Management of Medical Emergencies in Pediatric Dental Practice

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ABBREVIATIONS

GP	General practitioner
EMS	Emergency medical services
BPM	Breaths per minute
BP	Blood pressure
GFR	Glomerular filtration rate
BSA	Body surface area
BLS	Basic life support
CPR	Cardiopulmonary resuscitation
PALS	Pediatric advanced life support
IV	Intravenous
IM	Intramuscular
SC	Subcutaneous
AEDs	Automated external defibrillators
CO_2	Carbon dioxide
O_2	Oxygen
NH_3	Ammonia
HCL	Hydrochloric acid
LA	Local anesthesia
IDT	Intradermal test
DLST	Drug-induced lymphocyte stimulation test
IgE	Immunoglobulin E
NSAIDs	Nonsteroidal anti-inflammatory drugs
DM	Diabetes mellitus
WHO	World Health Organization
IDF	International Diabetes Federation
HAE	Hereditary
AAE	Acquired
C1 INH	C1 inhibitory deficiency
CNS	Central nervous system
CVS	Cardiovascular system
MRD	Maximum recommended dose
CT	Computed tomography
CBCT	Cone beam computed tomography
PEB	Post extraction bleeding
EACA	International normalized ratio
INR	Epsilon-aminocaproic acid

PART A

MISHAPS IN PEDIATRIC DENTISTRY

CHAPTER 1

INTRODUCTION

DR PALLAVI SURYARAO

Mishaps or procedural accidents are those unfortunate occurrences that happen during treatment, some owing to inattention to detail, others totally unpredictable.[1]

The dental professional is faced with a daily continuum of clinical situations requiring an integration of fact, experience, interpretation, application and analysis. The ability to confront these situations in a systematic and successful manner characterizes the problem-solving approach to treatment and evaluation. These mishaps may occur despite the best dental care.[1]

Children have a habit of placing various objects in their mouths as a part of normal development. Accidental ingestion or embedment of an object in hard and soft tissues of the oral cavity is commonly encountered. The incidence is more frequent in the age group three to six years, where the child develops a habit of inserting new objects of interest in the mouth due to curiosity about them. Although this is considered a part of early childhood development, at times, impaction of a foreign object in the soft or hard oral tissues may have serious consequences. A paucity of information exists regarding the prevalence of foreign body impaction in the primary dentition, but a recent article by Diaconescu et al., from a credible scientific source, reveals that the peak incidence of foreign body ingestion is between the ages of six months and four years and has an equal gender distribution.[2]

Very young children are at risk of swallowing or aspirating numerous household objects. This risk is enhanced during dental procedures on these children as they tend to be very uncooperative due to their age and lack of maturity in understanding the importance of the treatment. The use of physical barriers, sedation or general anesthesia is not possible, practically, in every child scheduled for dental treatment.

Incidences of accidental ingestion of endodontic instruments are rare in clinical practice, but if it occurs it can be serious and need urgent medical attention. Due to the lack of use of rubber dams, cases have been reported of accidental ingestion of files, reamers, irrigation needles, crowns, inlays, onlays, posts and rubber dam clamps.[3]

Ingestion or aspiration of materials can even occur after the dental treatment is over, such as partial removable and fixed prosthesis, orthodontic appliances such as brackets and broken molar bands, etc. Uncooperative children, medically compromised patients such as those with psychosis, Alzheimer's disease or Parkinson's disease; those who are mentally disabled: patients with an excessive gag reflex; patients who have undergone oral cavity surgery, those with compromised motor function, etc., are all prone to such accidents.[3]

One life-threatening mishap that occurs with greater than expected frequency in a dentistry setting are those reactions associated with the administration of drugs, such as administration of a local anesthetic, the most used drug in dentistry. Other situations are produced entirely by stress, e.g., vasodepressor syncope, hyperventilation, etc. The occurrences where pre-existing medical problems are exacerbated by stress include acute cardiovascular attack, asthma, convulsions, etc. Therefore, management of stress becomes an essential element to minimize the occurrence of such situations. It is therefore incumbent upon all clinicians not only to be aware of factors that affect the success or failure of treatment, but also to comprehend the extensive integration of these factors during the problem-solving thought process that forms the treatment planning of these cases and assessment of the treatment provided.[4]

