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CLINICAL PRACTICE

FOREIGN BODY ASPIRATION IN DENTISTRY: A REVIEW

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A B S T R A C T

This article reviews the dangers of aspirating foreign bodies of dental origin. Two illustrative cases are presented, including an unusual case involving aspiration of an elastomeric impression material. The authors describe the techniques used to identify the foreign body. A radiodensimetric study of four impression materials demonstrates the difficulty of identifying most impression materials. The authors also present some strategies for reducing the risk of aspiration during dental procedures.

Many complications can arise from the routine delivery of dental care.[1] These complications include adverse drug reactions, allergic reactions to dental materials, physical injury from instrument slippage or breakage and swallowing or aspirating foreign objects. Any object routinely placed into or removed from the oral cavity during dental or surgical procedures can be aspirated or swallowed. These items can include teeth, restorations, restorative materials, instruments, implant parts, rubber dam clamps, gauze packs and impression materials. The possibility of swallowing or aspirating an object is increased by the common practice of placing the patient in a supine position for sit-down, four-handed dental treatment.[2]

Other factors that may increase the possibility of aspiration include age (a decreased gag reflex in elderly patients), medical conditions (such as stroke, dementia and Parkinson's disease), use of local anesthetics and altered states of consciousness associated with intravenous sedation.

Many reports in the literature describe the aspiration of dental instruments, restorations and prostheses.[3-20] In a 33-year retrospective review, Limper and Prakash[21] reported that the second most common cause of foreign body aspiration in the lungs was of dental origin.

The consequences of aspirating a foreign object or material can range from immediate obstruction of the airway to long-lasting pulmonary complications. Early complications can include hypoventilation of the distal lung segment with subsequent atelectasis and hypoxia. Later complications can include infection, such as lung abscess or pneumonia, and atelectasis.[22]

BARRIER TECHNIQUES

Researchers have described several strategies to avoid aspiration of objects during routine dental treatment.[2] The easiest and most common procedure for routine restorative and endodontic procedures is the use of the rubber dam,[23-27] which offers effective protection against aspiration or swallowing of endodontic instruments, broken burs, restorative materials and pins. While the rubber dam reduces the risk of aspiration during restorative procedures, it is possible for the dam clamp itself to be aspirated. To reduce this risk, Alexander and Delholm[7] and Meyers[28] have suggested that dental floss be used to secure the rubber dam clamp.

Many dental techniques preclude the use of the rubber dam, particularly during routine oral surgery and prosthodontic procedures. An alternative is to place a 4 × 4-inch gauze protective barrier in the oral cavity distal to the area where small items are being manipulated. The dentist may also place temporary loops on cast restorations for tethering the restoration with dental floss.[29] Dentists should also instruct patients

that if an object falls on the tongue, they should try to suppress the swallowing reflex and turn their heads to the side.

One prosthetic procedure that does not easily allow for the above barrier techniques is full arch impressions. An impression procedure may put a patient at risk of aspirating the impression material if a large amount of material and/or low-viscosity material is introduced to the posterior oral cavity. Medical emergencies can arise when practitioners hold the patient responsible for managing this mass if it flows into the oropharynx.

Two case reports that illustrate the problem of aspiration follow:

Case 1. During placement of an amalgam restoration in an 85-year-old man, the amalgam was dropped into the posterior oropharynx and was aspirated into the lung (Figure 1). A pulmonologist removed it the next day without complications using a flexible fiber-optic bronchoscope.

Case 2. As part of a comprehensive physical examination upon his early retirement, a 45-year-old man came to the pulmonary clinic of the Dwight D. Eisenhower Army Medical Center, Fort Gordon, Ga., for evaluation of what he thought was a three-year history of asthma. The patient related a history of wheezing and recurrent pulmonary infections that prevented him from performing his military duties. He had been treated with bronchodilators, theophylline and corticosteroids for the three-year period.

On careful questioning, the patient indicated that he had dental impressions taken the day before the onset of his initial symptoms, which caused him to gag severely. Chest radiographs did not show any aspirated material, and because the patient did not have obstructive pulmonary function, a pulmonologist performed bronchoscopy. He located a foreign body in the right lung and removed it with a flexible fiber-optic bronchoscope.

