

**Title:** Accidental Ingestion of an Implant Screwdriver: A Case Report and Literature Review

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## **Abstract**

Head and neck oncology patients are high risk for ingestion or aspiration of dental instruments during treatment, due to altered anatomy and sensation. This article describes a case report of accidental ingestion of an implant screwdriver during the prosthetic phase of oral rehabilitation of a 79 year old oncology patient. The management protocol is described which included referral to the medical Accident and Emergency department, where the object was safely removed from the stomach via endoscopy. A review of similar cases of ingestion/inhalation in the literature suggests implant screwdrivers should be retrieved as safe passage through the gastrointestinal system is not assured. Awareness of the medical history and risk factors should alert clinicians to be extra cautious, and preventative strategies should be implemented at all times. Preventative measures include ligation of instruments with floss/suture material, treatment in a more vertical position, and use of rubber dam where possible.

## **Introduction**

Accidental aspiration and ingestion of dental foreign objects is an infrequent occurrence. It may however lead to significant complications and must therefore be managed appropriately.

The incidence of ingestion is more prevalent than aspiration. Ireland (2005) reported on UK incidence with data from the Medical Defence Union and found 141 reported dentistry-related incidents over a 10 year period (137 ingestion, 4 aspiration)<sup>1</sup>. Susini *et al.* (2007) found a higher range in a French population with 29-56 ingestion cases and 1-7 aspiration cases per year<sup>2</sup>.

Prosthesis ingestion was the most common and represented 29% of all cases, followed by dental burs 27%, and endodontic items 18%. The prevalence of various ingested restorations combined (crowns, amalgam fragments, inlays) was 19%. 100% of the aspiration cases required hospitalisation, with only 36% of ingestion cases requiring hospitalisation. This may be due to the size and bluntness

of the ingested object deemed safe to pass through the gastrointestinal (GI) tract, however may also result from practitioners' lack of awareness of the risks associated with ingested foreign bodies.

Airway obstruction and aspiration are life threatening and patients may exhibit symptoms such as dyspnoea, coughing, gagging, choking, wheezing, stridor, cyanosis or loss of consciousness.

Depending on the signs, immediate management may involve encouraging the patient to cough, performing back blows, the Heimlich Manoeuvre, or cardiopulmonary resuscitation with urgent transfer to an Accident and Emergency (A&E) department. Signs and symptoms of ingested objects will depend on the position of lodgement. At the oesophageal level the patient may experience discomfort, saliva pooling/drooling, inability to swallow, and airway compromise if the object is large or the patient is unable to manage their saliva secretions. Sharp pointed objects lodged at this level are a medical emergency<sup>3</sup>. At the sub-oesophageal level symptoms may include abdominal pain or distension, vomiting, fever, haematemesis (vomiting blood), or passing rectal blood.

Imaging is crucial to identifying the location of aspirated and ingested foreign objects and in tracking safe passage through the GI tract. Plain radiographs such as panoramic, occlusal, cervical spine, chest and abdominal may be valuable. Metal detectors may assist with location of metallic objects, particularly in children. Computed tomography may allow identification of radiolucent objects such as acrylic resin prostheses or fragments. If imaging is negative for a radiolucent object, diagnostic bronchoscopy or oesophagogastroduodenoscopy (endoscopy) are indicated.

Aspirated foreign bodies are a medical emergency and they must be retrieved. This can be carried out by flexible bronchoscopy (flexible tube). If this is unsuccessful rigid bronchoscopy can be used however would require a general anaesthesia. Cricothyroidotomy is indicated if the physician is unable to intubate or ventilate the patient; it involves making an incision through the skin and cricothyroid ligament to establish an airway. Early complications of aspiration include acute

dyspnoea, asphyxia, cardiac arrest, laryngeal oedema, and pneumothorax. Chronic complications include oesophageal erosion and pneumonia.

