

Case Report

Laryngeal fracture treated with ultrasound-aided fixation using an absorbable plate system

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ABSTRACT

Background: Laryngeal trauma is not a frequently encountered disease in routine clinical practice. Blunt trauma with thyroid fractures may leave permanent voice impairment and respiratory impairment due to scar stenosis, requiring appropriate treatment.

Case presentation: We describe a 38-year-old man was referred to our hospital for evaluation of inability to speak loudly and difficulty with high-pitched voice that had begun after a falling tree struck him on the anterior neck. He underwent successful fixation of fractures in their laryngeal cartilage after trauma by using the ultrasound-aided fixation system using an absorbable plate.

Conclusion: Laryngeal fracture is a rare entity in patients with blunt cervical trauma. Ultrasound-aided fixation using an absorbable implant system is effective for optimal reduction and fixation of fractured laryngeal cartilage, and may become an alternative method in patients with adhered and unossified cartilage.

Introduction

Laryngeal trauma is not a frequently encountered disease in routine clinical practice. Immediate management of laryngeal trauma is to secure the airway with later treatment of vocal function, as patients can develop secondary functional dysphonia as a result of limitation of vibration of the vocal cords months after the trauma [1]. However, blunt trauma with thyroid fractures may leave permanent voice impairment and respiratory impairment due to scar stenosis, requiring appropriate treatment. In this case report, we describe one patient who underwent successful fixation of fractures in their laryngeal cartilage after trauma by using the ultrasound-aided fixation system using an absorbable plate.

Case report

A 38-year-old man was referred to our hospital for evaluation of inability to speak loudly and difficulty with high-pitched voice that had begun after a falling tree struck him on the anterior neck 2 weeks earlier while logging. He had initially visited a nearby otolaryngological clinic, was prescribed medication, and follow-up observation was initiated. However, his voice did not recover and he continued to be unable to voice high-pitched tones. Thus, he was subsequently referred to our hospital and underwent further examination. In initial clinical findings, the length of the left vocal cord was shortened, although mobility of the vocal cords was normal (Fig. 1a). On palpation of the cervical region, a hardening that appeared to be the end of a cartilage fracture was palpated.

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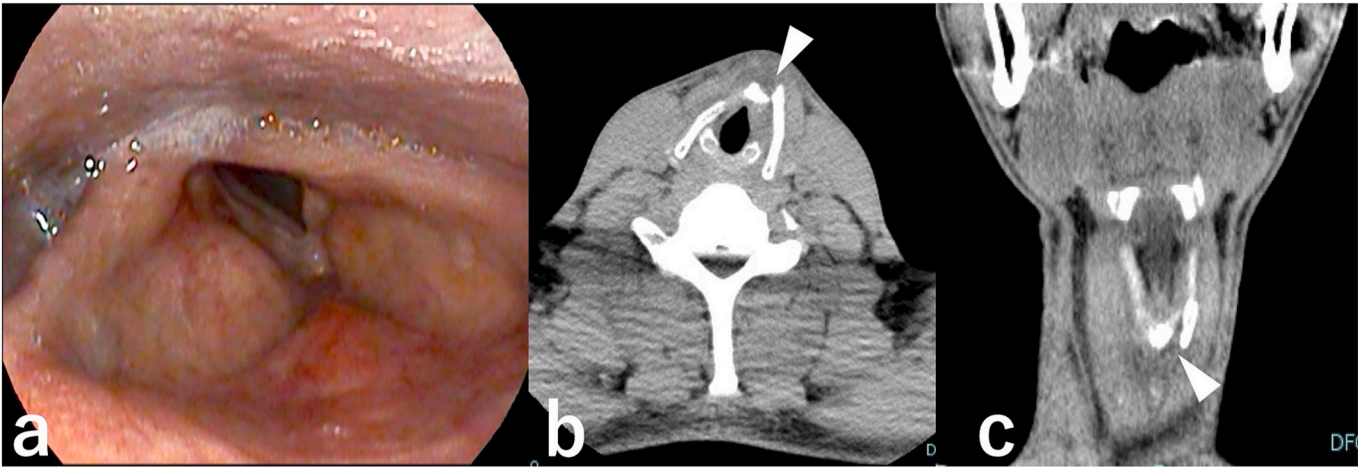


Fig. 1. Initial laryngeal finding (a) and CT imaging (b,c). White arrow heads showed the thyroid cartilage fracture.

