

Accidental aspiration/ingestion of foreign bodies in dentistry: A clinical and legal perspective

Department of Conservative Dentistry and Endodontics, Faculty of Dental Sciences, King George's Medical University, Lucknow, Uttar Pradesh, ¹Division of Conservative Dentistry and Endodontics, Centre for Dental Education and Research, All India Institute of Medical Sciences, New Delhi, India

Rakesh Kumar Yadav, Hemant Kumar Yadav¹, Anil Chandra, Simith Yadav, Promila Verma, Vijay Kumar Shakya

ABSTRACT

The potential of foreign body aspiration or ingestion is a worldwide health problem in dentistry. The general dental practitioners should be extremely attentive in handling of minor instruments during any intervention related to the oral cavity, especially in the supine or semi-recumbent position of the patient. Aspiration cases are usually more critical and less common than ingestion. We report a case of iatrogenic aspiration of an endodontic broach, which gets disclosed during the recording of past dental history of the patient. The patient was asymptomatic during that time. A quick posterior-anterior chest radiograph was taken which revealed the presence of broach in the lower lobe of the left lung. The patient was immediately referred to the pulmonary medicine department where the fiberoptic bronchoscope retrieval was planned, and the same was carried out successfully under local anesthesia. Although such accidents have rare occurrence, the associated risks and morbidity are too high to be overlooked, especially from the viewpoint of special care, resources, and the associated financial cost required for their management. Moreover, practitioners are also liable for malpractice litigation given the fact that such cases are avoidable. This article also discusses relevant review literature, risk factors, symptoms, and management of such iatrogenic accidents along with drawing attention to the significance of preventive measures and their role in avoiding meritorious legal and ethical issues.

Address for correspondence:

Dr. Rakesh Kumar Yadav,
Department of Conservative Dentistry and Endodontics, Faculty of Dental Sciences, King George's Medical University, Lucknow, Uttar Pradesh, India.
E-mail: rakeshanita10@yahoo.in

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INTRODUCTION

Iatrogenic accidents during routine clinical procedures are unpredictable and can occur sometimes regardless of all the possible precautions taken. The golden line "prevention is better than cure" seems to be more of saying and less of a belief when we see cases such as accidental aspiration/swallowing of foreign objects. These foreign objects can be of various sizes and shapes, ranging from small, large, elongated, round, sharp,

and blunt and can get wedged anywhere either in the gastrointestinal (GI) or the respiratory tract. Webb *et al.*^[1] reported that 92.5% of the swallowed foreign bodies enters the GI tract and 7.5% of these instances in the tracheobronchial tree. Various studies have stated that in all cases reported, only 10–20% cases necessitate nonsurgical intervention, and 1% or less requires surgical retrieval.^[2,3]

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Since in cases of accidental aspiration or ingestion the risk of morbidity, expenses of specialty care, and the potential liability for negligence and malpractice are too high to be ignored, early recognition and diagnosis are the key to prevent serious consequences. Any delay in the proper management and timely intervention of such accidents may cause severe sequelae^[4,5] and can be lethal.^[6] Moreover, such accidents are also a source of emotional distress to patients and their families and can also dampen the reputation as well as the morale of a dentist. Therefore, the purpose of this review article is to report a case of aspiration of an endodontic broach and to discuss the relevant review literature, risk factors, symptoms, and proper management of such iatrogenic incidents for health and safety of the patient along with drawing attention of the general dental practitioners to the significance of preventive measures and their role in avoiding meritorious legal and ethical issues.

CASE

A 60-year-old male patient reported to the Department of Conservative Dentistry and Endodontics, King George's Medical University, Lucknow, India, with a chief complaint of pain in right lower second molar for which he had already undergone root canal treatment at some private dental clinic. While obtaining a complete history of the present illness, the patient revealed that an instrument had slipped accidentally from dentist's finger into the posterior region of the oral cavity, following which it had been swallowed. The dentist had assured the patient that the instrument will be excreted out with time. The patient reported no discomfort and respiratory obstruction even after 1 week of the accident.

