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Incident Management Guidelines for an Ingested Orthodontic Object

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Abstract: *Dental materials or components of orthodontics devices can fall into a patient's oropharynx, and be swallowed or inhaled. In this paper a short review of accidental foreign body ingestion/aspiration prevention, evaluation, and relevant incident management guidelines are presented. In addition, a case of an accidentally swallowed piece of archwire during a chair side procedure is reported.*

Keywords*: foreign body, ingestion/aspiration, incident management guidelines, and orthodontic objects*

Introduction

Accidental swallowing of an orthodontic appliance or fragments of the appliance, during a chair-side procedure or later, can cause problems in a patient's respiratory or gastrointestinal systems. A variety of incidents are reported in orthodontic literature; such as swallowing a trans palatal arch,[1] a fragment of a twin-block appliance,[2] maxillary expansion appliance key,[3,4] a spring retainer[5] and a piece of an arch-wire.[2,3,6,7] The objective of this paper is to present a short review about accidental foreign body ingestion/aspiration, preventive approaches, evaluation methods and relevant incident management guidelines. A case of an accidentally swallowed piece of orthodontic arch-wire during a chair side procedure is also reported.

Prevention

The use of preventive methods are very foundational in a non-maleficence work ethic. It is clear that prevention is the best approach, via the mandatory use of precautions during all dental and orthodontic procedures. These procedures include using a rubber dam, ligatures, throat pack, etc. when possible.[6,8] In prevention of accidental ingestion of orthodontic objects, the following precautions are suggested by Dibiase and colleagues:[9] adequate retention of the appliances and regular supervision, avoid using sharp edges, hook the pointed wire component as much as possible, use a barrier when adjusting small components on orthodontics appliances such as a gauze napkin, and attach floss to loose components while placing them intraorally.

Evaluation

If a displaced object in the oropharynx cannot be found in the supratonsillar recess, followed by the epiglottic vallecula and the piriform recess, it should be assumed that it has either been swallowed or aspirated and further evaluations are required.[10] Practitioners need to be familiar with the signs and symptoms related to accidentally ingested or inhaled foreign bodies. Signs or symptoms could be different depending on the location of the object. For instance, it could be lodged at the oropharyngeal level, oesophageal level, or sub-oesophageal level. If the object moves beyond these locations in the gastrointestinal tract, bleeding, obstruction, impaction, or perforation, while rare, have been known to occur.[10,11]

Overall, about 60% of foreign bodies become trapped at the oropharyngeal level, commonly at, or just below, the level of the cricopharyngeus muscle. In this situation, patients usually have a clear sensation of something being trapped that is relatively well localized, with the patient's discomfort ranging from mild to quite severe, saliva drools and an inability to swallow may be present; Airway compromise, infection, or perforation may occur if large objects are trapped at this level.

If a foreign body is stuck at oesophageal level there is usually an acute presentation in adults; a vague sensation of something being stuck in the center of the chest or epigastric region. In addition, there may be dysphagia and if there is a complete oesophageal obstruction salivary pooling/drooling might occur. Gagging, vomiting, retching, neck, and/or throat pain are some of the common presentations in children with foreign bodies in oesophageal. The presentation in children with partial oesophageal obstruction may be a chronic course featuring inability to feed, failure to thrive, fever, recurrent aspiration pneumonitis/pneumonia, or respiratory embarrassment/stridor due to tracheal impingement.[11]

Foreign bodies at sub-oesophageal level may present with a range of symptoms depending on the degree of advancement of the object through the gastrointestinal system. The object at this level might cause vague symptoms such as fever, recurrent vomiting, passing rectal blood, abdominal distension, and discomfort. Furthermore, other symptoms of acute or sub-acute intestinal obstruction may be present. If an object perforates the oesophagus it can cause acute mediastinitis with chest pain, dyspnoea and severe pain associated with swallowing (dysphagia). Signs of pneumonitis/pleural effusion might also be present.[12] In addition, acute/sub-acute peritonitis is a sign of perforation below the level of the oesophagus.[11] Perforations, most commonly occur at the ileocecal junction and the sigmoid colon and the symptoms vary among abdominal pain, fever, nausea, vomiting, and abdominal distension, making diagnosis difficult. However, usually in 2 to 12 days a foreign body traverses the intestinal tract (Tables 1 and 2).[1-4,6,7,10-17] Over all, the esophageal obstruction symptoms could be inability

to swallow, muscle incoordination, pain on swallowing, hematemesis or vomiting needs to be followed very seriously. Tracheobronchial obstruction with symptoms, such as dyspnea, coughing, gagging, choking, or wheezing could also be life threatening.[5]

