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Case Report

Submental tracheal intubation: A useful alternative during orthognathic surgery in an acromegalic patient with a history of cranial base surgery

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ABSTRACT

Submental tracheal intubation is an alternative technique for use in patients with airway difficulties in whom oro- or naso-tracheal intubation is contraindicated. Here, a planned submental tracheal intubation was used during orthognathic surgery in an acromegalic patient who had previously undergone trans-sphenoidal surgery (TSS) for removal of a pituitary adenoma, which involves removal of the sellar bone covering the anterior surface of the cavernous sinus. This helped prevent serious complications, such as intracranial penetration during nasotracheal intubation. Submental tracheal intubation can reduce the morbidity associated with repeated attempts at tracheal intubation in acromegalic patients who have undergone cranial base surgery and in whom orthognathic surgery is planned.

1. Introduction

Maxillofacial surgery, especially orthognathic surgery, requires complex and precise intraoral work with intermaxillary fixation for correct occlusion. In terms of securing the airway during such surgery, orotracheal intubation is usually contraindicated, as it could interfere with these maxillofacial surgical procedures. Therefore, nasotracheal intubation is generally considered suitable for many types of orthognathic surgery [1].

However, in trauma victims with extensive maxillofacial injuries, including midface and skull base fractures, nasotracheal intubation might be contraindicated due to the many possible traumatic complications of the procedure, such as epistaxis, bacteremia, and perforation of the pharyngeal mucosa, even though intraoperative intermaxillary fixation for reconstruction of occlusion is required [2–4]. In particular, attempting nasotracheal intubation in patients with fractures of the skull base, sphenoid sinus and cribriform plate may result in intracranial penetration and placement of endotracheal tubes in the brain parenchyma. The situation could be further complicated by unrelated anatomical difficulties, such as hypertrophic obstruction of the nasal passages, in patients requiring orthognathic surgery [5]. When neither orotracheal nor nasotracheal intubation is suitable, tracheostomy is often used as the conventional technique of airway management. However, due to the number of inherent complications of the procedure, such as hemorrhage, recurrent laryngeal nerve damage, subcutaneous emphysema, tracheal stenosis, and the resultant cosmetically undesirable scar [6–8], oral and maxillofacial surgeons are often hesitant to perform elective tracheostomies.

Submental tracheal intubation has been focused on as an alternative technique for resolving most of the problems described above. The technique of introducing an endotracheal tube via the submental route has been widely established for airway management. Except for extensive craniomaxillofacial trauma, this approach has already been used in patients with nasal obstruction requiring reconstruction of fractures and orthognathic surgery [9].

Acromegaly is a disease most often caused by benign somatotrophic pituitary adenomas that lead to elevated secretion of growth hormone (GH) and insulin-like growth factor 1 (IGF-1) [10,11]. A persistent increase in these hormones leads to known acromegaly-associated systemic comorbidities, including heart failure, arthritis, impaired glucose tolerance, and craniofacial abnormalities. Mandibular prognathism is one of the typical craniofacial changes, which may cause malocclusion. Pituitary adenomas are treated surgically via a trans-sphenoidal approach,

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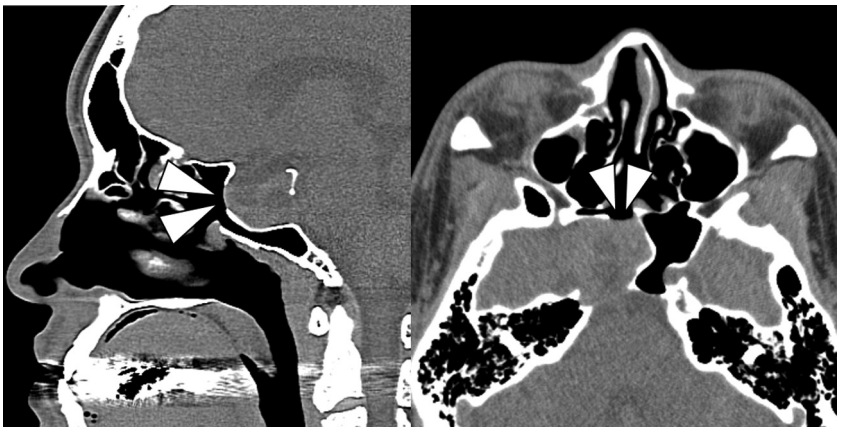

Fig. 1. Radiographic examination of the skull base was performed before orthognathic surgery. Right panel: sagittal CT scan demonstrating the bone defect in the sella turcica (arrowhead). Left panel: axial CT scan demonstrating the same bone defect (arrowhead).