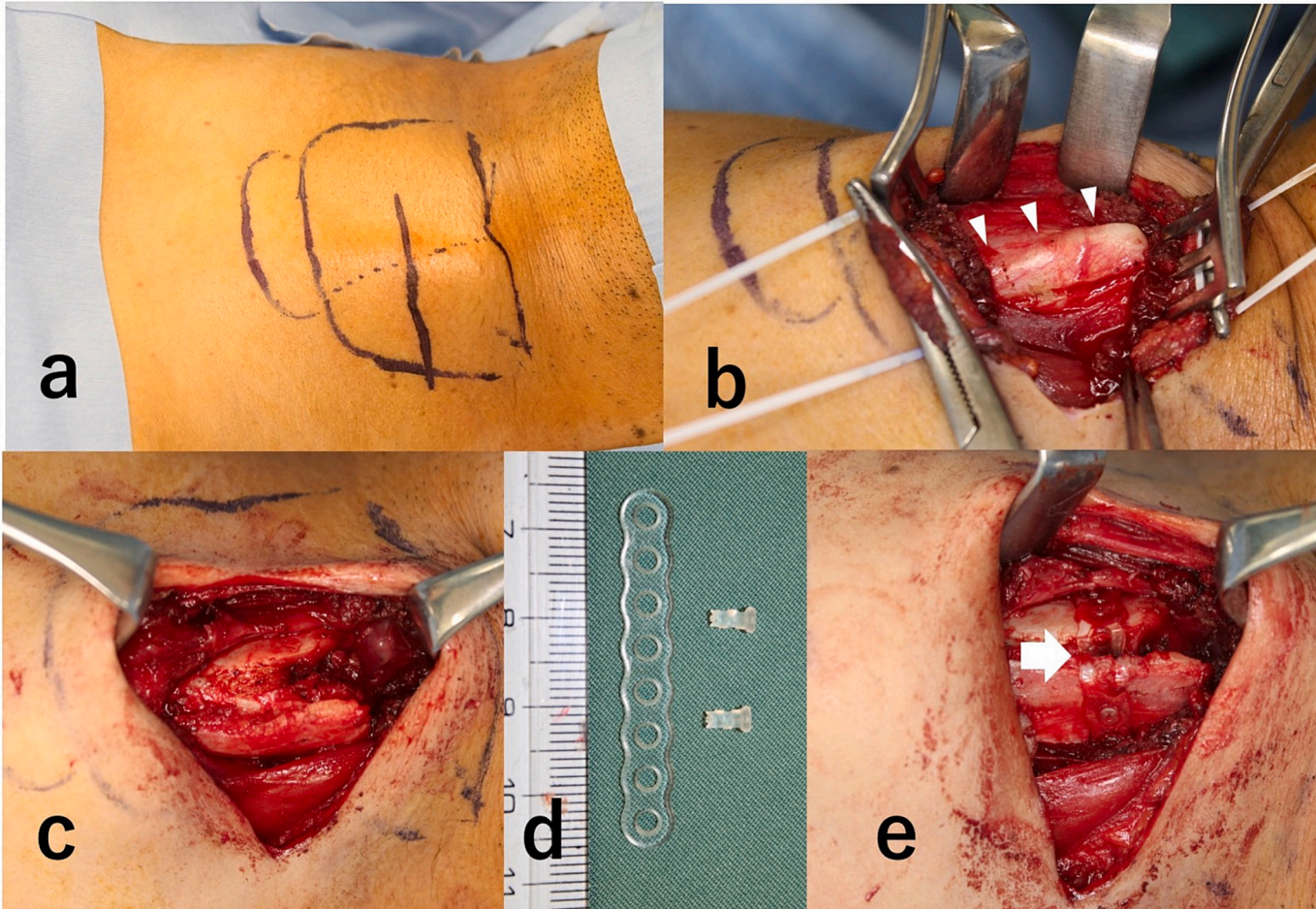


Fig. 2. (a) A horizontal anterior cervical incision was made. (b) The thyroid cartilage fracture was exposed (white arrow head). (c) The fracture fragments of cartilage were firmly adhered to each other. (d) The ultrasonic dissolvable absorbable plate (sonic weld plate) and absorbable pin. (e) The fracture fragments of cartilage were fixed by absorbable plate (white arrow).

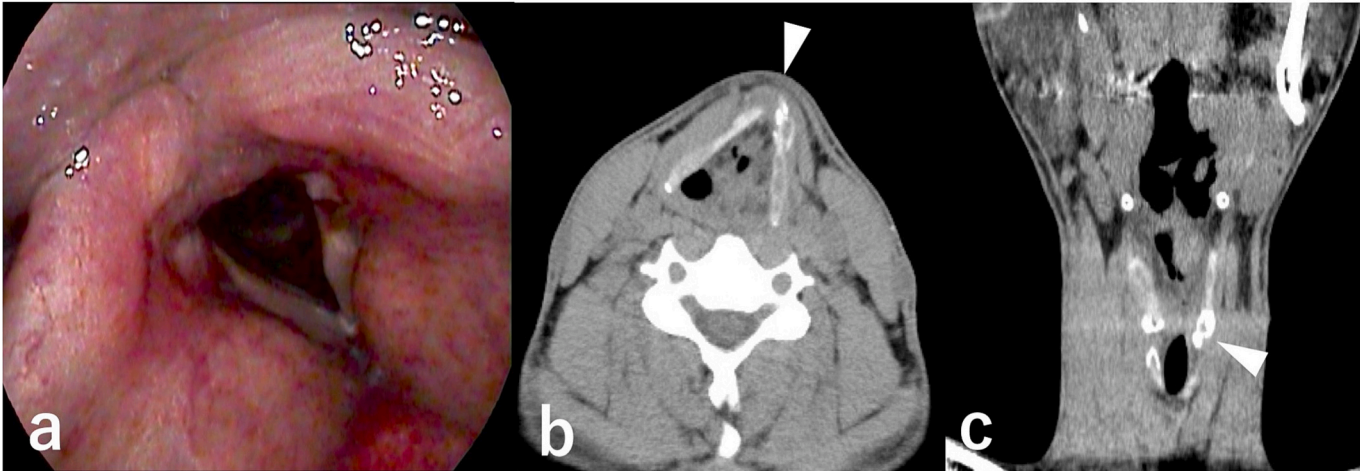


Fig. 3. Laryngeal finding after the surgery (a) and CT imaging (b,c). White arrow heads showed that the thyroid cartilage fracture had been repaired.