Displacement injuries are more common than tooth fractures, with avulsion representing approximately 13% of the injuries to primary teeth. In cases of primary incisor avulsion, it is not recommended to replant the avulsed tooth because of the risk of damaging the developing, permanent successor that lies in close proximity to the root of the primary incisor. Avulsed primary teeth are most commonly found at the site of the accident, may occasionally be swallowed and are very infrequently inhaled.[5]

Recognition of mishaps is the first step in their management; this may be by radiographic or clinical observation or as a result of a patient complaint. The correction of mishaps may be accomplished in one of several ways, depending on the type and extent of the procedural accident. Unfortunately, in some instances the mishap causes such extensive damage to a tooth that

it may have to be extracted. Evaluating mishaps is complicated and resists simple analysis.[6]

Grossman noted that 87% of accidentally ingested foreign bodies entered the alimentary tract whereas 13% aspirated into the respiratory tract. Ingestion/aspiration can be life-threatening or can cause serious complications such as choking, esophageal tissue perforation, intestinal ulceration or perforation, bronchial stenosis, abscess formation, hemorrhage or a fistula. Proper measures must be taken by the dentist to prevent accidental ingestion of endodontic instruments. For example, the proper use of a rubber dam minimizes the risk of ingestion. Likewise, a patient in whom coordination of deglutition and the cough reflex is affected must be seated in an upright position and any objects prone for swallowing must be tethered with a ligature. Generally, it is advisable to seat patients in an upright position to avoid such accidents. For radiographic examination, x-ray films or digital sensors should be tethered or the use of the paralleling technique is more appropriate to prevent accidents.[3]

A re-evaluation of the prognosis of the tooth involved in a pedodontics mishap is necessary and important. The re-evaluation may affect the entire treatment plan and may involve dentolegal consequences. The dental standard of care requires that a patient be informed about any procedural accident. This literature provides much information that can help prevent procedural accidents. It is also true that experience can teach many valuable lessons if one pays attention. When a file separates in a canal or the floor of a chamber is perforated while searching for canal orifices, or any of several unfortunate procedural accidents occur, the course followed is to immediately inform the patient, correct the mishap and re-evaluate the prognosis. Dentists must be able to manage emergency situations in which patients accidentally swallow dental instruments or materials during treatments and procedures. Treatment evaluation can help with the prevention of future occurrences of the various mishaps.[6]

The purpose of this compilation is to present the commonest pedodontic mishaps and approaches in order to recognize, correct and prevent them.[6]

CHAPTER 2

MISHAPS IN DIAGNOSIS

DR N.D. SHASHIKIRAN

Defining diagnostic errors and a timely diagnosis rely on many factors, including the knowledge, experience and skill of primary care providers and the resources available to them. Diagnosis is a high-risk area for errors in primary care. Primary care providers typically see high numbers of people and their conditions are often difficult to diagnose due to potentially difficult clinical representation. Primary care providers may have limited experience with uncommon diseases and varying access to diagnostic tests. The term "provider" is used to refer to the primary care workforce. A diagnostic error emerges when a diagnosis is missed, inappropriately delayed or is wrong. Diagnosis can be completely missed, incorrect (patients told they have one diagnosis when there is evidence of another) or delayed (an abnormal test result is suggestive of chronic disease, but no one has told the patient). There may be overlaps in these classifications.

Diagnoses often occur over time, rather than at one point in time, and include the initial assessment, performing and interpreting diagnostic tests, follow-up and tracking the introduction of diagnostic information, referral-related communication and coordination, and patient behavior, adherence and engagement.

Diagnostic errors can occur at each of these points. Diagnostic errors are a failure to provide an accurate and timely explanation of the patient's health problems or to communicate that explanation to the patient. They are considered to be missed opportunities to make a correct or timely diagnosis based on the available evidence. The missed opportunity may result from cognitive or system factors or both.

To reduce hindsight bias, there should be evidence of omission (failure to do the right thing) or commission (doing something wrong) at the point in time at which the error occurred. This shows the relationship between diagnostic

errors, missed opportunities and patient harm. Opportunities could be missed by providers, care teams, systems or the patient. A preventable error or delay in diagnosis may occur due to factors outside of a provider's immediate control and have little to do with the provider's actions.[7]

Rather than target all delays in diagnosis, health care organizations could hone their detection strategies by focusing on clear areas for needed improvement and choose at least one diagnostic error detection strategy.

To learn only from one's own mistakes would be a slow and painful process and unnecessarily costly to one's patients. Experiences need to be pooled so that doctors may also learn from the errors of others. Accurate and timely diagnosis is central, and represents one of the most challenging aspects of primary care. Diagnostic error is increasingly recognized as a research priority and has been described as the next frontier for patient safety.