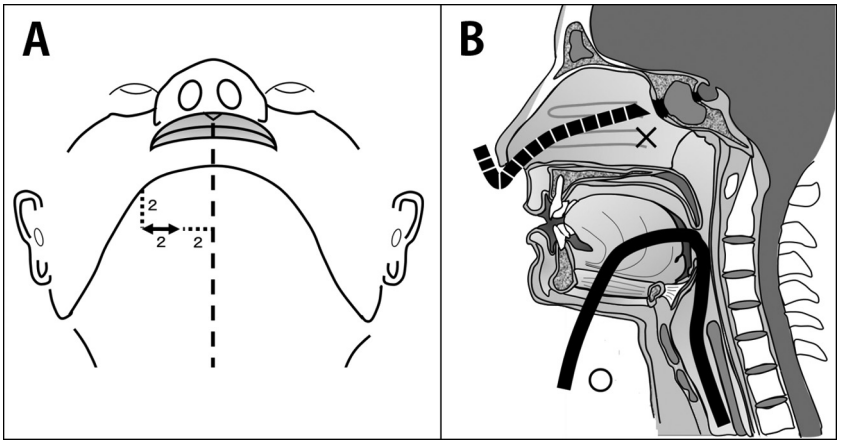

Fig. 2. Schematic diagram of the skin incision and route of endotracheal tube for submental tracheal intubation. (A) The incision follows the '2-2-2 rule'. The incision line lies 2 cm from the midline and 2 cm medial to the mandible in the submental region, and is 2 cm long. (B) When performing nasotracheal intubation, the tip of the endotracheal tube may inadvertently penetrate the intracranial space in patients with anatomical difficulties, such as skull base bone defects (dashed line). Hence, orotracheal intubation as the first step of the submental intubation procedure is preferred in such cases. After initial standard orotracheal intubation, the proximal end of the endotracheal tube is pulled out through the floor of the mouth.

which preserves normal brain tissue but requires removal of the sellar bone covering the anterior surface of the cavernous sinus [12]. These patients often require repeated operations, and hence, repeated endotracheal intubations. The intubation procedure is, however, associated with the risk of unexpected events, such as intracranial penetration via the bone deficit by the endotracheal tube, particularly if nasotracheal intubation is attempted [13].

The purpose of this report is to discuss a clinical case of submental tracheal intubation for airway management during orthognathic surgery in an acromegalic patient undergoing trans-sphenoidal surgery.

2. Case description

A 30-year-old female, weighing 87.4 kg and 176.7 cm tall, was referred to our hospital with the chief complaint of a protruding lower jaw in October 2010. The patient was previously diagnosed with a growth hormone-secreting pituitary adenoma, for which she underwent trans-sphenoidal surgery (TSS) three times within 4 years (between the age of 18–22 years) at our hospital. Extraoral examination revealed mandibular prognathism, bulging of the eyebrow arch, enlargement of the nose and thickened lips. Intraoral examination revealed macroglossia, class III malocclusion with interdental separation of mandibular incisors, and a 2 mm shift of the mandibular midline to the right. Lateral cephalometric photography showed a sella–nasion–A point angle (SNA) of 74.1°, sella–nasion–B point angle (SNB) of 80.1°, and A point–nasion–B point angle (ANB) of −5.9°, significant prominence of the mentum, ballooning of the sella turcica, and expansion of the frontal sinus. Based on the radiological and clinical findings, a diagnosis of midface hypoplasia and severe mandibular prognathism associated with acromegaly was made. Following the case analysis for planning treatment, she was scheduled for presurgical orthodontic treatment and orthognathic surgery (maxillary advancement by Le Fort I osteotomy and mandibular set back by sagittal split ramus osteotomy). These procedures usually involve securing of the airway using the nasal route. However, we anticipated difficulties in using the nasal route for intubation, due to the defective cranial vault resulting from TSS. Computed tomography (CT) confirmed the presence of an approximately 10 mm × 10 mm size bone defect at the bottom of the sella turcica near the anterior surface of the cavernous sinus (Fig. 1), which could lead to occurrence of the serious complication of intracranial penetration during nasotracheal intubation. Hence, nasotracheal intubation was contraindicated in our patient. Orotracheal intubation was naturally avoided due to the fact that intermaxillary fixation is needed for correct occlusion. After discussion with the anesthesiologists,