To confirm the status of the instrument, patient was sent to the Department of Radiodiagnosis for an immediate posterior-anterior, lateral chest, lateral neck, and abdomen radiographs. On radiographic examination, a radiopaque object in the lower lobe of the left lung was observed [Figure 1]. Physical assessment showed normal breathing sounds and respiratory rate. The patient was informed about the presence of the instrument aspirated into the lung and was immediately admitted to the Department of Pulmonary Medicine to attempt its removal as soon as possible. High-risk consent was obtained from the guardians accompanying the patient. All the vital statistics were obtained and found within normal range. Flexible fiberoptic bronchoscopy was planned for inspection and removal of the instrument after explaining about the procedure and its outcome. A successful bronchoscopy was performed on the next day. After that, it was found that the retrieved instrument was an endodontic barbed wire broach [Figure 2].

DISCUSSION

Incidences in dental literature

The general trend in dentistry is to treat patients in a supine position to improve visibility, accessibility to the oral cavity as well as the ergonomic comfort for operators. Although the supine position seems more susceptible to accidental aspiration/ingestion of foreign bodies,^[7] such mishaps may occur in any position at any time not only during dental treatment but also after treatment as the patients carry the appliances or prostheses in their mouths. There is a wide variation in the incidence of such iatrogenic accidents. Tamura *et al.*^[8] in a review in Japan reported an incidence of 3.6–27.7% of all foreign bodies, with a considerably higher incidence in adults than children. The ingestion cases usually prevail over aspiration, especially in children. There is a higher risk (80%) of accidental aspiration of foreign bodies in children below 3 years of age.^[9]

Although anything introduced in the oral cavity can potentially lead to a mishap, the swallowing of some foreign objects is more common than others. Dental items have been reported as the second most commonly ingested/aspirated foreign objects in adults.^[4,10,11] Single-tooth cast or prefabricated restorations get more likely aspirated during their try-in and cementation.^[12] Susini *et al.*^[13] reported the percentage of endodontic instruments aspirated and ingested as 2.2%, 18%, respectively. Grossman^[14] in 1971 reported that 87% of ingested endodontic K files goes into the alimentary tract and 13% in the respiratory tract. Tiwana *et al.*^[11] in a 10-year institutional review of aspiration and ingestion in dental practice reported that among all dental specialties, fixed prosthodontic treatment had the highest incidence of adverse outcomes followed by orthodontic treatment.

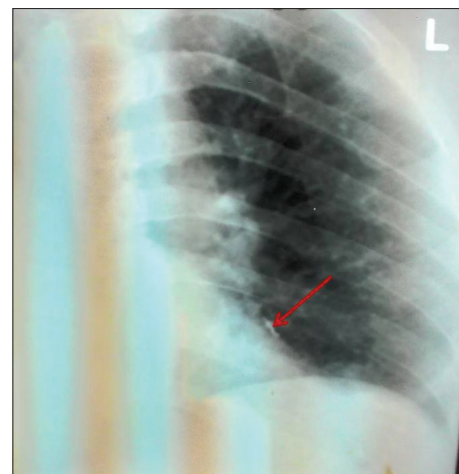


Figure 1: Posterior-anterior view of chest radiograph showing an endodontic broach (red arrow) in the lower lobe of the left lung



Figure 2: Endodontic broach retrieved during bronchoscopy

Dental literature is stuffed with several cases of the ingestion or aspiration of small items signifying their catastrophic effects. These reported foreign bodies in dental practice include tooth as whole, root tips and screwdriver,^[4,15-19] brackets, orthodontic wires, expansion keys and retainer,^[20-22] drills, amalgam fragments, temporary crowns, pins and metallic posts,^[13] and impression materials.^[7] There are also reports on large swallowed objects such as dental clamps,^[23] the extremity of an endodontic apical locator,^[24] endodontic file,^[25] and even the 12.7-cm long tip of a triple syringe.^[26]