Although research into diagnostic error in primary care is limited, diagnostic errors are known to occur frequently and causes are broadly categorized into system, patient, and doctor factors. Doctor factors are further divided into knowledge deficits and cognitive errors due to mistakes in clinical reasoning. The dual theory of cognition proposes that the cognitive processes involved in decision-making involve two interacting systems: system 1 (fast, automatic and effortless); and system 2 (slower and analytical). Two qualitative studies used this model as a theoretical framework for analysis when exploring strategies for diagnostic closure and diagnostic error.[8]

A misdiagnosis is, simply put, a wrong diagnosis. An erroneous diagnosis can take a number of forms, from a missed diagnosis in which no medical problem is identified when a problem exists, to a diagnosis which later turns out to be wrong, such as classifying a benign tumor as malignant. Misdiagnosis is a form of medical error, and while it is difficult to get accurate statistics on wrong diagnoses, some statistics place the rate at around one to two percent, with varying consequences. There are a number of reasons why a misdiagnosis can occur.

People who have suffered as a result of a misdiagnosis are often tempted to blame lazy doctors or medical personnel, but all kinds of things can be involved, including malfunctioning medical equipment, a patient's decision to conceal information, a language barrier between doctor and patient, inexperience on the part of the doctor, or a situation in which a diagnosis is extremely unusual, making it hard for a doctor to recognize the signs. Sometimes a disease may also manifest in an unusual way, with a doctor

excluding a diagnosis because the symptoms do not fit and later realizing that the patient's case was atypical.[8]

Dentists play an important role in the early diagnosis and treatment of oral lesions. Ideally, this involves not only a thorough oral and sometimes a radiographic examination to identify the condition, but also confirmation of the clinical impression by biopsy and subsequent microscopic evaluation. However, treatment based solely on a clinical impression of the diagnosis, without histologic confirmation, can result in serious consequences, particularly when the lesion is precancerous or cancerous. In a study by Kondori, Mottin and Laskin, of the clinical diagnoses made by dentists submitting specimens for histopathological examination, 43% were incorrect.

General dentists misdiagnosed 45.9%, oral and maxillofacial surgeons 42.8%, endodontists 42.2%, and periodontists 41.2% of the time. The most commonly missed clinical diagnoses were hyperkeratosis (16%), focal inflammatory fibrous hyperplasia (10%), fibromas (8%), periapical granulomas (7%) and radicular cysts (6%). Cancerous lesions were misdiagnosed 5.6% of the time.[8]

Causes of Diagnostic Mishaps

Key causes

All aspects of the diagnostic process are vulnerable to error. Studies of diagnostic errors often reveal a number of root causes in each case. The causes may include cognitive errors, such as a failure to synthesize the available evidence correctly or a failure to use physical examination or test data appropriately. In fact, there is evidence that cognitive errors can be identified in over half of the cases of diagnostic errors. System flaws may also contribute to diagnostic errors as a result of problems with communication or coordination of care, problems with the availability of medical record data and insufficient access to specialists. A study in one developed country found that process breakdowns most frequently involved the patient-practitioner clinical encounter (79%), followed by referral problems (20%), patient-related factors (16%), follow-up and tracking of diagnostic information (15%) and performance and interpretation of diagnostic tests (14%). Almost half of all diagnostic errors involved more than one of these processes. Patient-practitioner encounter breakdowns were primarily related to problems with history-taking (56%), examination (47%) or ordering diagnostic tests for further work-up (57%). A wide range of factors may contribute to diagnostic errors (Table 1).

Table 1. Factors that may contribute to diagnostic errors in primary care.

Factors	Possible issues contributing to error
Access to high quality primary care	Limited access due to lack of money, remoteness, illiteracy, travel constraints or a limited number of health care facilities.
Availability of health care professionals and specialists	Lack of sufficient, competent health care professionals, for example, due to lack of training, outward migration or a poor employment situation. Specialty expertise may not exist or may be limited in number or quality.
Teamwork	Poor teamwork, lack of learning and feedback when errors occur.
Availability of diagnostic tests	Diagnostic tests limited in scope, availability or quality.
Communication	Little or no sharing of medical information.
Care coordination	Consultations delayed or test results lost or a lack of health records documenting care.
Follow-up	Limited follow-up reduces the ability for diagnostic impressions to evolve.
Affordability of care	Care unaffordable or compromises other basic needs such as food or housing.
Training of health care providers	Training is suboptimal, in particular lack of training for clinical reasoning; certification and licensure requirements are deficient.
Availability of health informatics resources	Health informatics resources, including internet access, may not be available, especially in remote areas; unaffordable subscription or download fees for medical information.
Culture	Some cultures may be punitive, which discourage sharing and inhibit learning; physician-centric systems limit the value of the team. Patients may feel it is more appropriate to be passive care recipients.
Human factors and cognitive issues	The work environment and systems may be subject to distractions, interruptions and a lack of organization of information.