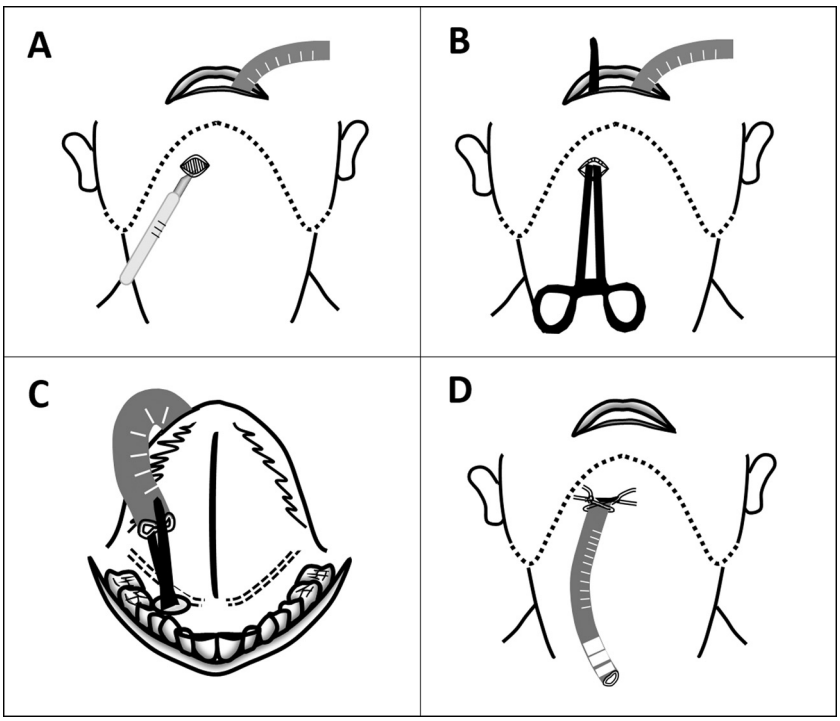

Fig. 3. Submental tracheal intubation technique. (A) The initial incision through skin, subcutaneous tissues and platysma muscle. (B) A hemostat was passed from the submental incision through the soft tissues of the floor of the mouth. (C) The end of the endotracheal tube was grasped by a hemostat and pulled through the tunnel in the submental region. (D) The tube was secured to the submental skin with 2-0 silk sutures to avoid displacement during surgery.

submental tracheal intubation was selected for airway management.

3. Anesthesia procedure and submental technique

The thickness of the neck and macroglossia became a risk of difficult direct laryngoscopy followed by the preoperative airway physical examination using difficult airway management (DAM) [14]. However, the interincisor distance was 40 mm, mallanpati classification was class 1, range of motion of head and neck was good. After preoxygenation, anesthesia was induced prior to intubation by intravenous injection of midazolam 0.1 mg/kg, propofol 2 mg/kg, and rocuronium bromide 0.6 mg/kg. Anesthesia was maintained with 1.5% sevoflurane with volume-controlled ventilation in a circle system, and continuous infusion of remifentanil. Orotracheal intubation was initially performed by standard direct laryngoscopy with a spiral endotracheal tube (7.5 mm).

After the patient was positioned supine on the operating table, a 2 cm long skin incision was made in the submental region, 2 cm from the midline, and 2 cm medial to and parallel with the mandible – following the so called "2-2-2 rule" (Fig. 2A) [5]. After incision of the platysma (Fig. 3A), and investing layer of the deep cervical fascia, curved forceps were used to perform blunt dissection in the lingual surface of the mandible, behind the caruncles of the salivary duct, penetrating the floor of the mouth for creation of a tunnel (Fig. 3B), through which the proximal end of the endotracheal tube was withdrawn from the oral cavity. For this, the universal connector was removed and the pilot tube cuff was grasped by the forceps and pulled through the passage in the floor of mouth. The tip of the forceps was then quickly re-inserted through the submental incision to grasp the end of the endotracheal tube (Fig. 3C, Fig. 4A). The submental tracheal tube was secured to the skin with 2-0 silk sutures (Fig. 3D, Fig. 4B). Thereafter, surgery was performed as planned.

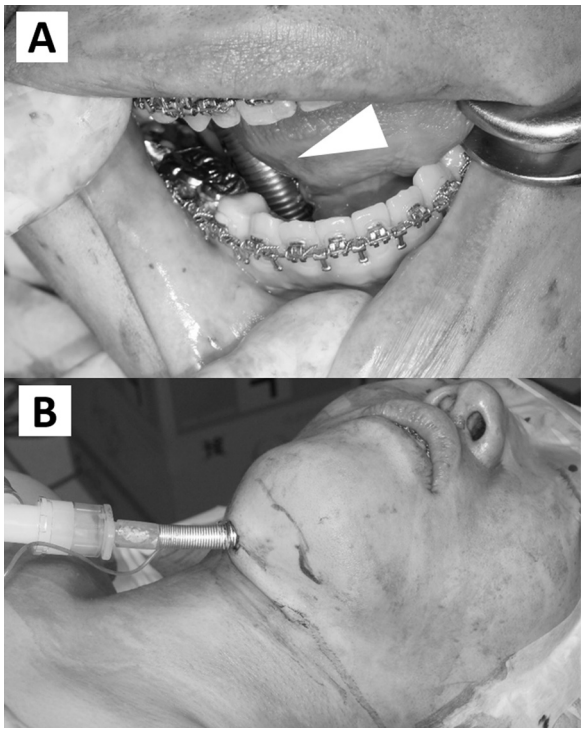

Fig. 4. Intra- and extra-oral appearance of submental tracheal intubation. (A) The endotracheal tube was seen in the oral cavity (white arrowhead). (B) The endotracheal tube externally positioned through a tunnel in the submental region.

