospective studies, frequently, the airway repair was carried out within 8 h of the original injury[11,12]. Steven *et al*[7] suggested that patients with acute laryngeal trauma should undergo surgery within 24 h, or as soon as the patient can be brought to the operating room. Thanks to the short distance and rapid transportation, our patient received timely surgery within the window period.

In previous studies, several methods of repair and fixation were introduced. In a cadaveric study, miniplate fixation provided an easy procedure, tolerability, and superiority for thyroid cartilage fractures compared to wire fixation[22]. de Mello-Filho and Carrau reviewed 20 cases of laryngeal fractures repaired with miniplates, and most of them had good recovery of respiration, phonation and deglutition[23]. In

the present case, the choice of repair was miniplate fixation, with good prognosis of various laryngeal functions.

Interdisciplinary cooperation is important because the force of high velocity damage usually causes multiple injuries, such as thyroid cartilage fracture and cervical injury. Emergent life-saving airway or hemodynamically stabilizing procedures have priority over spinal precautions[24]. Prehospital spinal immobilization is necessary in patients who have unstable fractures without an initial neurologic deficit[25]. In this case, good outcome was also attributed to spinal immobilization with a cervical collar and post-operative bed rest, which reduced the adverse effects of transportation and activity. Undoubtedly, a healthy physical condition before injury and high degree of compliance with treatment also played a role in achieving a good outcome.

## CONCLUSION

External laryngeal trauma is rare but potentially fatal, which may be accompanied by injuries to other areas. Contrast-enhanced CT scanning is important for judging the severity of injuries. Maintaining airway patency is the key to patient management. Timely and appropriate treatment with interdisciplinary cooperation is essential for subsequent rehabilitation.

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