Ingested objects may cause perforation, either directly if they are sharp, or as a result of prolonged lodgement. Management of ingested foreign body will depend on the risk of perforation and may include monitoring with periodic imaging, or retrieval via endoscopy or laparotomy (a surgical incision into the abdominal wall). The safe passage of ingested foreign bodies is dependent on the shape (regular/irregular/sharpness), diameter, length, and initial anatomic location. Most objects pass in four to six days, however may take up to four weeks. The transit time increases with longer irregularly shaped foreign bodies. This can be expected to be longer than three days with an object length of 2.25cm or more<sup>4</sup>. The safe passage rate is 63-80% for objects less than 3cm in length<sup>5</sup>. Initial location of the object below the oesophagus increases the rate of safe passage (>70% compared to 12% for the oesophagus)<sup>5,6</sup>. If an ingested object is monitored, patients should inspect their stools for passing the object. If the object is sharp, daily radiographs are taken, and failure to progress after three days requires an urgent laparotomy<sup>3</sup>. Blunt objects are reviewed radiographically on a weekly basis, and failure to pass through the GI tract necessitates endoscopy/laparotomy<sup>3</sup>. Early complications may include mucosal abrasions, bleeding, gastric outlet obstruction, and perforation. Mediastinitis, peritonitis, abscess or fistula formation are secondary complications.

### **Case presentation**

A 79 year old edentulous male oncology patient received multiple dental implants in the maxilla to allow an implant-retained prosthesis. The medical history includes pT1N1M0 squamous cell carcinoma of the left floor of mouth. Treatment included extraction of remaining teeth, resection with radial forearm free flap reconstruction and selective left neck dissection in November 2014 (with tracheostomy tube removed after the immediate post-operative period). He suffered cardiac

arrest over 10 years ago and was on many medications including Clopidogrel. The patient was on a semi-solid diet due to difficulty swallowing, with a long-standing history of severe gag reflex.

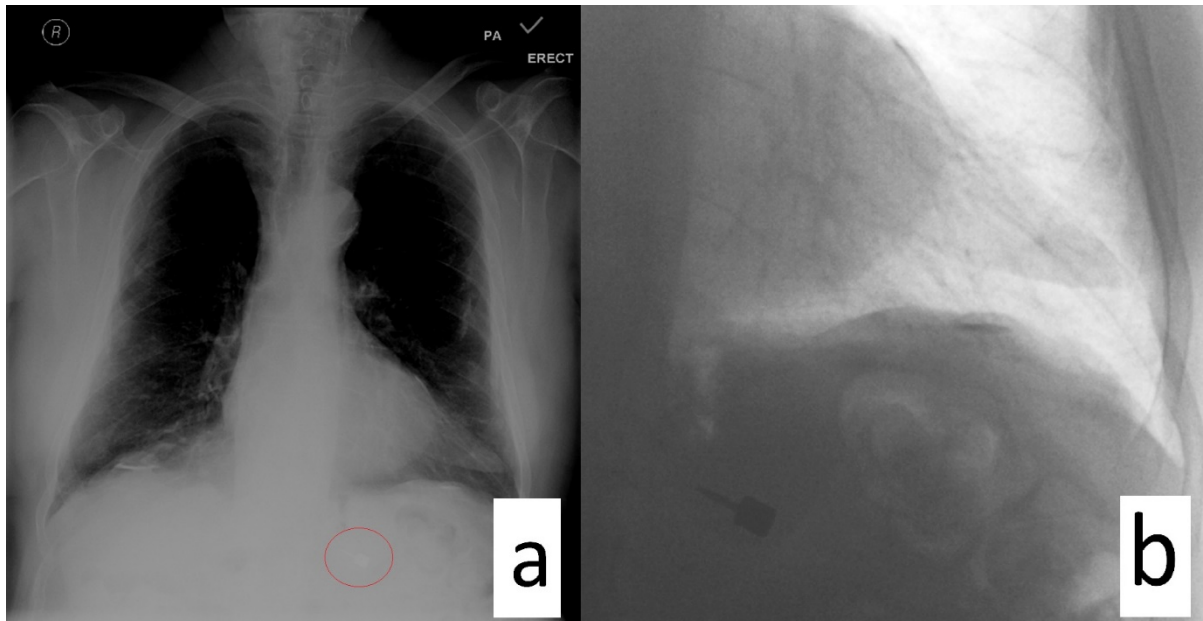
The patient attended the Restorative Dentistry Department at Liverpool University Dental Hospital for the prosthodontic phase of treatment, two years following oncology treatment. An implant fixture level impression by a specialty registrar in Restorative Dentistry was being undertaken.

