

# Traumatic displacement of maxillary permanent incisor into the nasal cavity

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## Abstract

**Purpose** The purpose of this paper was to describe a case of unviable alveolar repositioning of an intruded tooth into the nasal cavity and to bring the subject of intrusive tooth injury among patients with dentoalveolar fractures to the attention of trauma surgeons.

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**Patient** A 26-year-old male was involved in a car accident and crashed his mouth against the dashboard due to sudden deceleration. Intraoral examination revealed an anterior maxillary dentoalveolar fracture and absence of the central maxillary incisors, right lateral maxillary incisor, and left maxillary canine. Computed tomography showed a dislocated tooth in the nasal cavity. The “missing” left maxillary canine was easily recovered from the floor of the left nostril.

**Conclusions** Because complete dislocation of a tooth can cause a frontal sinus abscess, an airway complication, a respiratory tract obstruction, and a complicated lung abscess or sinusitis, anytime a tooth is not accounted for after a dentoalveolar trauma, the possibility that it has been fully intruded should be considered. Computed tomographic scan should be a routine diagnostic study in all cases with associated missing anatomical structures in the oral and maxillofacial region. The need to involve the dental professional in the initial assessment of dental trauma in emergency rooms in hospitals is important in order to identify how many teeth might be missing after dental trauma and to correctly reposition the avulsed teeth when possible.

**Keywords** Dentoalveolar trauma · Tooth intrusion · Nasal cavity

## Introduction

Dental injuries such as crown/root fracture, subluxation, avulsion, and concussion are very common following facial trauma [1, 2] and occur from various causes. In healthy children, traumatic injury is often precipitated by sports or motor vehicle accidents [3]. Medical conditions such as

seizure disorders can also predispose patients to oral/facial trauma [4].

Fragments and teeth may displace anteriorly, posteriorly, or vertically. Most dentoalveolar fractures are in front of the maxilla and mandible. In these areas, the fracture and its results are important regarding cosmetic appearance [5].

Luxation injuries comprise 15–61% of dental traumas to permanent teeth, while frequencies from 62% to 73% have been reported for the primary dentition [6]. Intrusive luxation is one of the five different types of luxation injuries that can be recognized, represented by displacement of the tooth deeper into the alveolar bone. This injury is accompanied by comminution or fracture of the alveolar socket, and the direction of dislocation follows the axis of the tooth. With increasing age, the frequency and the pattern of injury change. In the primary dentition, intrusions and extrusions comprise the majority of all injuries, a finding which is possibly related to the resilience of the alveolar bone at this age. In contrast, in the permanent dentition, the number of the intrusive luxation injuries is considerably reduced and usually seen in younger individuals [6].

Current management strategies for this injury include: waiting for the tooth to return to its primary position (passive repositioning), immediate surgical repositioning, and repositioning with dental traction by orthodontic devices (active repositioning). In cases of dentoalveolar trauma with extreme loss of alveolar bone, repositioning of an intruded tooth may be difficult.

The purpose of this paper was to describe a case of unviable alveolar repositioning of an intruded tooth into the nasal cavity and to bring the subject of intrusive tooth injury among patients with dentoalveolar fractures to the attention of trauma surgeons.

## Case report

A 26-year-old male presented to the emergency department of the João XXIII Hospital, Belo Horizonte, Brazil. He was involved in a car accident about 12 h before. He was sitting at the front passenger seat, and as he was not using a seat belt and the car had air bag only for the driver seat, he crashed his mouth against the dashboard due to sudden deceleration after a collision with another car.

Past medical history was unremarkable and he was taking no medication. Clinical examination showed laceration of the upper lip and of the right nasal vestibule. The patient reported partial bilateral nasal obstruction. Intraoral examination revealed an anterior maxillary dentoalveolar fracture and absence of the central maxillary incisors, right lateral maxillary incisor, and left maxillary canine. There was extreme mobility of the left lateral maxillary incisor

and gross gingival and mucosal trauma. There were no clinical signs of other facial fractures.