If the incident occurs during the chair-side service, the patient should be kept in a supine position, his/her head should be turned to one side or turned face down to encourage the object to fall into the cheek or fall out of the mouth and not into the oropharynx. The patient should be asked to cough, and then the mouth and oropharynx should be carefully examined. If the object is visible, it should be removed immediately with either forceps or high-speed suction.[10] If the object is not visible, further evaluations are required with radiographic imaging (x-ray),[3,6,7,15,18] computed tomography (CT),[13,19,20] and/or magnetic resonance imaging (MRI).[21,22] Chest and abdominal x-rays are mainly used for tracking the location of an ingested foreign body.[7,15] CT and 3D-CT is an essential tool for the diagnosis of foreign bodies and provides remarkably clear images.[13,20]

Management

Management of ingested or aspirated foreign bodies depends on the severity of the symptoms. The patient age, clinical condition, the size, shape, content, anatomic location of the ingested object(s), and the time since ingestion are some of the critical determinant factors for the need and timing of an intervention for foreign body ingestion.[23] For example, the mucosal appearance of the pink acrylic often used in orthodontics can complicate its visualization and removal with radiographs and endoscopes.[10] An incident management guideline is suggested in Tables 1 and 2.

If the foreign body is obstructive and the patient is in respiratory distress, dislodgement of the foreign body should be initially attempted with cardio-pulmonary resuscitation (CPR) techniques such as back blows and Heimlich maneuver for aspiration by a medical practitioner with the appropriate training.[10,17] Once an airway has been established, the patient should be transferred for further emergency medical attention at a hospital or medical center (Table 1). The patient should still be referred for immediate medical attention even if the object has passed the vocal cords and there is no obstruction of the airway. All foreign objects in the respiratory tract need to be removed as soon as possible because the localization and removal of the object will be more difficult if edema, excessive secretions, and formation of granulation tissue occur (Table 2). Even though spontaneous expectoration of inhaled foreign bodies occurs in 1-2% of cases, it is not recommended to wait for this to happen. When standing upright, postural drainage is no longer present and the foreign body may dislodge from its original location and obstruct the airway.[10] Bronchoscopes are usually used for retrieval of objects in respiratory system.[24]

In a foreign body ingestion/aspiration incident, the patient should always be referred for medical imaging and specialty evaluations. In addition, early removal of objects with sharp edges is essential in order to prevent perforation in respiratory or gastrointestinal walls.[25] On occasion, a large amount of cellulose, laxatives, and foods such as bananas in a patient's diet can theoretically aid the passage of the object through the gut.[10]

Overall, ingested foreign bodies could be managed by observation, endoscopy, or surgery. Different equipment could be used for ingested foreign body retrieval, such as endoscope (rigid or flexible esophagoscopes) and retrieval devices.[23,26] In children, it has been reported that ingested objects are manageable with a success rate of 75% by endoscopy and/or observation.[23] Surgical intervention should always be reserved as a last resort. However, for objects larger than 6 cm in children and longer than 10 cm in adults, it appears that surgical intervention is necessary. For objects smaller than 6.5 cm, in adults, endoscopy and/or observation will result in a success rate of approximately 50%.[27] However, blunt or rounded objects with a diameter larger than approximately 2.5 cm will fail to pass the pylorus and will need to be retrieved by gastroscopy techniques.[14]