During placement of the impression coping in a supine position, the patient was asked to open their mouth wider and a rapid movement by the patient dislodged the sterile gauze placed to protect the trachea/oesophagus and the operator simultaneously lost control of a Hex Short (2cm) Screwdriver (ASTRA TECH Implant System™) and it was dropped in the patient's mouth. The immediate management involved asking the patient not to swallow, the dental chair was up-righted and the patient advised to gargle with water. Despite several attempts, the patient was unsuccessful in removing the driver from the oral cavity. The patient had a sensitive gag reflex which precluded examining the posterior oral cavity. Soon after, the patient no longer felt the screwdriver at the back of the throat. There were no signs or symptoms of airway obstruction or perforation. The patient was immediately informed of what had occurred and the provisional diagnosis of swallowed or inhaled dental tool. The patient and his relative were advised that it was likely the tool was swallowed, and if allowed to pass through the gastrointestinal tract there is a risk it may cause perforation, therefore a referral to Accident and Emergency (A&E) department for assessment was required. A&E staff were contacted to alert them of patient transfer.

The specialty registrar accompanied the patient and his relative to the department. A chest radiograph was requested which showed the screw driver was in the stomach (Figure 1). A Gastroenterologist examined the patient as well as the replica screw driver provided, thus enabling assessment of the sharpness, size and potential damage it may cause. The recommendation was for endoscopic retrieval, and the patient requested the procedure to be carried out under intravenous

sedation. Consent for endoscopy was obtained with the risks outlined in Table 1, as well as consent for photography during endoscopy.

**Figure 1:** Chest radiograph (Posterior-anterior) with screwdriver location encircled (a), and improved visualisation with the reverse contrast mode (b)



**Table 1:** Risks of endoscopy under intravenous sedation as outlined on consent form

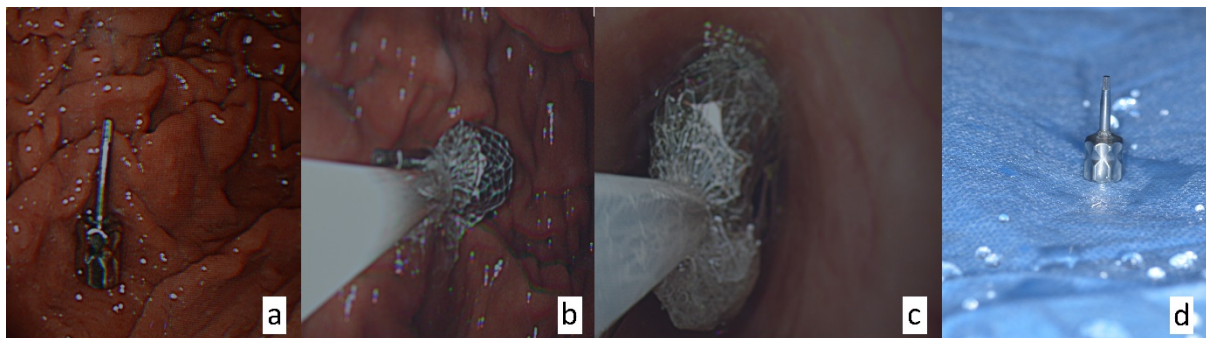
Perforation, bleeding
Failure of procedure and need for further treatment under general anaesthesia
Damage to teeth/dental restorations
Adverse reaction to sedation/ throat spray
Aspiration pneumonia

The screw driver was retrieved via endoscopy using a retrieval net (Roth Retrieval Net®) (Figure 2). The net is opened above the object and then pressed firmly down to make a pocket in the netting, which is then closed to capture the object securely. During removal the sharp end of the screwdriver

was pointed downwards, successfully preventing damage to the oesophageal mucosal lining. The patient was discharged that day. An incident report was completed.