High-risk factors

During any surgical or nonsurgical intervention related to the oral cavity, it is very crucial to identify risk factors linked with accidental aspiration/ingestion of foreign bodies and thus to avoid the potential life-threatening emergencies.^[4,7,10] In a healthy state, the larynx acts as a protective sphincter at three different levels at the inlet of the air passage: Epiglottis and aryepiglottic folds, false vocal cords (ventricular folds), and true vocal cords. For aspiration to happen, a foreign object must have to pass these three lines of defense. Patients with reduced laryngeal closure are more prone to aspirate saliva, minor dental appliances, instruments or their parts.

Several patients are at higher risk for aspiration or ingestion. Children aged 1–3 years are at greater risk of swallowing because they chew incompletely with incisors due to the lack of molar eruption and objects or fragments may be propelled posteriorly, triggering a reflex swallow. Elderly, IV sedated, inebriated, mentally handicapped, or traumatized patients with altered states of consciousness are usually more susceptible to swallow because of the decreased gag reflex, swallowing incoordination, or other impaired protective airway mechanisms.^[11,27] Sedation decreases both the protective swallowing and cough reflexes. All patients subsequent to cerebrovascular accidents, head trauma, or surgical

procedures affecting tongue should be evaluated carefully for aspiration or ingestion due to delayed triggering of swallowing reflex. Patients with psychiatric illness, head and neck cancer, and neurologic conditions, such as stroke, dementia, cerebral palsy, brain tumors/injuries, Parkinson's disease, amyotrophic lateral sclerosis usually have higher risk due to functional impairment of swallowing mechanism.^[4,7]

Difficult handling of small slippery (saliva contact) instruments in a limited working region pose an increased risk of aspiration or ingestion and requires special care because of the usual supine or semi-recumbent position of patients.^[20] The numbing effect of anesthetic agents and loss of gag reflex mechanism, excessive or unexpected patient movements during treatment, inadequate lightening, ineffective assistance, limited mouth opening, and unexpected breakage or detachment of poor quality instruments or its components are also significant contributing factors to aspiration/ingestion of foreign items in dentistry.^[4,28] Patients with pregnancy, obesity, and sliding hiatal hernia are also at greater risk of aspiration or ingestion of foreign objects due to increased intra-abdominal pressure, which affects the deglutition reflex resulting in dysphagia, especially in a reclined position.^[29] Edentulous patients are more susceptible to ingestion of minor items entombed in food bolus due to reduced tactile sensitivity of palate owing to the denture. Therefore, it is always important to carefully review the patient's medical history during the initial appointment and perform a comprehensive physical examination.

Symptoms related to aspiration

Signs and symptoms of aspiration or ingestion differ in conformity with the size and shape of the foreign body and whether it is free, fixed, or perforating. Aspiration can occur anywhere along the tracheobronchial tree. The right bronchus is usually the most common site in adults because of the anatomic configuration.^[5] However, it has been reported in all pulmonary lobes.^[10] The most common symptoms of laryngotracheal obstruction are dyspnea, cough, and stridor. A laryngeal choking of the airway by foreign objects results in respiratory difficulty with or without cyanosis and signs of hands clutched to the throat, depending on whether the choking is partial or complete.^[30] However, bronchial foreign bodies are associated with cough, decreased air entry, dyspnea, and wheezing. Moreover, some inadvertently aspirated small foreign objects can pass through the vocal cords without obstructing the upper airway and remain asymptomatic for several months.^[31] Their long-term retention can result in late complications such as vocal cord paralysis, postobstructive pneumonia, atelectasis, bronchiectasis, pneumothorax, hemorrhage or lung abscess,^[5] and death.^[6]

