


## CASE REPORT

# Do maxillary dentures protect the skull base from penetration injury?

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**Key Clinical Message**

Foreign bodies penetrating from the oral cavity can damage surrounding tissues. This case is considered an extremely rare and fortunate instance in which a maxillary denture appeared to weaken the external force and change the direction of the scissors, preventing damage to vital organs.

**Abstract**

The patient was a 73-year-old man. While on a ladder pruning a plant, he accidentally fell. The gardening scissors passed through the maxillary sinus from the maxillary alveolus and penetrated below the zygomatic arch. At the time of injury, the patient was wearing a metal-frame denture on the maxilla, and contact between the cutting edge and the denture was speculated to have weakened the piercing force of the blade and changed the direction of the cutting edge. This extremely rare case demonstrates how a maxillary denture could reduce the severity of a penetrating injury caused by scissors.

**KEYWORDS**

gardening scissors, maxillary denture, maxillofacial fracture, penetration injury, protection

## 1 | INTRODUCTION

In daily life, foreign body penetration from the oral cavity into surrounding tissues is uncommonly observed. Transoral penetration injuries may compromise vital structures such as large vessels, airways, and crucial neurological structures, risking severe consequences for the patient.<sup>1–4</sup> In cases of pharyngeal trauma, subcutaneous emphysema, pneumomediastinum, infections such as retropharyngeal abscesses or mediastinitis, and vascular damage have been reported.<sup>5–7</sup> In particular, although the incidence of vascular damage is less than 1%, this event is potentially life threatening.<sup>8</sup>

In cases of intracranial injury, not only is brain tissue damaged, but recovery has significant sequelae. The most common pathway for penetrating skull base injury is reportedly via the orbit, followed by the oral and nasal cavity, and the types of foreign bodies most often causing injury are metallic (37.5%), wooden (28.1%), or plastic (28.1%).<sup>9</sup> Among the complications of penetrating skull base injury, infection has been the most common, with a reported overall rate of 64%–70% and a mortality rate of 14%–57%.<sup>9</sup>

Here, a case involving an individual wearing a maxillary metal-framed prosthesis who fell from a ladder while pruning a plant is reported. The gardening scissors

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penetrated from the maxillary alveolus to the inferior zygomatic arch through the maxillary sinus. The cutting edge of the gardening scissors was considered to have hit the maxillary denture, reducing the external force and deflecting the cutting edge to avoid damage to important surrounding tissues such as the brain tissue.

## 2 | CASE HISTORY/ EXAMINATION

A 73-year-old man with full maxillary and mandibular dentures was brought to the emergency room (ER) with excessive bleeding due to a penetrating wound caused by gardening scissors. The patient had accidentally fallen from a ladder while pruning a plant and stabbed himself in the mouth with the gardening scissors. The patient instinctively removed the scissors in surprise, at which point he noticed considerable bleeding and lost consciousness (Figure 1). His family found the man and called emergency services due to persistent bleeding.

The patient had a history of diabetes and was taking glibenclamide. At the first medical examination in the ER, blood pressure was 84/62 mmHg, heart rate was 129 beats/min, and Glasgow Coma Scale score was 3 (eye opening