Follow-up included the consultant in Restorative Dentistry contacting the patient via letters, the first following the incident and the second once the investigation was complete, with apologies and offers to meet to discuss the incident and report. The patient indicated he was happy with the management of the incident and wished only for a copy of the report. The patient reported the post-operative complication was limited to minor throat discomfort on the day of the incident which subsided.

**Figure 2:** a) 2cm Hex implant screwdriver (ASTRA TECH Implant System™; DENTSPLY Implants, Molndal, Sweden) in stomach lining, b) Roth Retrieval Net (U.S. Endoscopy Group, Mentor, Ohio) tightened around screwdriver, c) screwdriver in oesophagus during removal, d) retrieved screwdriver



### Discussion

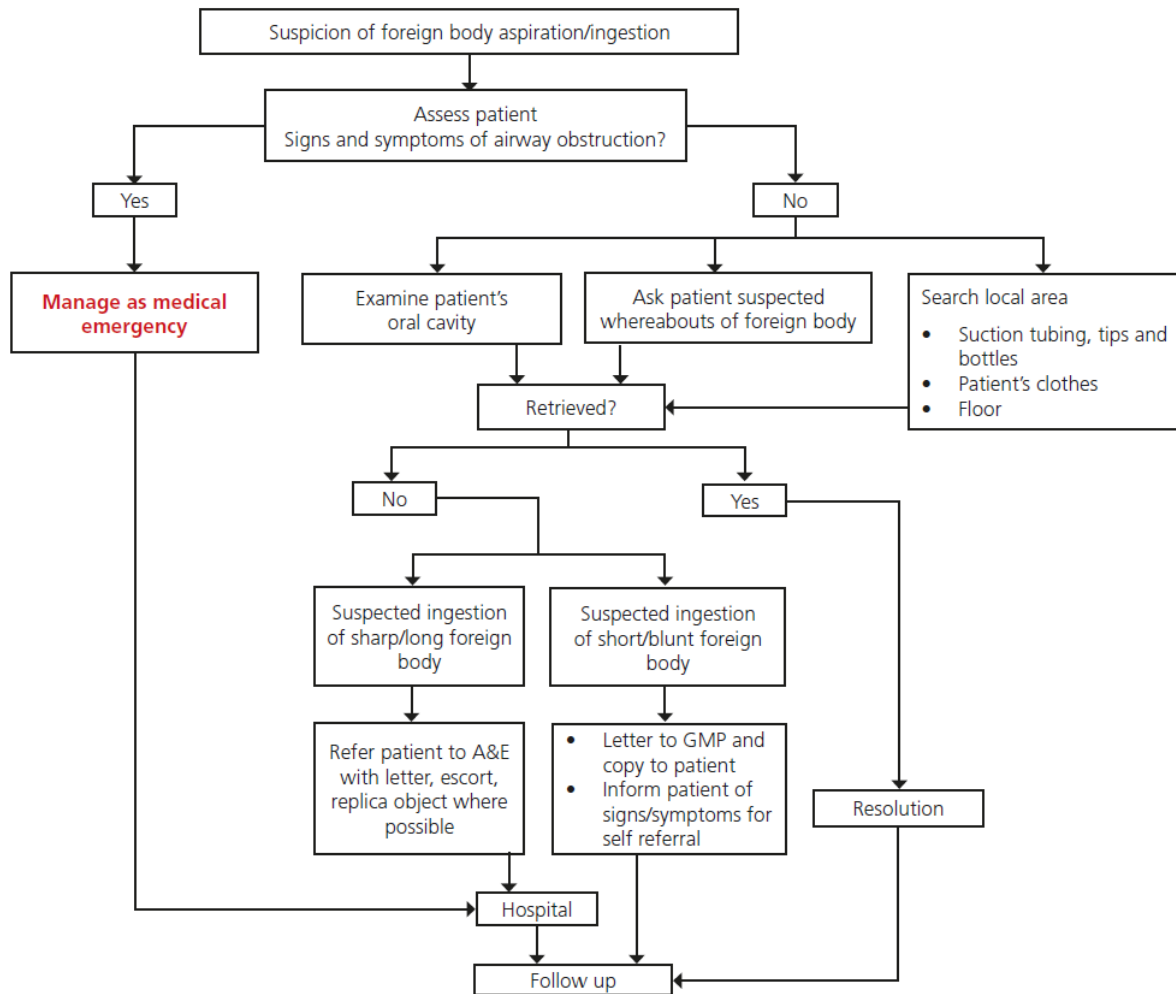
It is very difficult to differentiate between aspiration and ingestion as frequently there is an absence of symptoms or signs. However, unless a patient is fully conscious and is quite certain that an object has not been inhaled, it is advisable to arrange referral to A&E for a chest radiograph to exclude inhalation. In those cases where the patient and dentist are fairly confident that the object has been swallowed, referral to A&E is only necessary if the object is large enough or sharp enough to cause GI injury. If a decision is made to allow the foreign body to pass, it would be prudent to write a letter