Potential solutions

Interventions to reduce diagnostic errors have focused on improving the knowledge and skills of providers as well as addressing systems issues, such as communication, record keeping and test ordering processes. However, evidence about the effectiveness of approaches to reducing diagnostic errors is limited. It is likely that a combination of interventions would be most effective.

Improving education and skills

Research suggests that providers may not always think through their decisions or interpret information well. Certain aspects of diagnostic reasoning might be more important, more common or more amenable to interventions. Interventions that could potentially improve clinical reasoning include training in how to practice reflectively and tools, such as mnemonics, checklists or online decision support tools that assist with differential diagnosis. Embedding decision support tools in electronic health records provides point-of-care support for diagnosis and treatment. Having more robust evidence about which clinical features provide the greatest diagnostic value in primary care settings is essential. Improving the reliability of diagnosis requires better education of primary care providers. Trainees would benefit from explicit training in clinical reasoning, patient safety, human factors, critical thinking, managing uncertainty, cognitive heuristics and biases, test limitations, probability concepts, reliability science and systems thinking. Training focused on the causes and impact of diagnostic error might help providers become more competent in error prevention. Simulations and feedback can be a helpful way to learn.

Improving health systems

Systems that work in urban environments with easy access to technical support might face different challenges from those that function in dispersed rural areas. The stage of economic development of the country or community also affects the options in health system design. However, in all health systems it is likely that diagnosis could be improved by enhancing access to care and appropriate expertise, ensuring the competency of providers and primary care teams, making high-quality diagnostic testing services (e.g., radiology/laboratory) available and providing a suitable work environment with safe and effective health information technology (IT) to

help optimize care. Relatively little is known about how best to measure the quality of primary care, particularly in lower resource settings.

However, countries with stronger primary care systems have healthier people. There are large discrepancies globally in the number, type and dispersion of primary care providers. Government policies that build primary care as part of the overall health care system are essential. In areas where access to primary care is limited, health care providers other than doctors can deliver primary care, but it is important that these providers have appropriate training and support. Low-income countries may wish to prioritize reducing diagnostic errors in conditions that can be improved with a relatively minor investment. For example, these could include cancer or infection diagnoses or improved follow-up of patients seen for emergency care. Health IT could be leveraged to improve diagnosis at multiple levels and could facilitate both the measurement and the reduction of errors.

Health information technology

Many forms of health IT could help to reduce diagnostic errors in countries across the world. If internet access is available, remote consultation and diagnosis can be useful. Remote readings of radiology imaging, cardiology, ophthalmology, pathology and dermatology have been used successfully. This increases access to subspeciality expertise, often in real-time. Health IT can also support diagnostic reasoning, help to detect errors and enhance follow-up and tracking. Table 2 summarizes a range of health IT approaches and tools that can be used to reduce diagnostic errors.[7]

Table 2. How health information technology can reduce diagnostic error.

Process	How technology can help
Assists in information gathering	Helps ensure that prior records and data are available. Aids the collection of key clinical data, ensuring that relevant important questions are asked, improving completeness of parts of the history that are often neglected (e.g. smoking, family history and recent travel) and; using trigger tools to identify patients more likely to have a diagnostic error *(27)*.
Improves information organization and display	Decreases the cognitive burden and distraction and highlights key information to ensure they are not overlooked.
Helps generate a broad differential diagnosis	Suggests key follow-up questions or tests to consider; differential diagnosis generators are used to offset premature closure around a single diagnosis.
Supports the weighing of diagnostic probabilities	Combines clinical data probabilities with diagnostic testing information to calculate/revise the probability of a given disease. Facilitate the use of clinical prediction rules to help improve the weighing of diagnostic priorities/ probabilities.
Helps develop a diagnostic plan	Helps streamline "next steps" using order sets, default testing suggestions, guideline packages, for example, health IT can flag patients with an unexplained iron deficiency anaemia and automate or suggest the ordering of appropriate next steps.
Improves access to reference information	Provides access to information, journals, images and clinical guidelines.
Facilitates patient follow-up	Supports reliable, rather than ad hoc approaches to patient follow-up. For example, reminder tools can alert providers about the follow-up of abnormal tests or the ongoing monitoring of unresolved problems.
Enables and improves screening programmes	Improves compliance using automatic reminders and generating population-based reports. Helps identify high-risk patients, and patients who have been lost to follow-up.