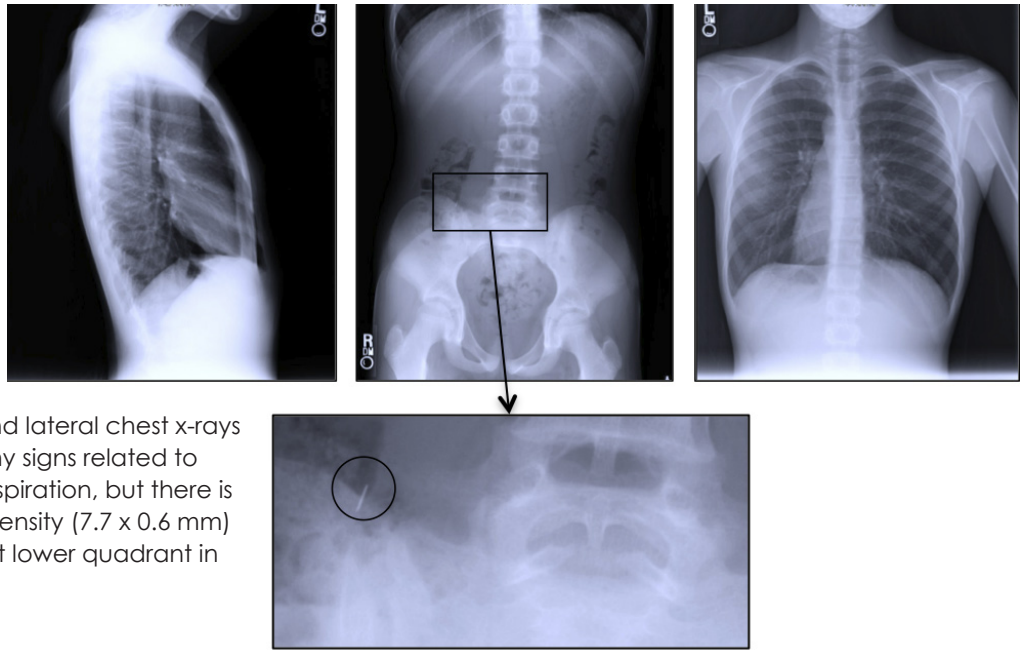

Figure 1 - PA and lateral chest x-rays do not show any signs related to foreign body aspiration, but there is a linear radio density (7.7 x 0.6 mm) seen in the right lower quadrant in the KUB image.

Table 1. Respiratory or gastrointestinal obstruction evaluation and management guideline

Incident	Swallowed object at orthodontic or dental office caused obstruction	
Evaluation	Pulmonary obstruction: Airway compromised and patient cannot breathe	Esophageal obstruction: Patient cannot swallow and salivary pooling/drooling might occur
Management	Emergency care (such as Heimlich maneuver for aspiration): Keep up-to-date with CPR as the recommendations do change	
	Contact medical emergency services (911 in the US) Escort patient to hospital and set up proper referrals	
	Complete proper documentation and follow up with patient and medical center	

Table 2. Aspirated or ingested object evaluation and management guideline

Incident	Swallowed object at orthodontic or dental office is suddenly disappeared					
Evaluation	Clinical observation					
	Monitor, maintain airway and keep patient in reclined position					
	Retrieval attempt by dentist and patient					
	If not retrieved: Escort patient to hospital and set up proper referrals					
	Radiography			Computed Tomography		
	Identify exact location: Respiratory tract or Gastrointestinal tract					
	Oral cavity	Oro-pharyngeal soft tissues	Pharyngeal spaces	Respiratory tract	Esophagus	Stomach & abdominal cavity (gastric-duodenal)
Management	Dentist	Dentist/ OMFS/ENT	OMFS/ENT/ Otorhinolaryngology consultation	Pulmonary specialist/ Otorhinolaryngology consultation	ENT/Gastrointestinal specialist	Internist/ Gastrointestinal specialist
	Confirm that the object is intact and reassure patient	Immediate retrieval with surgical or nonsurgical approaches, such as rigid bronchoscopes			Monitor for 2 to 12 days, examine stools and follow up with possible signs and symptoms	
					If not discharged after monitoring period and/or still present in follow up imaging, refer for retrieval with endoscopic or surgical approaches	
	Complete proper documentation and set up routine medical and dental follow ups, unless some particular signs or symptoms are present					

Proper documentation is necessary in the case of an ingestion/aspiration incident. The documentation should include how the incident occurred, size and shape of the object, location, witnesses, time date, preventive measures, patient condition, any other significant discussion, referral paper works and follow up plans.[8,28]

Case Report

A 9-year 11-month old girl sought treatment concerned about a cross-bite and space between her maxillary and mandibular teeth. Upon clinical examination it was determined that she had no major issues in her medical history. She did have a history of thumb sucking, but, only at nighttime. Her molar relationship was Class II end-on on the right side and Class I on the left. She had unilateral posterior cross bite with 5 mm anterior open bite, 2 mm overjet, retroclined mandibular incisors, proclined maxillary incisors, centric occlusion-centric relation (CO-CR) discrepancy with a functional shift to the right. Her mandibular dental midline was also 3 mm deviated to the right. Patient's treatment was planned for approximately 12-18 months of phase I orthodontic treatment with rapid palatal expansion with tongue/thumb habit appliance and upper/lower 2x4 if needed followed phase II orthodontic treatment.