to the general medical practitioner with the details of the incident, the size and shape of the object (with a photocopy of a replica adjacent to a ruler, or a photograph of a similar object) and request for follow-up. A copy of this letter should be given to the patient, this will be useful to A&E staff should the patient develop symptoms and self-refer. If the object is large or sharp, then referral to A&E with a written letter and an escort should be arranged.

Contemporaneous documentation of the incident, and follow-up (with compensation where required) are of vital importance to minimise adverse litigation outcomes. Common reasons for litigation include failure to refer to a specialist, failure to diagnose correctly, failure to accurately document findings and treatment, and failure to inform the patient of iatrogenic events<sup>7</sup>. If any of these measures are overlooked, negligence claims may result. Mismanagement of a preventable incident will exacerbate it. Dentists must therefore be aware of a protocol for prevention as well as management of aspiration and ingestion cases. A flow chart for management of inhalation/ingestion episodes is presented in Figure 3.

**Figure 3:** Algorithm for management of inhalation/ingestion of foreign object





Though 80% of ingested foreign objects will pass safely through the GI tract<sup>3</sup>, the decision of how to manage the patient must be made by a medical practitioner. Clinicians should not delay in referring the patient to A&E for assessment, as with time lapse the foreign object may progress further through the GI tract and retrieval may become more difficult and require more invasive procedures. The American Society for Gastrointestinal Endoscopy guideline for management of ingested foreign bodies may be used to plan treatment and follow-up<sup>3</sup>. The guideline recommends all objects in the stomach with a diameter greater than 2.5cm and sharp-pointed objects longer than 6cm in or above the duodenum should be retrieved. A sharp-pointed object carries a risk of perforation as high as 35% for passing through the GI tract; therefore, it should be retrieved endoscopically if this can be done safely<sup>3</sup>. Sending a replica of the object where possible is useful as the medical specialist may

assess which retrieval approach and device to use and may even practice to grasp the replica with the available devices to help determine this. Endoscopic retrieval of foreign bodies is 94-98.8% successful<sup>8,9</sup>.

Ingestion retrieval techniques carry risks, and even the safest method endoscopy may result in significant complications such as deep lacerations with minor bleeding (16%), ulcer (5.7%), perforation (1.5%), and abscess (0.5%)<sup>10</sup>. The risk of perforation is higher in the upper oesophagus<sup>11</sup>. Risk factors for endoscopic complications and failures were sharpness of object (hazard ratio 2.48) and greater than 12 hour duration of impaction (hazard ratio 2.42)<sup>10</sup>. Prior GI tract surgery or congenital gut malformations increase the risk for obstruction or perforation<sup>3</sup>. The use of an overtube or protector hood reduces the risk of mucosal injury on retrieval.