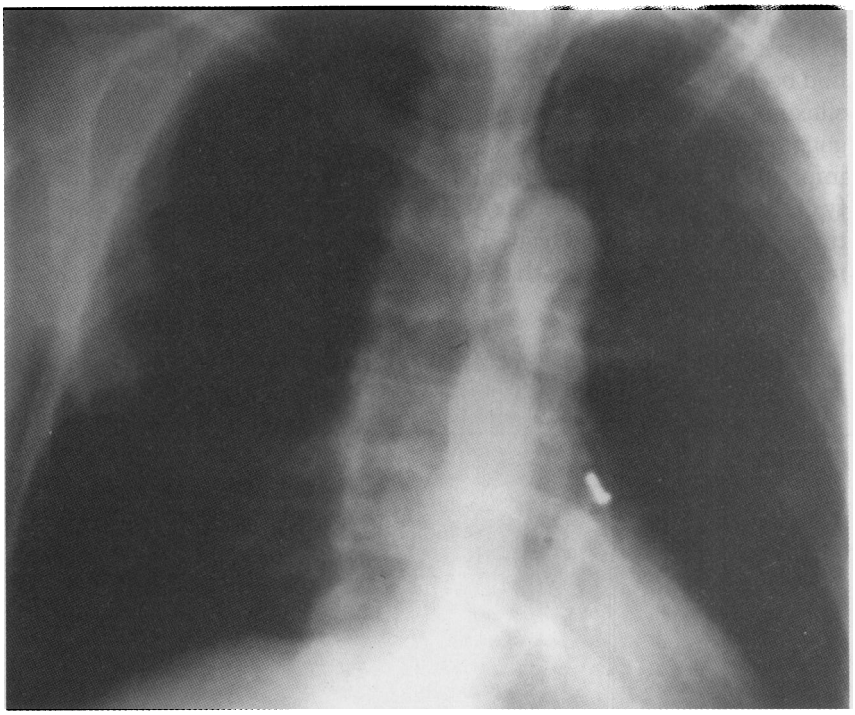

Figure 1. Chest radiograph showing amalgam in the right lung of Patient 1.

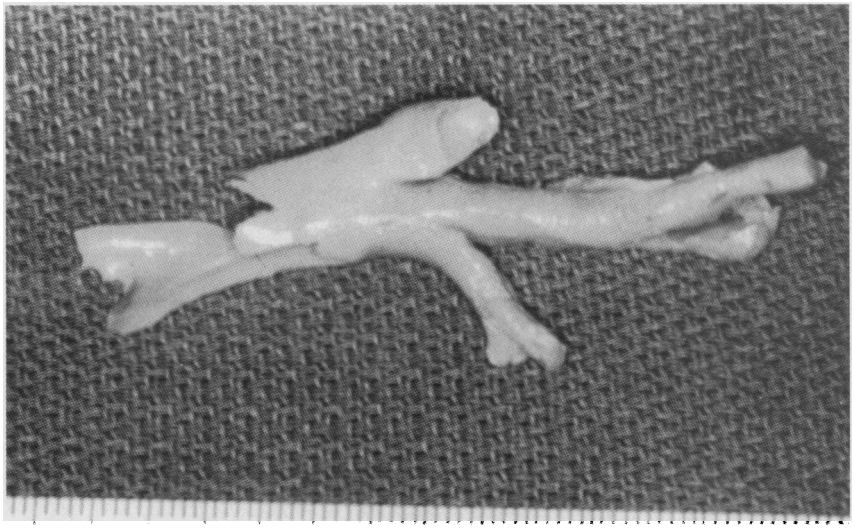

Figure 2. Foreign body removed from the right lung of Patient 2.

The recovered material was initially identified by its color and consistency as well as the dental history of the patient (Figure 2). The patient's dental record indicated that a maxillary tooth had been prepared for a crown on July 20, 1990, and a final impression had been made. The next

entry, recorded two weeks later, indicated that a new impression had been made with polyvinylsiloxane because of the patient's gagging episode during the first impression. To confirm the identity of the material, an X-ray spectroscopic graph of the recovered material was compared with that of a sample of the impression material (Figure 3).

DISCUSSION

These case reports demonstrate the importance of radiodensity and mass of any aspirate of dental origin in regard to it being discovered on a chest radiograph. While the pulmonologist was able to easily see the amalgam in the first patient, it was not possible to see the mass of impression material in the second patient on a routine chest radiograph. Because it was not clear to us how much impression material is necessary to be distinguished radiographically, we conducted a simple experiment.