During one of her adjustment appointments for replacing upper and lower arch wires with .016 x .022-in nickel-titanium (NiTi) she accidentally swallowed a piece of the lower NiTi arch wire when the distal end-cutter did not hold the segment after trimming the distal portion of the wire. This allowed it to rest in the cheek area, but due to saliva being present, the wire began to float. Following the clinician's instruction about turning her head to the side and avoid swallowing, the patient accidentally swallowed the piece of wire. Upon inspection in the mouth, no piece of wire was visible. The patient did not cough or exhibit any other signs of aspiration. The patient's legal guardian was informed about the incident, and referred to a radiology lab for a lateral and posteroanterior (PA) chest x-ray, as well as an abdomen x-ray with kidneys, ureters, and bladder (KUB) x-ray. The patient's parents were unable to have the x-rays immediately, and the x-rays were taken two days after the incident. The clinician followed up the patient and she did not have any signs or symptoms during the two-days before taking x-rays.

The radiologist's final report based on the chest PA and lateral x-ray stated, "The lungs are free of the infiltration. The lungs are free of the infiltrates. No unusual radiodensities are noted. The heart and pulmonary vessels are not enlarged. The bony thorax appears intact." Furthermore, in regards to the abdomen x-ray with KUB, the radiologist reported, "There is a linear radiodensity seen in the right lower quadrant which measures 7.7 x 0.6 mm. This is consistent with an ingested wire. It is impossible to determine if it lies within the colon or small bowel in this region. No obstruction or ileus is seen. No osseous abnormality is seen. No sign of organomegaly is noted. This should pass without difficulty" (Figure 1). The radiologist's opinion was that the foreign body should pass without difficulty.

Discussion

Orthodontic components or parts of them can fall into the oropharynx, and being swallowed or inhaled by patient. This can happen during a chair-side service when the patient is in a supine or semi-recumbent position. In addition, detached or broken pieces of removable orthodontic appliances might also be accidentally inhaled or ingested by the patient. Foreign bodies entering the digestive tract usually do not represent a serious medical problem unless they become impacted or cause perforation of the gut wall. 80-90% passes through without incident. On the other hand, a foreign body in the airway is a serious threat to a patients' health since it can be a cause of accidental death. The risk of causing serious harm depends on the size, shape, and flexibility of the object.[6,10,15,29-31] Overall, if such accidents happen, one has to assume the worst when a dental item disappears. Proper management of such an incident when it occurs is crucial to the health and safety of the patient.[6,8]

Conclusions

Patients who are suspected of having ingested/aspirated a foreign body need to be carefully managed. A practitioner should be aware of emergency care and incident management protocols. If the object is not retrieved after initial evaluations, it is important to make sure that the patient's airway is not compromised, escort him/her to a hospital and setup proper referrals for clinical and imaging examinations by appropriate specialists. Further treatments will be performed according to the patient's signs, symptoms, and the location of the foreign body. Preventive measures are always the best option in such an incident. If an incident occurs, proper management and clear documentations are essential.

References

1. Abdel-Kader HM. Broken orthodontic trans-palatal archwire stuck to the throat of orthodontic patient: is it strange? *J Orthod* 2003;30:11.
2. Rohida NS, Bhad WA. Accidental ingestion of a fractured Twin-block appliance. *Am J Orthod Dentofacial Orthop* 2011;139:123-125.
3. Monini Ada C, Maia LG, Jacob HB, Gandini LG, Jr. Accidental swallowing of orthodontic expansion appliance key. *Am J Orthod Dentofacial Orthop* 2011;140:266-268.
4. Nazif MM, Ready MA. Accidental swallowing of orthodontic expansion appliance keys: report of two cases. *ASDC J Dent Child* 1983;50:126-127.
5. Hinkle FG. Ingested retainer: a case report. *Am J Orthod Dentofacial Orthop* 1987;92:46-49.
6. Milton TM, Hearing SD, Ireland AJ. Ingested foreign bodies associated with orthodontic treatment: report of three cases and review of ingestion/aspiration incident management. *Br Dent J* 2001;190:592-596.
7. Obinata K, Satoh T, Towfik AM, Nakamura M. An investigation of accidental ingestion during dental procedures. *J Oral Sci* 2011;53:495-500.
8. Hill EE, Rubel B. A practical review of prevention and management of ingested/aspirated dental items. *Gen Dent* 2008;56:691-694.
9. Dibiase AT, Samuels RH, Ozdiler E, Akcam MO, Turkkahraman H. Hazards of orthodontics appliances and the oropharynx. *J Orthod* 2000;27:295-302.
10. Tripathi M, Bano N, Gaur A, Kaushik S. Accidental subdural injection of local anaesthetic: diagnosis by pressure measurement and response to aspiration of injectate. *Eur J Anaesthesiol* 1997;14:455-457.