A review of the literature found five cases of aspiration and nine cases of ingestion of implant screwdrivers. Four of the aspiration cases were retrieved with bronchoscopy<sup>12,13,14</sup> and the fifth laryngoscopy<sup>12</sup>. One of the aspiration cases had complications of pneumothorax, late laryngeal obstruction requiring tracheostomy and pleural effusion requiring drainage with a two week hospitalisation period<sup>15</sup>. This demonstrates how a preventable incident can have significant morbidity with a chain reaction of adverse events. Three of the nine ingestion cases passed safely through the GI tract, two of which passed within five days<sup>16,17</sup>, the third case time-frame is unknown<sup>18</sup>. These three patients were referred to hospital for assessment, endoscopic retrieval under local analgesia failed in one case<sup>16</sup>, and repeat radiographic imaging confirmed safe passage in all three patients. Five of the nine cases required retrieval when the screwdriver failed to progress. One case was managed with successful endoscopic retrieval<sup>19</sup>. Three of the cases were managed with colonoscopic retrieval<sup>17,20,21</sup>, one case required laparotomy and colostomy (sectioning of the damaged segment of colon and diverting the end to an opening in the abdominal wall)<sup>22</sup>. The management is unknown in one case<sup>23</sup>. As only 33% passed safely through the GI tract, the authors

are satisfied that this incident was managed appropriately and recommend that implant screwdrivers are endoscopically retrieved as the treatment of choice.

High risk factors for aspiration and ingestion of foreign bodies are outlined in Table 2. This patient was at high risk due to head and neck oncology reconstructive surgery resulting in limited mouth opening, partial loss of sensation, and a long-standing history of problematic gag reflex resulting in inability to examine the posterior mouth and potentially retrieve the screwdriver. Preventative strategies should be implemented at all times, with particular caution for high risk patients.

Protection of the oropharynx with rubber dam where possible is advised, especially for cementation of indirect restorations and endodontic procedures. There are however numerous interventions when rubber dam cannot be used, such as in edentulous patients, impression taking or orthodontic procedures. In these cases, throat packs and gauze may be used however the latter is unpredictable. The most effective method of prevention in these scenarios is ligation of tools/instruments with lengthy floss or silk suture material<sup>24</sup>. Implant screwdrivers allow for ligation and this strategy would have prevented this incident. Prevention should also include patient positioning in a more upright position with the patient's head turned to the side. It is prudent to give instructions to patients with regards to changing head position or increasing mouth opening only after all tools/instruments have been removed from the oral cavity, to avoid sudden movements resulting in loss of control by the clinician. A firm grip of all objects is advised, as well as high volume aspiration by the assistant.

Table 2: High risk factors<sup>8</sup>

<b>Population group</b>	<b>Circumstances</b>
Children, particularly under the age of 6 <sup>3</sup>	Loss of consciousness
Elderly	General anaesthesia

Pregnant or overweight	Conscious sedation
Incarcerated individuals seeking release to a medical facility	Local analgesia
Sedated/inebriated	Supine positioning
Learning disabilities	Unexpected/excessive patient movement
Psychiatric disorders	Inadequate lighting
Brain diseases that cause impaired swallowing, e.g. Cerebral palsy, brain tumours or stroke, Parkinson's disease	Lack of /inefficient use of high volume suction during dental procedures
Altered mechanics and functional impairment, e.g. anatomic abnormalities, oesophageal disease	
Denture wearers	

## Conclusions

Awareness of the medical history and risk factors should alert clinicians to be extra cautious, and preventative strategies should be implemented at all times. Oncology patients are high risk for ingestion or aspiration of dental instruments due to altered anatomy, sensation and potential limited mouth opening. Preventative measures include ligation of instruments with floss/suture material, treatment in a more vertical position, and use of rubber dam where possible. In the event of an ingested implant screwdriver, endoscopic retrieval is recommended.

## Declarations

The authors declare no conflict of interest.

### Manufacturers' Details

- Hex Short (2cm) Screwdriver, ASTRA TECH Implant System™; DENTSPLY Implants, Molndal, Sweden
- Roth Retrieval Net, U.S. Endoscopy Group, Mentor, Ohio

### Consent for publication

The authors have written informed consent obtained from the patient for publication of this case report and accompanying images.

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None.

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