Cervical computed tomography (CT) imaging showed that the thyroid cartilage was tilted to the left side, and a longitudinal fracture of the left lateral plate of the thyroid cartilage was observed with a deviation of 6 mm - Schaefer Classification 2 (Fig. 1b, c). Maximum phonation time was 35.7 s, and his high-pitched voice was 175 Hz by performing phonation function test. The patient underwent surgery under general anesthesia. A horizontal anterior cervical incision was made (Fig. 2a), exposing the anterior cervical muscles. After cutting the anterior cervical muscle, the thyroid cartilage fracture was exposed (Fig. 2b). The fracture fragments of cartilages were already firmly adhered to each other (Fig. 2c). We re-disarticulated the fracture fragments, and the thyroid cartilage was not fully ossified, and making pin holes to fix the fracture fragments of cartilage were difficult and became loose. However, we managed to perform a four-point fixation to fix the ultrasonic dissolvable absorbable plate (sonic weld plate) and absorbable pin using an ultrasonic device (Fig. 2d,e). At 1 month after the surgery, laryngeal findings showed improved left vocal cord length (Fig. 3a). Subjectively, the patient was able to speak louder and his high-pitched voice improved to 209 Hz. Maximum phonation time was improved to 44.1 s CT findings showed that the thyroid cartilage fracture had been repaired and there was nearly improvement in left vocal fold length (Fig. 3b, c).

Discussion

Trauma to the larynx can result in airway narrowing and voice dysfunction, depending on the cause and site of injury. Internal fixation after laryngeal cartilage reduction using various reconstructive materials has been reported, such as thread, steel wire, titanium plates, biodegradable miniplates, and titanium mesh. Kirby et al. [2] reported that steel wire was superior to nylon for internal fixation. In 1990, Woo et al. [3] reported the use of titanium miniplates for facial trauma in the treatment of traumatic laryngeal injuries, and subsequently reported the use of titanium miniplates for laryngeal trauma. Tasca et al. [4] reported inion biodegradable plate enabled rigid fixation and healing of this fracture with no complications, and it is useful due to radiolucentness and no use to remove. Sato et al. [5] reported that titanium mesh can be freely fabricated into various shapes and sizes to fit the complicated form of the laryngeal cartilage. It can also be fixed in various positions with thread, steel wire, or screws because of many small holes. Ultrasound-aided fixation is a recently developed alternative method. An absorbable pin is attached to the tip of a device called a sonotrode, which vibrates the pin with ultrasound. When the vibrating pin is inserted into a hole drilled in the bone, the friction generated at the pin-bone interface causes the edges of the pin to melt into the bone, allowing the biodegradable polymer to flow into the cortical bone layer and cancellous bone cavities. Pilling E et al. [6] reported that this device solves the problem of excessive torsional forces and subsequent fractures of the screw. Theoretically, the fusion of the plate and pinhead is the defining feature of a mechanical device over a fixation technique. In addition, Lee et al. [7] reported the clinical usefulness of ultrasound-aided fixation using an absorbable plate system in patients with zygomatico-maxillary fracture, and the advantages of ultrasound-aided fixation methods include optimal surgical manipulation, shorter insertion time, avoidance of fracture of the fixation elements, and higher three-dimensional load capacity. In this case, the patient was a 38-year-old man and operated on 30 days after the injury, and the thyroid cartilage was unossified, and the fracture fragments of cartilage were already firmly adhered to each other. The pin holes for plate fixation became loose due to unossified cartilage, but the ultrasonic dissolvable absorbable plate was able to fix the cartilage because the pin itself melted into the thyroid cartilage. This ultrasound-aided fixation using an absorbable implant system is effective for optimal reduction and fixation of fractured laryngeal cartilage, and may become an alternative method in patients with adhered and unossified cartilage.

Conclusion

Laryngeal trauma is not a frequently encountered disease in routine clinical practice. Blunt trauma with thyroid fractures may leave permanent voice impairment and respiratory impairment due to scar stenosis, requiring appropriate treatment. Ultrasound-aided fixation using an absorbable implant system is effective for optimal reduction and fixation of fractured laryngeal cartilage, and may become an alternative method in patients with adhered and unossified cartilage.

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Patient consent

Consent to publish the case report was not obtained. This report does not contain any personal information that could lead to the identification of the patient.

Declaration of competing interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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