Symptoms related to ingestion

In majority of the cases, ingested foreign bodies usually pass through the GI tract uneventfully. In case of any obstruction, dysphagia and odynophagia are the most frequently noticed symptoms. However, symptoms such as coughing, gagging, drooling of saliva, chest pain, muscle incoordination, incessant twitching, nausea, hematemesis, and regurgitation may be perceived during esophageal obstruction.^[32] At potential sites of impaction along the GI tract, the symptoms vary between abdominal pain, fever, nausea, vomiting, and abdominal distension that may complicate diagnosis. Sharp, pointed, and elongated objects such as endodontic reamers and files may fail to pass the fixed curvatures of the duodenum, thereby resulting in impaction or perforation. Such perforations can be fatal. Cockerill *et al.*^[33] has reported a case of toothpick ingestion that resulted in death due to a perforation in the third portion of the duodenum and advanced through the inferior vena cava.

Clinical management of aspiration/ingestion emergencies

A suggested set of steps has been summarized in Figure 3 for the clinical management of inadvertent aspiration or ingestion emergencies in dentistry. Aspiration cases are usually more disastrous than ingestion and must, therefore, be taken care of as an emergency situation to prevent disastrous consequences.

When an iatrogenic accident occurs, it is very important to remain calm, composed, and to know how to manage and protect themselves against such events. The practitioner must be able to recognize signs and symptoms of air and gastric obstruction if any dental item gets lost into the oropharynx. The patient should be positioned in a reclined phase, and encouraged to cough forcibly to ensure a clear airway. If forceful coughing does not bring any improvement, and the airway is getting compromised with symptoms such as inspiratory stridor, choking, and forced breathing, the Heimlich maneuver should be carried out to alleviate the laryngeal obstruction. If retrieval of the foreign body does not become feasible, basic emergency life support treatments must be initiated till any definite intervention.

If the airway is not compromised, assessment for any lost or missing instrument and its component should be done promptly with a high suspicion of mishap. Therefore, it is vital to always examine, explain, and review all equipment used during dental procedures. If the object is found in the oral cavity, its retrieval, identification, and confirmation that the object is intact should be immediately followed by reassuring the patient. If the object is not retrieved, in such circumstances, the patient should be placated, but informed about the complications and must be escorted to the hospital to confirm the status

of the object using comprehensive diagnostic tests (chest and abdomen radiographs) and to decide the required medical action regardless of how well the patient looks. In case of radiolucent objects, computed tomography and diagnostic bronchoscopy become very fruitful in identifying their anatomic location.^[8,11]

If the foreign body has entered the respiratory tract, before extracting the foreign object, its anatomic location (larynx, trachea, lobar, and segmental bronchi), shape, composition, and extent of entrapment by granulation tissue, inflammatory polyp, or edema must be identified to avoid the associated risks and further complications.^[20] Once localized, bronchoscopy is the treatment of choice for removal of aspirated items. However, there is still a debate about whether to use flexible or rigid bronchoscopy. The decision is usually made based on the object size, localization, medical facility, and personnel expertise. Although rigid bronchoscope recommends better control and visualization of the airway, easier use of removal instruments and efficient airway suctioning in a massive bleed, the requirement of general anesthesia is its primary disadvantage.^[34] Flexible fiberoptic bronchoscopy is relatively safe, easy, cost-effective procedure in experienced hands and can be performed under local anesthesia. It seems to be more efficient, especially in adults and has a higher success rate (>90%) than rigid bronchoscopy.^[35] It is superior to rigid bronchoscopy in cases of distally wedged objects, mechanically ventilated patients or in the spine, jaw, and skull fracture.^[10]

If the foreign body has entered the GI tract, its removal is determined according to the patients' age, size, shape, composition, anatomic location of the object, and time since the ingestion.^[36,37] The possible sites of impaction along the GI tract are areas of physiologic angulation or pathologic narrowing, such as the pharynx, upper esophageal sphincter, middle third of the esophagus, lower esophageal sphincter, pylorus, duodenojejunal flexure, ileocecal junction, appendix, rectosigmoid junction, anus, or patients with previous GI surgery or congenital gut malformations.^[36-38] The judgment of the risks of aspiration, obstruction, or perforation determines the timing of endoscopy. Flexible endoscopy is the procedure of choice to retrieve such objects in the GI tract.^[36]