A computed tomography (CT) scan with axial and coronal sections and tridimensional reconstruction was carried out to rule out intrusion of the missing teeth and show the true extent of the dentoalveolar fracture. A hyperdensity image at the axial CT section (Fig. 1) into the nasal cavity was noted and suspected to be a tooth (arrow). The tridimensional CT clearly confirmed this (Fig. 2). Posterior–anterior and lateral chest radiographs were performed to verify whether the other missing teeth had been aspirated or swallowed. Because no other tooth was found, it was assumed that the other missing teeth were lost at the accident scene. The driver did not find the teeth inside the car.

Under local anesthesia, the intraoral wound was debrided and irrigated with saline solution. Exploration was achieved through the open wound and revealed extreme loss of alveolar bone in the premaxilla and no visual signs of the missing teeth. The left lateral maxillary incisor was removed because it was completely loose with no more sufficient alveolar bone to replant the tooth in place. The “missing” left maxillary canine was easily recovered from the floor of the left nostril (Fig. 3) and confirmed as the canine by its morphology. It was decided not to replant it for the same reason considered for the lateral incisor (complete lack of alveolar bone). The lacerated gingiva, the mucosa, and the nasal vestibule were sutured.

The patient received a 7-day course of oral amoxicillin and 0.12% chlorhexidine gluconate mouth rinse and was reappointed within 7 days. The patient’s postoperative course was uneventful. The oral rehabilitation plan, not yet performed, is autogenous osseous graft in the premaxilla followed by dental implants and prostheses.



**Fig. 1** Axial CT. Hyperdensity image into the nasal cavity



**Fig. 2** Tridimensional CT confirmed the suspicion of a tooth into the nasal cavity

## Discussion

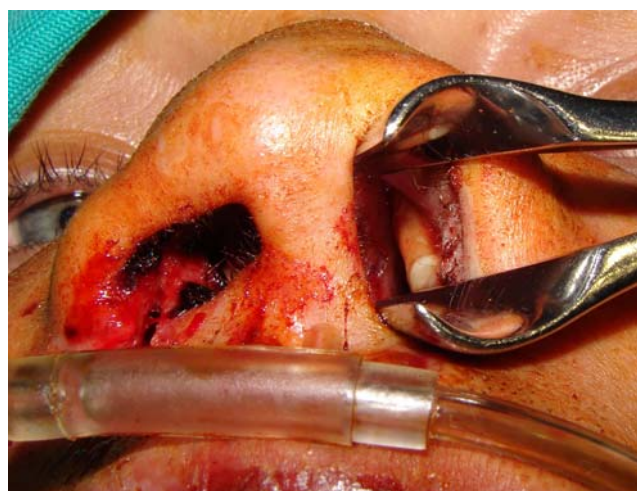
Intrusive tooth injury, which is defined as the displacement of a tooth deep into the alveolar bone, usually involves maxillary teeth and has been one of the most serious dental injuries with difficult treatment [7]. The tooth most vulnerable to trauma is the maxillary central incisor which sustains approximately 80% of all dental injuries [8]. The canines are rarely involved because of the medial pillar of maxillae which is difficult to penetrate. Therefore, the present case with intrusion of a permanent canine can be considered rare. Unless the impact force is considerable, the posterior teeth are seldom involved because of their anatomic position and multiple roots [9]. Primary dentition teeth are more often involved because the apices of intruded teeth can be shoved through the relatively thinner vestibular bone more easily than those of the permanent dentition [10].

The frequency of dentoalveolar injuries in all of maxillofacial fractures varies from one study to another. Data from previous studies showed that nearly 50% of all school-age children experience some form of dentoalveolar fracture between the ages of 6 and 18 [11]; 30% of children suffer from trauma to their primary dentition [12], and 22% suffer from trauma to their permanent dentition [13]. More recent studies reported that the occurrence rate of dentoal-

veolar fracture in maxillofacial trauma was changing from 1.9% to 76.3% [14, 15].