Process	How technology can help
Provides tools for collaborative diagnosis	Facilitates access to second opinions from experts and makes it easier to solicit colleagues to discuss challenging cases, for example, via telemedicine or electronic consultations.
Facilitates diagnostic feedback to clinicians	Establishes a clear chain of events while documenting the care process more accurately; any errors ultimately discovered can be fed back and shared as a learning experience by all.
Helps detect diagnostic errors	Double checks can help catch mistakes; electronic algorithms can detect missed opportunities for diagnosis and discrepancies.
Facilitates practice improvement research	Produce epidemiologic data and comparisons between providers, practices or geographic locations to allow the exploration of differences in patient outcomes and adverse events related to possible diagnostic error.

Improving access to testing

Access to diagnostic tests could significantly reduce diagnostic error, particularly in low-income countries. This applies to diagnosis both for communicable and non-communicable diseases. Interventions for improving diagnostic services would need to be considered a high priority given the high rates of delayed cancer diagnosis and the difficulties in making diagnoses based on clinical features alone. Pathology and imaging services to support diagnostic testing are often limited in low-income countries.

In these settings, point-of-care testing may offer improved access to diagnostic and laboratory tests for monitoring non-communicable diseases, as well as rapid microbiological tests for infections such as HIV, malaria and sexually-transmitted infections. Health care providers would need to be trained in point-of-care testing and monitoring.

Learning from errors

Health care organizations need ways to routinely assess the quality of diagnostic care. Strategies include tools that identify potential errors or triggers by looking at patients' records, assigning "clinical champions" to

encourage reporting and learning from errors, and identifying breakdowns in processes for the follow-up of abnormal findings[27, 28]. Finding and analyzing individual cases of diagnostic error provides an opportunity to understand the problem and explore solutions. Non-punitive and non-defensive discussions are valuable for improving awareness and learning how to avoid potential solutions errors.

These discussions can take place at clinic meetings and should involve all members of the health care team. Where possible, a formal root cause analysis could become a routine part of the learning effort. A key challenge is to understand the provider's circumstances at the time of error, thus, trying to avoid the hindsight bias that can arise when events are reviewed retrospectively. The goal is to understand why the actions (or inactions) made sense at the time and what could be improved in the future. As well as discussing problems, interventions that worked well should also be identified and emphasized

Conclusion

Mistakes in diagnosis can be reduced by attention to detail and obtaining as much information as possible before making the diagnosis. In terms of arriving at a correct diagnosis, the baseball rule of "three strikes and you're out" can be applied to endodontics; before making a definitive diagnosis, obtain at least three good pieces of evidence supporting the diagnosis. For example, a radiograph showing a tooth with an apical lesion may suggest pulp necrosis. But to be certain of that diagnosis, it is necessary to have additional information such as a lack of response to electric pulp testing. A draining sinus tract leading to the tooth apex should be proved radiographically with a gutta-percha point inserted in the tract and radiographed. Three such pieces of information make a diagnosis of pulp necrosis reasonable and a treatment plan that includes root canal therapy logical.[9]

CHAPTER 3

MISHAPS IN ISOLATION

DR SAVITA HADAKAR

> "Every patient must be considered infectious and the same infection control procedure must be applied for all patients".
>
> - Ed Besner

The use of the rubber dam serves multiple purposes which focus on patient protection and comfort, doctor protection and facilitation of treatment. Studies have shown that microorganisms can be reduced quite considerably when a rubber dam is used because it will prevent salivary contamination. During the various treatments, application of a rubber dam for proper isolation is also a well-established part of the procedure.[9]

The purpose of a rubber dam placement is to improve the overall quality of dental treatment. Indications for rubber dam placement are moisture control, visibility, patient protection and patient treatment.

Rubber dam placement allows the clinician to achieve a dry field by isolating the tooth (or teeth) indicated for treatment from oral fluids and other oral tissues (lips, cheeks, tongue and gingiva). This protects the patient from swallowing or aspirating (drawing into the lungs) debris and dental objects that are used during the procedure. It also protects the tissues from irritating materials used for the procedure, such as acids for etching enamel.