Since the most obstructions are usually noticed in the upper esophagus, which is associated with risks of aspiration and esophageal perforation with secondary mediastinitis,^[2] it should be promptly recovered by esophagoscopy. A foreign object should not be allowed to remain in the esophagus ahead of 24 h in any situation to minimize the serious sequelae.^[39,40] Once passed through the esophagus, the majority of foreign bodies (80–90%)

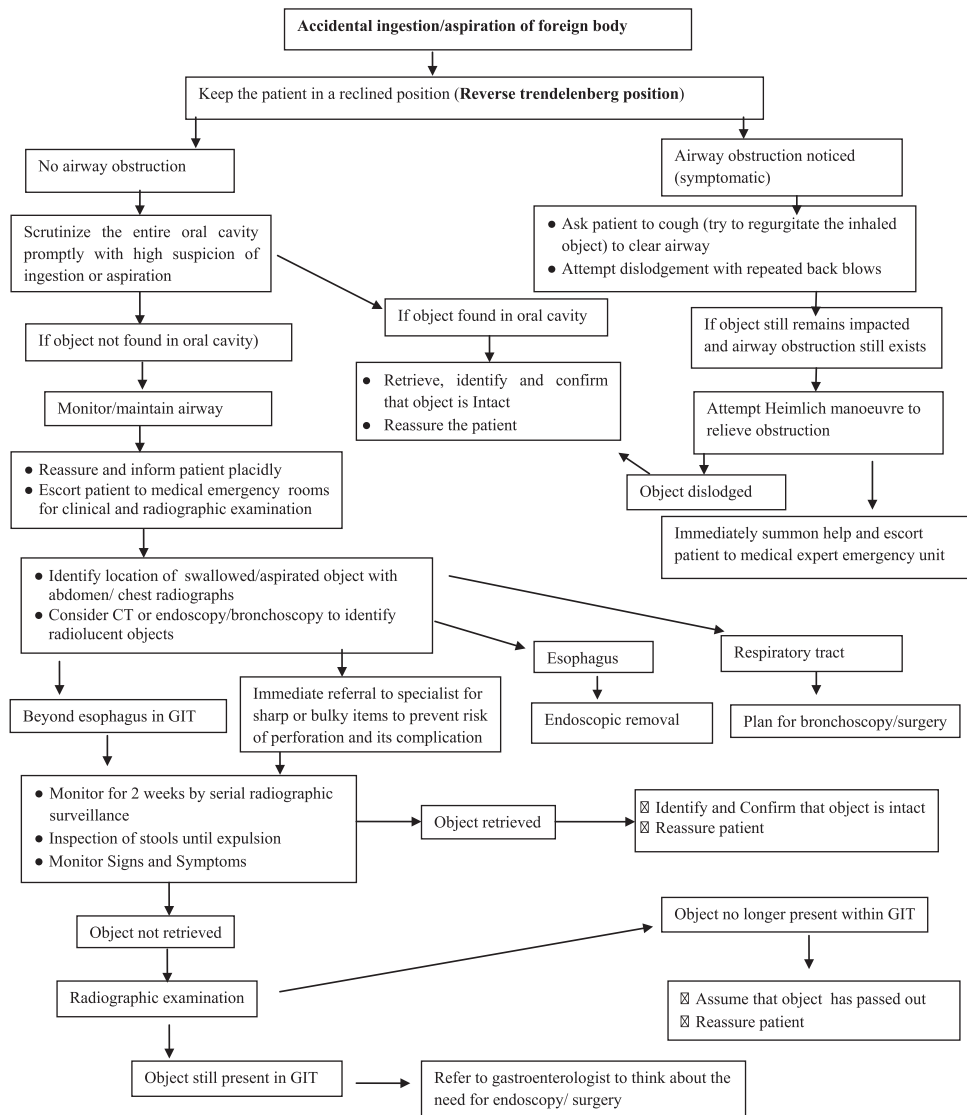


Figure 3: Algorithm for clinical management of inadvertent aspiration/ingestion emergencies in dentistry