In one study [16] in which the incidence of tooth injuries in a Swedish county for children 3 years of age was verified, intrusion injuries in primary teeth were seen in 11% of the injured girls and in 15% of the boys (age 0–12 years,  $n=323$ ). In another study [17] where 222 children were examined due to luxation injuries, 80.8% of the injuries involved the central primary incisors. Of 307 luxation injuries to primary teeth in that material, 15.3% were intrusions. The study of Onetto et al. [10] analyzed traumatic injuries in the primary and permanent dentition in children. The most common injuries in primary teeth were luxation (26%), intrusion (21%), and subluxation (18%). Falling was the most common cause of injury in both groups (82% primary dentition, 58% permanent dentition), followed by striking against objects (13% primary, 19% permanent) and bicycle accidents (9% permanent). Most injuries in children with primary dentition (68%) occurred at home, while children with permanent dentition had most accidents at school (38%). Previously reported complete tooth intrusion injuries in primary and permanent dentition were the results of motor vehicle accidents [9, 18–20], as here presented, fall [5, 21–25], and trauma from seizure disorder [4].

Although most studies examining the frequency of dentoalveolar fractures is in group of children, some studies have also analyzed the frequency of this trauma in adults with permanent teeth, as shown with the patient in this study. In a retrospective study of the etiology and pathogenesis of traumatic dental injuries, Andreasen [3] found that of 2,239 injured permanent teeth, only 3% were luxated intrusively. Tuli et al. [26] evaluated the overall place of dental trauma in facial injuries. During the 10-year period of the study, 49.9% (4,763 of 9,543) of the patients



**Fig. 3** Recovery of the tooth through the nasal vestibule

suffering from oral and maxillofacial injuries sustained dentoalveolar trauma. From those with dentoalveolar trauma, 154 patients had intrusions (3.23%).

The incidence of intrusion has its peak between the ages of 1 and 3 years. At 4 years, there is a tendency to see more of avulsion injuries [27]. This may be due to the developed root of the primary incisor and the following physiological shortening of the root by resorption and also the morphology of the bone. The marrow spaces of the bone are larger than those in older individuals, and the bone is said to be more of an elastic nature [28]. It has been reported that older persons were prone to bone fractures and younger persons were more susceptible to dentoalveolar trauma [29].

When tooth displacement occurs, the poorest prognosis is associated with intrusively displaced teeth. Potential complications include pulpal necrosis, pulp obliteration, root resorption, ankylosis, and loss of marginal support [30, 31]. For intruded teeth with closed apices, the incidence of pulpal necrosis is 100%, whereas in intruded teeth with open apices, the incidence of pulpal necrosis is 63% [31]. External root resorption has been reported as a complication of intrusive injuries in 58% of teeth with immature root formation and in 70% of teeth with complete root formation [31].

The anterior dentoalveolar area is prone to injury by facial trauma because it is more exposed than the posterior dentoalveolar region [1, 32, 33]. Moreover, there is another disadvantage: high esthetic demands in this area. The present patient will certainly have to pass through a complex and multidisciplinary treatment in order to reestablish his smile. In the posterior dentoalveolar area, the maxillary floor over the roots of the teeth is thin. Therefore, this may cause a tract between the oral cavity and maxillary sinus after the dentoalveolar injury [5]. Some cases of teeth dislocation into the maxillary sinus due to trauma were reported [5, 9, 19, 20, 34, 35]. The mechanism of injury described in some cases was a strong impact (high velocity impact during a traffic accident) from below after an upward direction, parallel to the tooth axis [19, 34]. The tooth was shoved through the alveolar process into the maxillary sinus, with some degree of alveolar fracture. This process may occur with associated trivial injuries such as mouth laceration [34] or severe facial fracture. In cases of primary teeth intrusions, the direction of intrusion has been discussed by other authors and is of course an important matter in evaluating the sequelae and potential developmental disturbances to the erupting permanent teeth [36].

An intrusion of an incisor tooth into the frontal sinus following trauma was reported [18]: The incisor, dislodged by the trauma, had entered into the nasal cavity of the opposite side via the wound across the frenulum of the upper lip and thus into the frontal sinus through the anterior ethmoid cells. Kamaraj and Paul [37] also found a tooth in the frontal sinus of a completely dentulous patient.

Surprisingly, the tooth was from the co-passenger traveling facing the patient who had collision due to sudden deceleration.