11. Parolia A, Kamath M, Kundubala M, Manuel TS, Mohan M. Management of foreign body aspiration or ingestion in dentistry. *Kathmandu Univ Med J (KUMJ)* 2009;7:165-171.
12. Tiwana KK, Morton T, Tiwana PS. Aspiration and ingestion in dental practice: a 10-year institutional review. *J Am Dent Assoc* 2004;135:1287-1291.
13. Gayer G, Petrovitch I, Jeffrey RB. Foreign objects encountered in the abdominal cavity at CT. *Radiographics* 2011;31:409-428.
14. Zitzmann NU, Elsasser S, Fried R, Marinello CP. Foreign body ingestion and aspiration. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1999;88:657-660.
15. Absi EG, Buckley JG. The location and tracking of swallowed dental appliances: the role of radiology. *Dentomaxillofac Radiol* 1995;24:139-142.
16. Ford DE. Commentary. Preprosthetic orthodontic intervention for management of a partially edentulous patient with generalized wear and malocclusion. *J Esthet Restor Dent* 2012;24:101-102.
17. Arsati F, Montalli VA, Florio FM, Ramacciato JC, da Cunha FL, Cecanho R et al. Brazilian dentists' attitudes about medical emergencies during dental treatment. *J Dent Educ* 2010;74:661-666.
18. Deliberador TM, Marengo G, Scaratti R, Giovanini AF, Zielak JC, Baratto Filho F. Accidental aspiration in a patient with Parkinson's disease during implant-supported prosthesis construction: a case report. *Spec Care Dentist* 2011;31:156-161.
19. Foltran F, Ballali S, Passali FM, Kern E, Morra B, Passali GC et al. Foreign bodies in the airways: a meta-analysis of published papers. *Int J Pediatr Otorhinolaryngol* 2012;76 Suppl 1:S12-19.
20. Takada M, Kashiwagi R, Sakane M, Tabata F, Kuroda Y. 3D-CT diagnosis for ingested foreign bodies. *Am J Emerg Med* 2000;18:192-193.
21. Karaman E, Hacizade Y, Isildak H, Agayev A, Mercan H, Alimoglu Y et al. Carotid sheath-like foreign body in the neck. *J Craniofac Surg* 2010;21:1296-1298.
22. Chroustova D, Volf V, Dzupa V, Kryl P, Mandys V. The unusual cause of recurrent abdominal pain in an 11-year-old boy. *Nucl Med Rev Cent East Eur* 2006;9:77-80.
23. Ikenberry SO, Jue TL, Anderson MA, Appalaneni V, Banerjee S, Ben-Menachem T et al. Management of ingested foreign bodies and food impactions. *Gastrointest Endosc* 2011;73:1085-1091.
24. Sersar SI, Rizk WH, Bilal M, El Diasty MM, Eltantawy TA, Abdelhakam BB et al. Inhaled foreign bodies: presentation, management and value of history and plain chest radiography in delayed presentation. *Otolaryngol Head Neck Surg* 2006;134:92-99.
25. Lin CH, Chen AC, Tsai JD, Wei SH, Hsueh KC, Lin WC. Endoscopic removal of foreign bodies in children. *Kaohsiung J Med Sci* 2007;23:447-452.
26. American Society for Gastrointestinal Endoscopy. Guideline for the management of ingested foreign bodies. American Society for Gastrointestinal Endoscopy. *Gastrointest Endosc* 1995;42:622-625.
27. Gracia C, Frey CF, Bodai BI. Diagnosis and management of ingested foreign bodies: a ten-year experience. *Ann Emerg Med* 1984;13:30-34.
28. Fredekind RE, McConnell TA, Jacobsen PL. Ingested objects: a case report with review of management and prevention. *J Calif Dent Assoc* 1995;23:50-55.
29. Aytac A, Yurdakul Y, Ikizler C, Olga R, Saylam A. Inhalation of foreign bodies in children. Report of 500 cases. *J Thorac Cardiovasc Surg* 1977;74:145-151.
30. Ghori A, Dorricott NJ, Sanders DS. A lethal ectopic denture: an unusual case of sigmoid perforation due to unnoticed swallowed dental plate. *J R Coll Surg Edinb* 1999;44:203-204.
31. Tripathi T, Rai P, Singh H. Foreign body ingestion of orthodontic origin. *Am J Orthod Dentofacial Orthop* 2011;139:279-283.

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