Proper isolation during technique-sensitive dental procedures is important but is also sometimes difficult to achieve.[10]

Aspiration and ingestion

Aspiration or ingestion of a foreign object is a complication that can occur during any dental procedure.[9]

Prevention is best accomplished by strict adherence to the use of a rubber dam during all phases of endodontic therapy. Aspiration of a loosed clamp can be avoided by attaching floss to the clamp before placement.

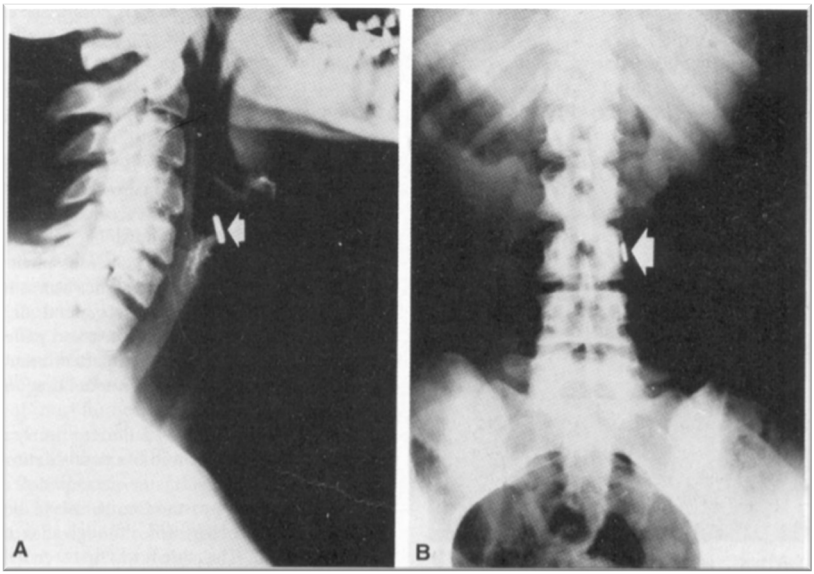

Figure 3-1: clamp detected in chest radiograph supraclavicular.

Case Report[11]

A four-and-a-half-year-old, male child came to a pediatric and dental clinic suffering from pain on his upper right quadrant. Upon clinical examination, a badly decayed, upper right, second deciduous molar was found that needed pulpotomy. A #8 Satin Steel rubber dam clamp was seated inside the patient's mouth, followed by a rubber dam sheet and was not secured with a dental floss. The patient moved unexpectedly and the clamp jumped into his throat. The patient was instructed to cough forcefully, but the clamp could not be retrieved. A thorough examination was done using a tongue depressor, but was not productive. There was no evidence of airway compromise, respiratory distress or abdominal tenderness. The parents were informed about the accident and were reassured. Chest and abdominal radiographs were taken and the clamp was detected in the chest radiograph supraclavicular as seen in Figure 3-1 (A and B). The patient was referred to the Department of Ear Nose and Throat and the clamp was removed under

general anesthesia, using a laryngoscope, as illustrated in Figure 3-2 (a and b), and without any evidence of trauma after removal.

Figure 3-2. a) Rubber dam clam, b) laryngoscope

Ingested foreign bodies that lodge in the gastrointestinal tract pass through the tract within a few days to a month. When such cases are not diagnosed or treated appropriately, it may cause serious complications. Owing to the shape and sharpness of the instrument, there are chances of perforation. Once the instrument is lost in the oropharynx, it is very important to determine whether the instrument has entered the digestive tract or respiratory tract. A radiographic examination with a posteroanterior and lateral chest radiograph (Figure 3-3), or abdominal radiograph is mandatory for determining the location, size and nature of the ingested foreign body. In the current case, a chest radiograph was advised as the patient was complaining of something sticking in his throat.

In case of a radiolucent foreign body, other diagnostic methods include a CT or MRI scan. Entry of a foreign body into the respiratory tract is potentially life-threatening, and the object requires prompt removal. Vigorous and spasmodic coughing and difficulty in breathing frequently occur immediately; however, a period without symptoms can last for years. The most common signs and symptoms of foreign body aspiration include coughing, wheezing and decreased breathing sounds. Preferentially, foreign bodies tend to be lodged in the right bronchial tree because of its vertical anatomical position. To overcome that situation, a rubber dam clamp must be secured with a dental floss.