Some authors described cases in which a primary incisor erupted into the nasal floor following a previous traumatic intrusion of the tooth [21] and primary teeth intrusion injuries into the nasal cavity [22, 23, 38]. An intrusion of a primary incisor into the maxillary buccal plate was also reported, remaining asymptomatic for 11 years [39].

Permanent tooth intrusion injuries into the nasal cavity are relatively rare [4, 9, 10, 24, 25, 40]. The majority of traumatic injuries affecting the permanent dentition are crown fractures [10]. Jones et al. [40] presented an interesting case of a patient with a persistent, foul-smelling mucoid discharge and obstruction of his right nostril which gave him a sensation of a foreign body that he suspected was a tooth. He had a history of dental injury to his upper incisors 16 years before and was under the impression that the upper central incisor had been avulsed and lost. Examination of the right nostril with a speculum showed a mobile foreign body in the floor of the nose that was attached to the underlying nasal mucosa. Intraoral examination showed an absent upper right central incisor, and anterior occlusal radiograph confirmed the presence of a tooth. His symptoms of nasal discharge, nasal blockage, and a putrid smell were typical, but were a timely reminder to us that injury leading to intranasal teeth can be followed by a considerable latent period before symptoms become evident. Table 1 compares reports of traumatic displacement of teeth into the nasal cavity, frontal sinus, and maxillary sinus.

Full intrusion of a tooth, however, may occur in patients with associated injuries ranging from a trivial frenulum laceration to a severe facial fracture [9]. Because the maxillofacial fractures are more dramatic, they may divert attention away from the dental aspect. These potentially hazardous injuries, although they occur rarely, should be carefully checked for during examination of patients with facial fracture to ensure that no tooth is fully intruded.

It seems that examination and some plain radiograph are enough for the diagnoses in most of cases. But in some rare patients, further imaging modalities and diagnostic examinations must be remembered in emergency service. Failure to recognize or obtain appropriate consultation can result in tooth or alveolar bone loss, resulting in problematic prosthetic rehabilitation [41]. According to Andreasen and Andreasen [42], a sufficient radiographic evaluation of the trauma is very important and increases the possibility of making a correct diagnosis with over 10%, from 80% to 91%.

Plain films are the least expensive and require less radiation, but they have been superseded by CT and cone beam computed tomography (CBCT) which offer superior

**Table 1** Reports of traumatic displacement of teeth into the nasal cavity, frontal sinus, and maxillary sinus

Author	Published	Reported cases	Tooth	Patient age (in years) and gender	Etiology	Local of tooth displacement
Ruprecht and Halhoul [34]	1979	1	Permanent incisor	17/Female	Motor vehicle crash	Maxillary sinus
Belostoky et al. [39]	1986	1	Primary incisor	10 (months) <sup>a</sup> /Female	Fall	Maxillary buccal plate
Hara et al. [18]	1993	1	Permanent incisor	46/Male	Motor vehicle crash	Frontal sinus
Cobourne et al. [21]	1996	1	Primary incisor	2 <sup>b</sup> /Female	Fall	Nasal cavity
Tung et al. [9]	1997	2	Permanent incisor	16/Female	Motor vehicle crash	Nasal cavity
			Permanent molar	22/Male	Motorcycle accident	Maxillary sinus
Tung et al. [19]	1998	1	2 Permanent molars	23/Male	Motorcycle accident	Maxillary sinus
Merkle [22]	2000	1	Primary incisor	29 (months)/Female	Fall	Nasal cavity
Thor [23]	2002	1	Primary incisor	3/Female	Fall	Nasal cavity
Martin [4]	2003	1	Permanent incisor	12/Male	Seizure disorder	Nasal cavity
Gumus and Coban [5]	2006	1	Permanent second premolar and molar	15/Male	Fall	Maxillary sinus
Jones et al. [40]	2006	1	Permanent incisor	10 <sup>c</sup> /Male	Not reported	Nasal cavity
Piskorowski [24]	2006	1	Permanent incisor	8/Male	Fall	Nasal cavity
Cai et al. [20]	2007	1	Permanent molar	17/Male	Motorcycle accident	Maxillary sinus
Kamaraj and Paul [37]	2007	1	Permanent incisor	Not reported	Motor vehicle crash	Frontal sinus
Luna et al. [25]	2008	1	Permanent incisor	7/Male	Fall	Nasal cavity
This study		1	Permanent incisor	26/Male	Motor vehicle crash	Nasal cavity