4. Results

Potentially fatal complications, such as intracranial penetration by the tip of the endotracheal tube during manipulation for traditional orotracheal intubation, did not occur. Other complications,

Table 1
Reported cases of intracranial placement of nasotracheal tubes.

Author	Age (yr)	Gender	Purpose	Past history	Etiology of bone defect	Region	Outcome
Marlow T [2]	29	M	Emergency	None	Skull base fracture	Cribriform plate	Died
Horellou MF [3]	44	M	Emergency	None	Skull base fracture	Upper part of the nasal fossa	Died
Paul M [13]	68	M	Postoperative management	Large pituitary adenoma	Trans-sphenoidal surgery	Sella turcica	Died
Allen F [22]	32	F	Oral surgery	Goldenhar syndrome	Congenital	Cribriform plate	Died

such as laceration or perforation of the pharyngeal mucosa, were also not observed. Moreover, the intubation did not interfere with the planed orthognathic operation and interdental occlusion could be easily checked. At the end of the surgery, the tube was disconnected and pulled back into the oral cavity. Once the submental skin wound was sutured to prevent wound infection, orotracheal extubation was uneventfully performed. The intraoral wound was left to heal secondarily.

5. Discussion

Submental tracheal intubation was first described by Altemir in 1986 [15], and has now become widely established for airway management in patients with craniofacial trauma with the possibility of basal skull fractures [16]. Many reports have described the application of this technique for other purposes, including for elective osteotomies, and all of them have agreed on the ease, safety and speed of this method [5,17,18,19]. To increase the simplicity and ease of performing this procedure, the '2-2-2' rule was devised to guide the surgical procedure in the submental triangle (Fig. 2A). Insertion of an endotracheal tube via the nasal passage in our acromegalic patient with skull base defects was deemed dangerous due to the potential for intracranial penetration by the tube (Fig. 1). Hence, after standard orotracheal intubation, tracheal intubation via the submental route was performed, since the planned surgical procedure involved intermaxillary fixation (Fig. 2 B). Although submental tracheal intubation is a fast and safe method associated with low morbidity, the potential complications of this method including bleeding, infection, orocutaneous fistula, sublingual mucocele, hypertrophic scarring, and disconnection of the tube from the circuit [20]. Scarring is one of cosmetic complications in submental tracheal intubation, however, it appears aesthetically obscure owing to its thin and linear line which can be integrated into the surrounding skin color [1]. In addition, a scar after this method is hardly seen from the front and considered acceptable because it is located at the lower part of the mandible while the one after tracheostomy is conspicuous.

In our case, although we were concerned that macroglossia, one of the main symptoms of acromegaly, could potentially interfere with orotracheal intubation and/or access to the soft tissues of the floor of the mouth by a hemostat [21], the patient did not experience any anesthesia or surgery-related adverse events.

Previous cases of the serious complication of inadvertent intracranial penetration by the endotracheal tube during nasotracheal intubation in patients with fractures and/or bone defects in the skull base are summarized in Table 1. In two cases, this inadvertent accident occurred during emergency airway management in patients with multiple traumas and skull base fractures [2,3]. Another case [13] involved attempted intubation in a reoperation patient who presented with pituitary adenoma 2 weeks after undergoing TSS; in that patient, the intracranial penetration occurred through the defect in the sellar bone. The other reported incident [22] involved a patient with Goldenhar syndrome, with a congenital bone defect in the cribriform plate. The outcome was death in all four cases, the reported causes being cerebral hemorrhage due to internal carotid artery injury and respiratory failure due to meningitis. In our case, anatomical difficulties due to the skull base bone defect secondary to TSS made nasotracheal intubation highly risky. Hence, we decided to secure the airway in our patient presenting for planned osteotomy using submental intubation, with her prior consent. Consequently, no postoperative complications associated with the submental technique occurred.

In conclusion, we described here successful use of submental tracheal intubation in an acromegalic patient with a history of cranial base surgery, who was scheduled for orthognathic surgery. This method should not only be limited to trauma patients, but should also be used in patients in whom nasotracheal intubation and direct tracheostomy need to be avoided.

Conflicts of interest

none

Ethics statement/confirmation of patient's permission

Ethics committee approval was not required for this case. We obtained the patient's permission to publish this case report.

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