pass out uneventfully through the anus, including the sharp pointed objects also over a period of several days to weeks.^[3,37] Govila^[41] has reported that endodontic instruments entering the GI tract pass out spontaneously in the feces in 4 days to 2 weeks. However, the risk of perforation is high with sharp objects. Therefore, regular assessment and serial radiographic monitoring of the progress of such an object are advised. In the meantime, the patients should observe their stools to confirm the passage of the foreign body. Use of a high-bulk diet may be helpful; however, there is no scientific evidence of the benefit of any special diet to support such objects' passage.

Sharp, pointed, and elongated objects (>6 cm in length) usually fail to pass the proximal duodenum. Owing to the higher risk of perforation, urgent endoscopy should, therefore, be attempted by a specialist to remove them before reaching the small intestine. Blunt and rounded

objects wider than 2.5 cm are less likely able to pass the pylorus and will need to be removed by gastroscopy. However, this recommendation has limited support.^[42,43] Purgatives/laxatives should be avoided because they increase the effect of the peristaltic contraction and thus make intestinal perforation more likely.^[2] In case of impaction noticed within mucosal folds of ileocecal valve and strictures, rectoscopy, colonoscopy, or surgical intervention may be necessary, depending on the object's location. Open abdominal surgery is also indicated if there is evidence of hemorrhage, intestinal obstruction, or perforation.

Strategies to prevent aspiration/ingestion in dentistry

Although several strategies have been employed in dentistry to avoid aspiration or ingestion of foreign objects, prevention is considered as the best method for managing such episodes. The use of a rubber dam is considered as the easiest, effective, and most

common preventive measure for routine restorative and endodontic procedures.^[44] However, many dental interventions do not allow the use of rubber dam primarily orthodontic, prosthodontic, and various microsurgical procedures. In these scenarios, the other recommended protective methods such as gauze throat screens, high vacuum suction, customized impression trays, floss ligatures for minor items, use of more upright position are practiced to minimize risk of ingestion or aspiration with special concern in patients with diminished protective reflexes.^[11]

The use of rubber dam not only reduces microbial contamination, the potential of swallowing/aspirating irrigants and instruments, but also enhances visual access to the canals, optimizes moisture control, and retraction of the soft tissue, thereby enhancing the efficacy of the endodontic procedure.^[45] However, there is a risk of rubber dam clamp aspiration/ingestion itself during the use. Therefore, the clamp should always be secured with dental floss to prevent the peril.^[7] Moreover, the clinical practice of rubber dam use varies widely among practitioners, across different parts of the world. Failure to use a preventive rubber dam is an unconscionable and universal phenomenon, which may create disastrous circumstances.^[11,20,28] No defensive measure either verbal or written can justify the failure to use a rubber dam in any circumstances.^[46]

The gauze screen (4 × 4 inch) is used to block the access of small items to the oropharynx. In patients intolerant to this safety measure due to high gag reflexes, the chair position becomes more meaningful during the intervention. Such patients should be seated more upright, with the head turned to one side and are asked to suppress their swallowing reflex if any small item drops in the oral cavity. All minor dental appliances, prostheses, and instruments should be secured with long floss for their rapid retrieval in case of displacement. The dentist can also prevent cast restoration being aspirated by using dental floss.^[47,48] All instruments should always be reviewed before, during, and after every dental procedure to minimize the risk of their separation, aspiration, and/or ingestion.