<sup>a</sup> The patient presented at age 12, but the accident occurred when she had 10 months of life

<sup>b</sup> The patient presented at age 6, but the accident occurred when she was 2 years old

<sup>c</sup> The patient presented at age 26, but the accident occurred when he was 10 years old

anatomic visualization [43]. Plain films may superimpose structures frequently underestimating the extension of fractures [44]. Advanced imaging modalities, such as CT and CBCT, are able to generate images easily in sagittal, coronal, and axial planes, eliminating the superimposition of anatomic structures [45].

CT is an excellent tool in the diagnosis and management of intrusion injury [9, 10]. CT scan offers a better image resolution than routine roentgenography and is more useful for an early and definite diagnosis. When full intrusion of a tooth in the region of the face is suspected, the facial CT scan may be indicated [9]. In this case, examination of the floor of the nasal cavity confirmed the CT diagnosis of tooth intrusion; CT study was crucial to establish the diagnosis in this patient.

According to a recent study, CT presented higher values surpassing panoramic images as the gold standard for the diagnosis of mandibular fractures because of its imaging-enhancing tools, better imaging quality, equivalent sensitivity in identification of fractures, decreased interpretation error, and greater interphysician agreement in the identification of mandible fractures [46]. Some studies support the contribution of CT findings for the surgical management of traumas [47], but limiting factors such as cost, availability, and radiation dosage promote CBCT as an acceptable alternative to evaluate maxillofacial fractures [44]. Never-

theless, our emergency service does not have such device yet.

When managing an oral–facial injury, priority should be given to removing avulsed teeth, fragments of tooth or bone, dental prostheses or appliances, and grossly loose teeth. These potential foreign bodies can compromise an airway, which is of particular concern for patients with depressed mental status who may have an impaired protective gag reflex. After the patient is stabilized, the complete examination for head and neck trauma should include evaluation of the dentition for missing teeth [24]. If an avulsed tooth is not present in the socket and is not recovered from the accident venue, it is prudent to rule out intrusion, aspiration, or ingestion of the missing tooth [24]. Tung et al. [9] reported a case in which an intruded incisor was nearly dislodged into the patient's respiratory tract, which could have caused life-threatening airway obstruction or a lung abscess. Holan and Ram [48] reported a case in which a 7-year-old girl was shown to have aspirated a primary maxillary incisor that had been avulsed and not recovered from the scene of the accident. Professional evaluation by auscultation may fail to detect an aspirated tooth. Should the patient develop a cough, breathing difficulty, or fever, tooth aspiration should be suspected and confirmed or excluded by means of a chest radiograph [48]. If a tooth has been ingested, it is likely to pass safely

through the gastrointestinal tract [49]. Another possibility is a dislocated tooth to the frontal sinus causing filling of purulent material, as described by Hara et al. [18].

Maintaining the viability of the periodontal ligament that is attached to the avulsed tooth is critical. One of the most important factors determining the prognosis for the tooth is the length of extra-alveolar time [50]. Ideally, the tooth should be replanted immediately (within 5 min) after the injury in an effort to preserve the viability of the periodontal ligament cells and so to optimize healing and minimize root resorption [51]. If immediate replantation is not possible, avulsed teeth should be stored in a physiologic storage medium such as milk, balanced salt solution, tissue culture media, and physiologic saline until the tooth can be replanted [52]. The mature permanent teeth with extraoral dry time of 1 h or less or teeth stored in a biological medium should be treated carefully to avoid further damage to the root surface and remaining periodontal ligament tissues. In cases of teeth with open apex, it is recommended to soak the tooth in doxycycline for 5 min before replantation. It was found that pulp revascularization was importantly enhanced [53].