**FIGURE 1** The gardening scissors that caused the injury. The blade length is over 20 cm.

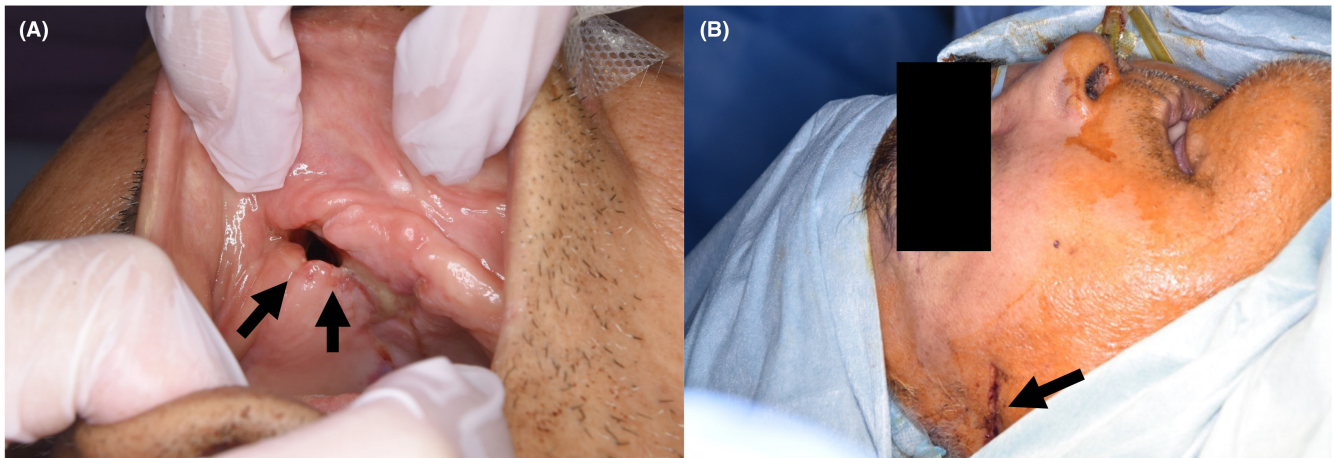
1, verbal 1, motor responses 1). Persistent bleeding was seen from wounds on the face and mouth. Facial examination revealed a laceration below the right zygomatic arch, communicating with the maxillary sinus. On intra-oral examination, the maxilla was edentulous and had a fissure around the right anterior alveolus that communicated with the maxillary sinus (Figure 2). This fissure was connected to the fissure on the skin surface under the zygomatic arch. The blade of the scissors was suggested to have entered through the oral cavity, passed through the maxillary sinus and penetrated below the right zygomatic arch. Other general examinations of the patient revealed bruises on the lower back. In addition, the dentures that were being worn had fallen out at the site of the injury and were brought to the ER by a family member.

Radiographic examination showed no damage to the brain tissue or skull base (Figure 3A,B). Complex bone destruction and fractures was observed in the right side of the zygomaticomaxillary complex (Figure 3A–D). No leakage of cerebrospinal fluid was observed, and eye movements appeared normal. Facial Injury Severity Scale (FISS) score<sup>10</sup> was 4.

## 3 | DIFFERENTIAL DIAGNOSIS, INVESTIGATIONS, AND TREATMENT

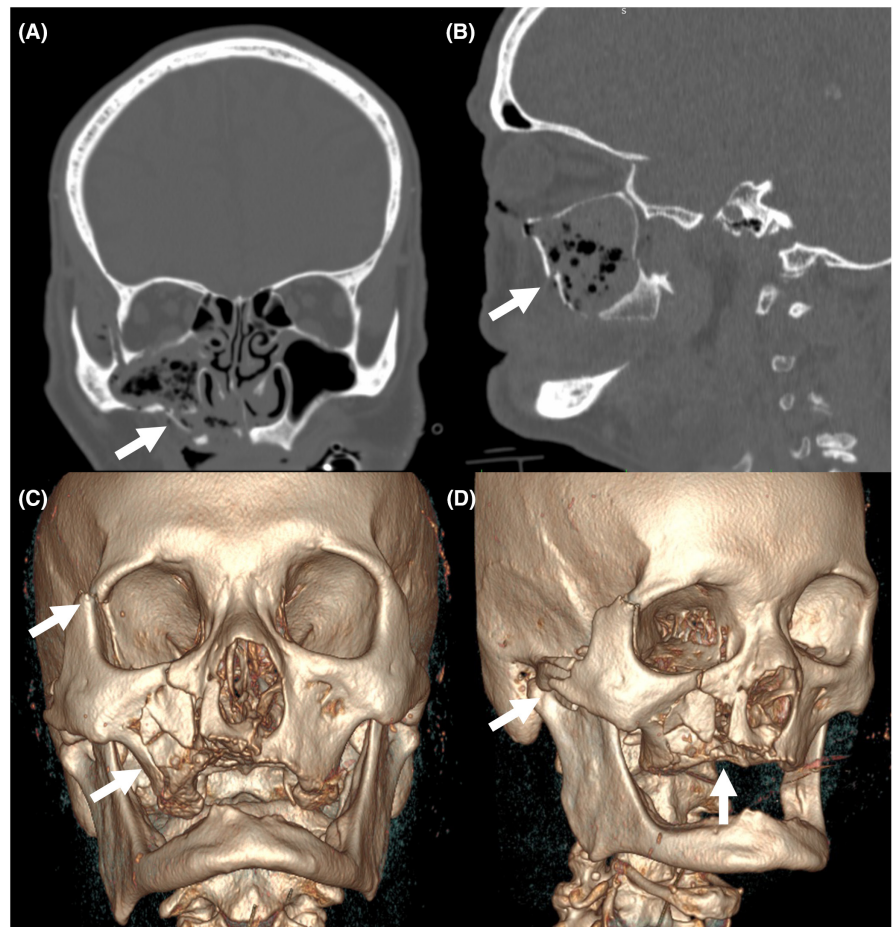
As initial treatment in the ER, intratracheal intubation was immediately performed and the airway was secured. Bleeding sites were then scrutinized, and hemostasis was achieved. Tetanus vaccine was also administered because the patient's tetanus vaccination history was not clear. The next day, tracheostomy was performed to stabilize the airway and reconfirm the absence of skull base damage and cerebrospinal fluid fistula. After the condition of the patient stabilized, facial bone reduction surgery was performed (Figure 4). After confirming the absence of residual foreign matter, the fracture of the zygomatic frontal suture and the infraorbital margin and the crushed maxillary sinus wall were repositioned and immobilized with plates and screws (Figures 4 and 5). The right zygomatic arch laceration was drained to prevent possible postoperative infection, and antibiotics were initiated with intravenous sulbactam/ampicillin at 6 g/day.