Full arch impression procedure does not easily allow for the above barrier techniques. Special care should be practiced during their use because after ingestion or aspiration, they often remain undetected both clinically and radiographically, thereby causing long-term severe complications. Patients with severe malocclusions and wearing orthodontic appliances are at risk to shred and swallow the impression material on removal. Therefore, use of sufficient amount of material with optimum viscosity and tear strength, especially in high-risk patients is recommended to get an accurate

impression and to decrease the probability of shredding and swallowing. Impressions should be taken in an upright position with special caution during denture relining immediately after implant surgery. Adequate recovery time should be given to postoperative patients often elderly, to have a full return to their swallowing and coughing reflexes before making impressions or performing chairside relines. After taking the impression, the oral cavity should be rinsed with high vacuum suction and examined for any residual debris.^[4]

Negligence and its legal implication

Minor dental procedures are challenging and technically demanding, and negligence can occur at any stage. The dictionary meaning of the term “negligence” is the failure to take care that a responsible person usually takes or lack of normal care or attention. Hence, during any procedures, the dentist must follow the standard practice guidelines. The ethical basis for the standard of care is to recommend the best therapy while minimizing potential harm, and to avoid placing a patient at an unreasonable risk of harm.^[49] The standard is one of the reasonable cares, not of perfection exercised by similar professions in similar cases and conditions due regard for the state-of-the-art. It vacillates between expert witnesses, evidence, new technology, and improved procedures. However, it must be remembered that the guidelines for standard of care set by any specialist, national specialty/organization, are templates, not legal mandates. The court will finally decide whether the practitioner is negligent or not.

If the standard of care is quite below the acceptable guidelines, many practitioners will be liable for various meritorious claims (any departure from the minimum quality of care). This can be due to the lack of updating knowledge by professionals and increase in public awareness about their rights. Common reasons for litigation include, but are not limited to, failure to refer to a specialist, failure to properly diagnose, failure to perform comprehensive diagnostic tests, failure to properly document and record all findings and treatment, dissatisfaction with prosthetics, treatment of the wrong tooth, hypochlorite accidents and other nonaccepted materials, root perforations, failure to obtain appropriate informed consent, failure to inform the patient of instrument separations in the canal, failure to use a rubber dam, extraction errors including the extraction of the wrong tooth, implant failure, paresthesia following endodontic treatment or a surgical procedure, temporomandibular dysfunction, poor crown margins, failure to pretreat the patient with prophylactic antibiotics when medically necessary, failure to obtain patient’s medical history, writing an improper prescription, child abuse, sexual harassment, and inappropriate use of intravenous sedation.^[50,51]

To deal with such type of claims, every practitioner must, therefore, incorporate the following lines of defenses in their practices. The first line of defense is to establish a good doctor–patient relationship so that the patient does not try to find legal advice. Attention should be paid to the manner in which information and opinions are shared. The influence of a casual comment should not be underestimated. The practitioner should be attentive to their communication style with patients.^[52] The second line of defense is to always have an appropriate informed consent from the patient before starting the treatment. The informed consent is not only just a standard of practice but also is the rule of law. The dentist must explain (a) the indicated procedure and its rationale in understandable language, (b) benefits of the procedure, (c) alternatives and their consequences, including no treatment at all, and (d) risks associated with the procedure. The third line of defense is maintaining proper record of all procedures performed to reduce liability for any claim.

CONCLUSION

- Early recognition of high-risk factors and location of swallowed foreign bodies during any surgical or nonsurgical procedure related to oral cavity are the keys to avoid catastrophic effects
- A close monitoring of clinical signs and symptoms should be done until the foreign body aspirated/ingested is excreted or removed
- The use of preventive measures such as rubber dam, gauze throat screens, or floss ligatures is an indispensable standard of care for patient safety in various contemporary dental practices
- The umbrella of all defenses is to practice within the accepted standard of care and within one's capabilities
- In this litigious era, dentists should always be aware of a protocol not only for prevention but also for management of such iatrogenic cases.

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