Treatment for intruded teeth with fully formed apices includes surgical repositioning or forced orthodontic eruption [4]. The poor long-term prognosis of the affected teeth dictated the definitive surgical therapy to be the treatment plan of choice. Prompt and appropriate management can significantly improve prognosis of many dentoalveolar injuries, especially in young patients [5]. Treatment is more important than diagnosis because the long-term consequences of mismanagement can be devastating. Unfortunately, many traumatized teeth are overtreated or left untreated, which leads to a much more complicated treatment later [5]. In rare cases, as in the present patient, injury may be more extensive and more serious than expected.

Unfortunately, even considering all observations for maintaining the viability of the periodontal ligament, replantation of the incisor tooth in the present case was not possible due to the great loss of alveolar bone. Loss of such structure makes tooth replantation impossible. Moreover, even considering that the replantation of an avulsed tooth after prolonged dry storage (18 h) with a successful long-term follow-up (2 years) was already reported in the literature [54], and the avulsed tooth in the present patient had been kept dry for about 12 h, there was no bone to replant the left maxillary canine. Usually, completely intruded teeth cannot be replanted because of associated comminution of the alveolar bone and should be removed to avoid infection [19].

Practitioners who treat patients with compromised neuromuscular or seizure conditions must be aware that these patients are predisposed to maxillofacial injury [4]. In situations where the possibility of trauma is likely, such as

in athletics, dentoalveolar and related fractures can be prevented through the use of mouth guards fabricated by health care professionals. The use of such dental protectors can significantly reduce the deflection of the teeth which are subject to an external force [26].

Preventive measures are geared to reducing the number of accidents and/or minimizing the severity of injuries. Several modes of prevention may serve to reduce the risk and to minimize complications resulting from automobile accidents which are one of the predominant causes of injury in the population. There are the following proposals to reduce traffic accidents: more adequate protection for both driver and passenger (increased seat belt and air bag use in cars); lower speed limits; better highway design; greater use of driver education programs; and more rigid requirements for license renewal, including thorough eye and medical examinations [55]. The incidence, severity, and mortality of craniomaxillofacial injuries in adults and children can be reduced significantly by using seat restraints [56]. The identification of dentoalveolar and facial fractures as part of the pattern of injuries associated with inappropriate restraint has significant educational implications. The air bag is also well established as an effective means of preventing serious head and face injury. The study results of Mouzakes et al. [57] indicated that the combined use of air bags and seat belts resulted in the greatest decrease in the incidence of maxillofacial injuries, followed by air bags alone and seat belts alone.

## Conclusions

A patient presenting with facial trauma may be distracted by other injuries, and a missing tooth may be presumed to have been avulsed during the accident but not recovered from the accident scene [24]. All missing teeth should be accounted for to ensure that they have not dislodged inside the body [9]. Because complete dislocation of a tooth can have life-threatening ramifications [24] and can cause a frontal sinus abscess [18], an airway complication, a respiratory tract obstruction, a complicated lung abscess, or sinusitis [9], anytime a tooth is not accounted for, the possibility that it has been fully intruded should be considered. For diagnosing intruded teeth, the use of radiographs, supplemented by CT, can be helpful [24]. CT scan should be a routine diagnostic study in all cases with associated missing anatomical structures in the oral and maxillofacial region because of the very complex anatomy of the maxillofacial region. The need for radiologic methods of investigation of the oral, perioral, and respiratory areas into which teeth may lodge may be crucial.

Practitioners who treat patients with compromised neuromuscular or seizure conditions must be aware that

these patients are predisposed to maxillofacial injury [4]. In situations where the possibility of trauma is likely, such as in athletics, dentoalveolar and related fractures can be prevented through the use of mouth guards fabricated by health care professionals. The combined use of air bags and seat belts may result in a great decrease in the incidence of dentoalveolar and maxillofacial injuries.

If an incisor is completely intruded into the nasal cavity, examination of the floor of the nostrils may reveal the protruding apex. Removing the incisor from the root through the nostril should be considered to avoid dislodging the tooth into the respiratory tract [9].

The need to involve the dental professional in the initial assessment of dental trauma in emergency rooms in hospitals is important in order to identify how many teeth might be missing after dental trauma and to correctly reposition the avulsed teeth when possible.

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