Since the dentures the patient was wearing were dislodged during the accident, examination of the dentures was performed to determine the effect of the dentures on the injury. The dentures were complete dentures with a metal frame for both the maxilla and mandible, and the palate of the maxillary denture was covered with metal. No significant damage to the upper or lower dentures was apparent (Figure 6).



**FIGURE 2** Initial photograph of the orofacial region. (A) The maxilla is edentulous and has a laceration in the anterior part that leads to the maxillary sinus. (B) A laceration below the right zygomatic arch, communicating with the maxillary sinus, had already been sutured by emergency room doctors (arrows).

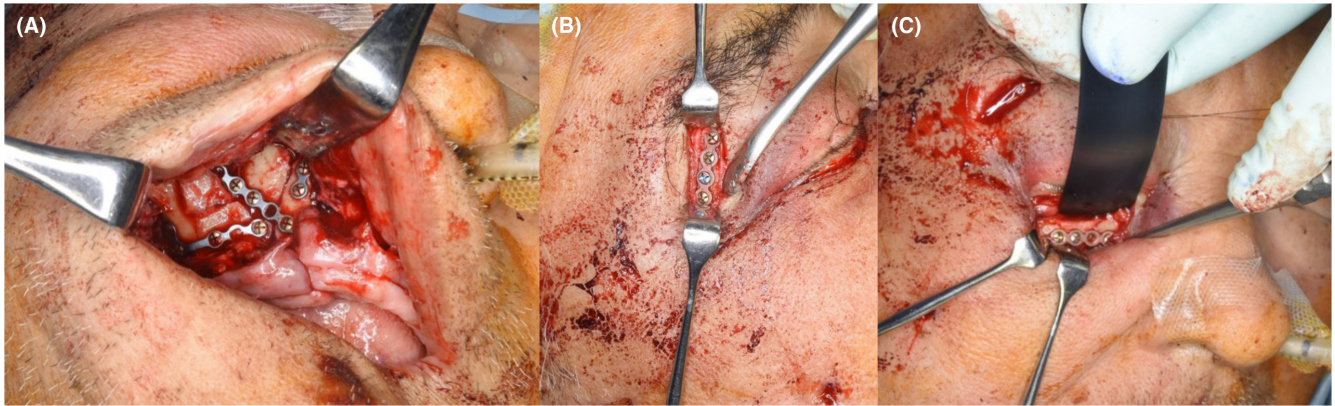
**FIGURE 3** Initial computed tomography (CT) shows fractures (arrows) on right side of the zygomaticomaxillary complex (A, frontal view; B, sagittal view; C, D, 3-dimensional [3D] views).



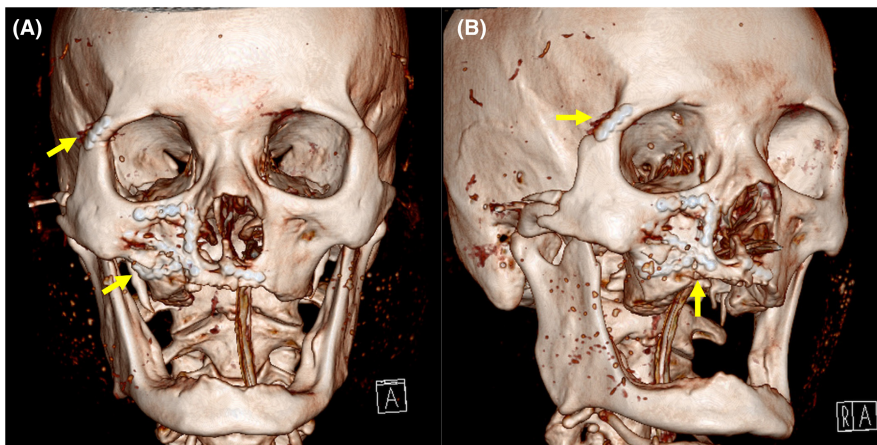
#### 4 | OUTCOME AND FOLLOW-UP

The postoperative course was uneventful, with no complications such as infection or dysfunction of the brain or eyeballs, with the exception of slight right facial nerve

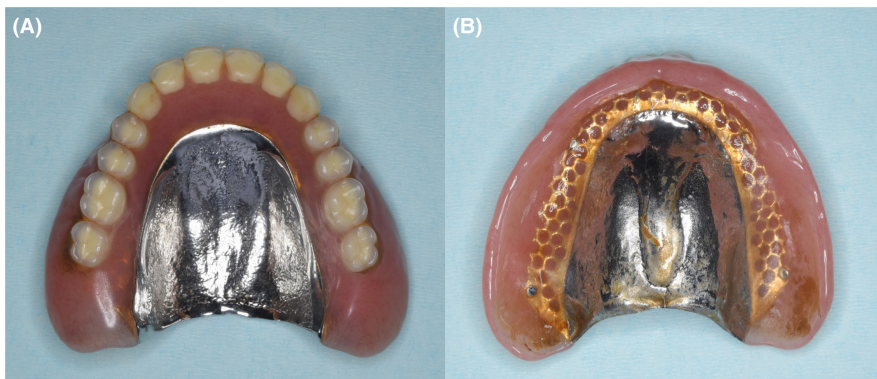
paresis. Plate and screw removal was performed after 6 months, and there were no abnormal findings in the wound. Facial nerve paresis had recovered by this point. Subsequent follow-up after 12 months showed no complications (Figure 7).



**FIGURE 4** Photograph during operation for the orofacial injury. (A) The fine anterior and lateral walls of the maxillary sinus are repaired with mini-plates and screws. The fractured zygomatic frontal suture (B) and infraorbital margin (C) are secured with mini-plates and screws.



**FIGURE 5** Postoperative 3D-CT images showing fixation of plate and screws (arrows).



**FIGURE 6** The full upper denture of the patient. (A) Front side. (B) Back side. No significant damage to the upper denture is evident.

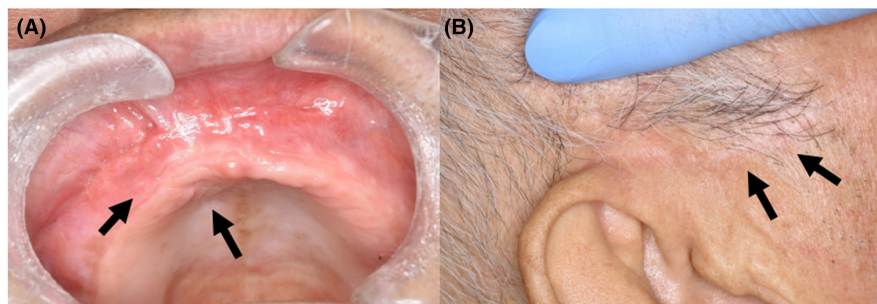
## 5 | DISCUSSION

An interesting point in this case was that the maxillary dentures likely protected the vital organs from penetration by the scissors. Few articles have addressed the relationship between dentures and sudden external force. From a search of cases of midface fractures among maxillary denture wearers, Cooter et al. noted that the presence of an upper denture modified the distribution of

forces occurring with injury to the midfacial skeleton.<sup>11</sup> To date, no reports have described dentures contributing to weaken external forces, such as those from penetrating foreign bodies.

Since the patient's recall of the events surrounding his fall was uncertain, proper fit of the denture at the time of injury was checked first. The complete denture had been made in a private clinic and showed good compatibility. The patient also stated that the denture had never fallen

**FIGURE 7** Photograph 12 months after injury. No complications involving the oral (A) or skin (B) wounds (arrows) were identified.



out just by opening his mouth wide. The maxillary denture was thus considered to have been correctly attached to the maxilla at the time of injury.

The mechanism of injury in this case was thought to have been as follows. First, the maxillary denture came off with a blow from the tip of the scissors, then the blade, with reduced kinetic energy from the collision with the denture, entered from the alveolus while changing direction of movement. Regarding the effect of dentures in reducing the external force, the cutting edge of the scissors in this case had a length of over 20 cm. In a similar case involving a fall from a ladder and similar scissors, the cutting edge had penetrated deep into the brain through the nasal cavity from the skin surface and beyond the skull base.<sup>12</sup> The ability of the scissors in the present case to penetrate was thus considered quite high. If no denture had been present, the cerebrum may have been deeply pierced.

As to the change in the direction of the blade, the direction of blade insertion was thought to have shifted laterally from the base of the skull following contact with the denture. As a result, the tip of the incision protruded from below the zygomatic arch to the skin surface after insertion into the maxillary sinus. Fortunately, the blade did not enter the pharynx, thus avoiding damage to various vital organs.

The denture in this case included a metal plate, and reinforcing a denture with a metal plate is generally considered to improve physical properties compared to an acrylic resin plate.<sup>13</sup> The metal plate in this case may have reduced the impact strength more than a resin plate would have, but this remains conjectural in the absence of direct comparisons in laboratory studies.

Penetrating trauma to the face can affect vital organs. Neskromna-Jędrzejczak et al. stated that the consequences of penetrating trauma depend on the anatomical structures affected, the scope of penetration, the impact and direction of the offending foreign body, and the resistance of tissues affected by the trauma.<sup>3</sup> They also mentioned that damage was more severe in cases with high FISS scores. In this case, the FISS was low because there was no damage to the upper face.

Infection is a major concern with penetrating injuries from foreign bodies. In particular, penetrating wounds

in the upper facial region require special attention, and mucosal damage is also considered to carry a high risk of infection.<sup>14</sup>

Tetanus should also not be overlooked as a possible infectious disease in cases of trauma, and proper treatment should be applied in patients who are not vaccinated or whose vaccination history is unclear. Many developed countries have effective tetanus vaccination programs; however, the efficacy of the vaccination gradually declines over time. Consequently, additional vaccinations may be necessary for high-risk wounds (e.g., contaminated wounds, punctures, avulsions, or wounds resulting from missiles, crushing, burns, animal or human bites, or frostbite) when more than 5 years have passed since the last vaccination and for low-risk wounds when more than 10 years have passed since the last vaccination.<sup>15</sup>

In cases of a penetrating foreign body, the foreign body may be pulled out by the injured individual or another person present at or after the time of injury, but it is generally considered important that the foreign body be left in place, not least because it might be acting as a tamponade preventing severe bleeding.<sup>16,17</sup> Hasty removal without precise knowledge of the exact anatomical locations involved and surrounding structures that might be compromised can have disastrous consequences, such as fatal bleeding.<sup>12</sup> In this case, after the scissors were removed by the patient, major bleeding and loss of consciousness occurred.

In conclusion, this case was considered an extremely rare and fortunate instance in which a maxillary denture appeared to weaken the external force and change the direction of the scissors, preventing damage to vital organs.

#### AUTHOR CONTRIBUTIONS

**Shunsuke Hino:** Writing – original draft; writing – review and editing. **Yosuke Iijima:** Methodology. **Shuto Mochizuki:** Data curation. **Nami Nakayama:** Project administration. **Miki Yamada:** Data curation. **Norio Horie:** Supervision. **Takahiro Kaneko:** Supervision.

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## CONFLICT OF INTEREST STATEMENT

The authors have nothing to disclose.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## ETHICS STATEMENT

This manuscript is a case report and is considered exempt prior to ethics committee review. In addition, written informed consent was obtained from the patient whose clinical photographs are included in this paper.

## CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

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