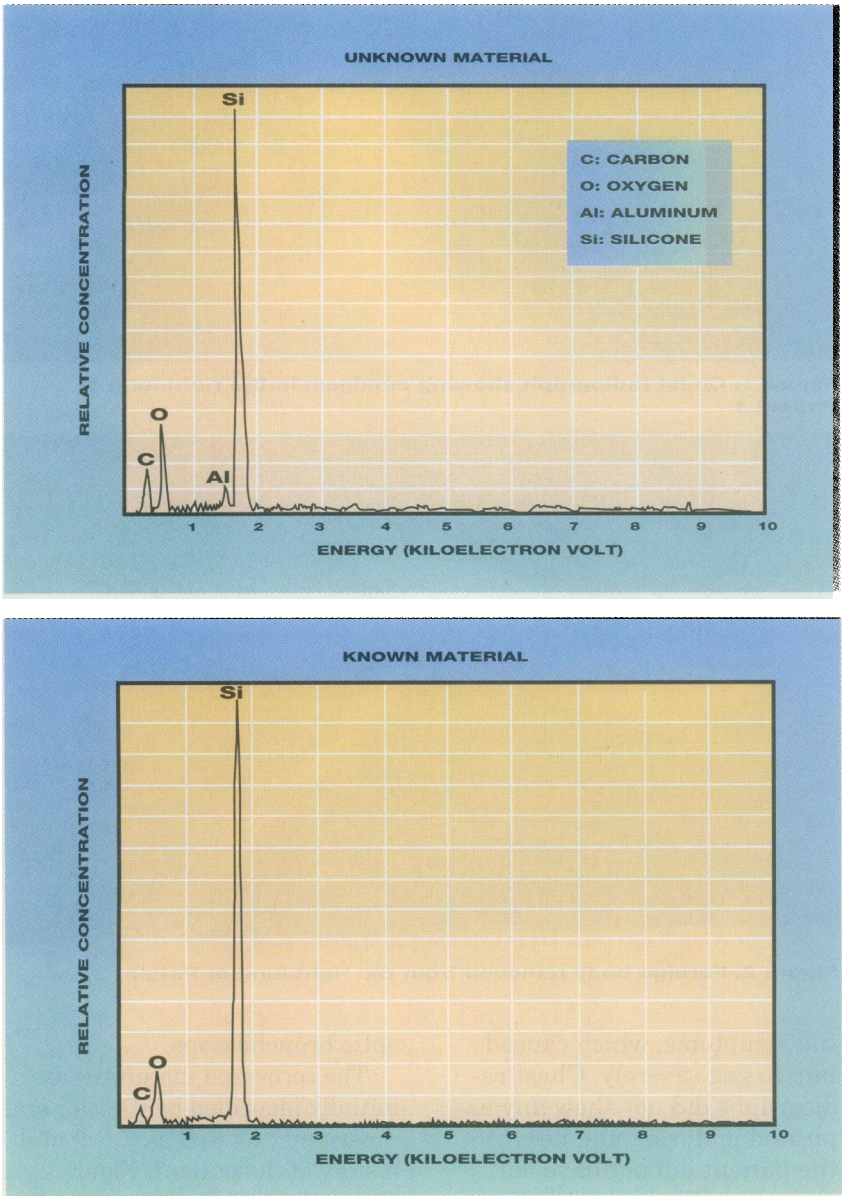

Figure 3. Top: An X-ray spectroscopic graph of the material removed from the right lung of Patient 2 (unknown material). Bottom: An X-ray spectroscopic graph of polyvinylsiloxane (known material). The x-axis indicates the elements present in the material being analyzed. Each element responds to X-rays at a discrete, identifiable energy level. The y-axis indicates the relative abundance of each element present.

Figure 4 demonstrates the radiodensity of four common impression materials. Using 10 steps of 1.4 millimeters each, we fabricated a step-wedge block of each material.

Figure 4 (top left) shows polyvinylsiloxane ("V") impression material. This is a polysiloxane base and accelerator available in low, medium, heavy and putty consistencies. The base contains a polymer of low-molecular weight and fillers. The accelerator is also a low-molecular-weight polymer with vinyl terminal groups. The accelerator also includes a catalyst of chloroplatinic acid and usually contains finely ground palladium or platinum for the absorption of hydrogen.[30] The inclusion of a metallic catalyst and scavengers may add slightly to the radiopacity of the material.

Figure 4 (top right) shows polyether ("E") impression material. In these materials, a low-molecular base of polyether is mixed with a catalyst of 2,5-dichlorobenzene sulfonate.[30]

Figure 4 (bottom left) shows irreversible hydrocolloid ("A") impression material in which potassium alginate reacts with calcium sulfate dihydrate to form an insoluble calcium alginate gel when mixed with water.[30] Modifiers such as potassium zinc fluoride, potassium sulfate, or silicates and

fillers such as diatomaceous earth may be responsible for the slight radiopacity present.

Figure 4 (bottom right) shows polysulfide ("P") impression material, which is supplied as a two-part base and accelerator system. The base contains a polysulfide polymer and titanium dioxide, zinc sulfate, copper carbonate or silica. The accelerator consists mainly of lead dioxide and dibutyl or dioctyl phthalate. Because of the high percentage of lead dioxide (60 to 68 percent)[30] in the accelerator, the polysulfide step-wedge block exhibits significant radiopacity.

As can be seen from the radiographs of all of the impression materials, only the polysulfide impression material demonstrates any significant radiopacity at a thickness similar to that of the recovered aspirated material from Patient 2.

By using judicious airway protection techniques, practitioners can avoid the problems encountered by the patients and doctors in these case reports.

By using judicious airway protection techniques (Box), practitioners can avoid the problems encountered by the patients and doctors in these case reports. The use of a rubber dam, with proper precautions, is an effective method of preventing aspiration. If the procedure precludes the use of a rubber dam, a gauze throat barrier is indicated. It is important to remember that the gauze also can be aspirated[31] and should be controlled by attaching floss or leaving a long trailing edge of the gauze. In all dental procedures, a high-velocity evacuation system should be available.

DENTAL IMPRESSION TECHNIQUES

Dental impressions usually prevent the use of barrier tech-

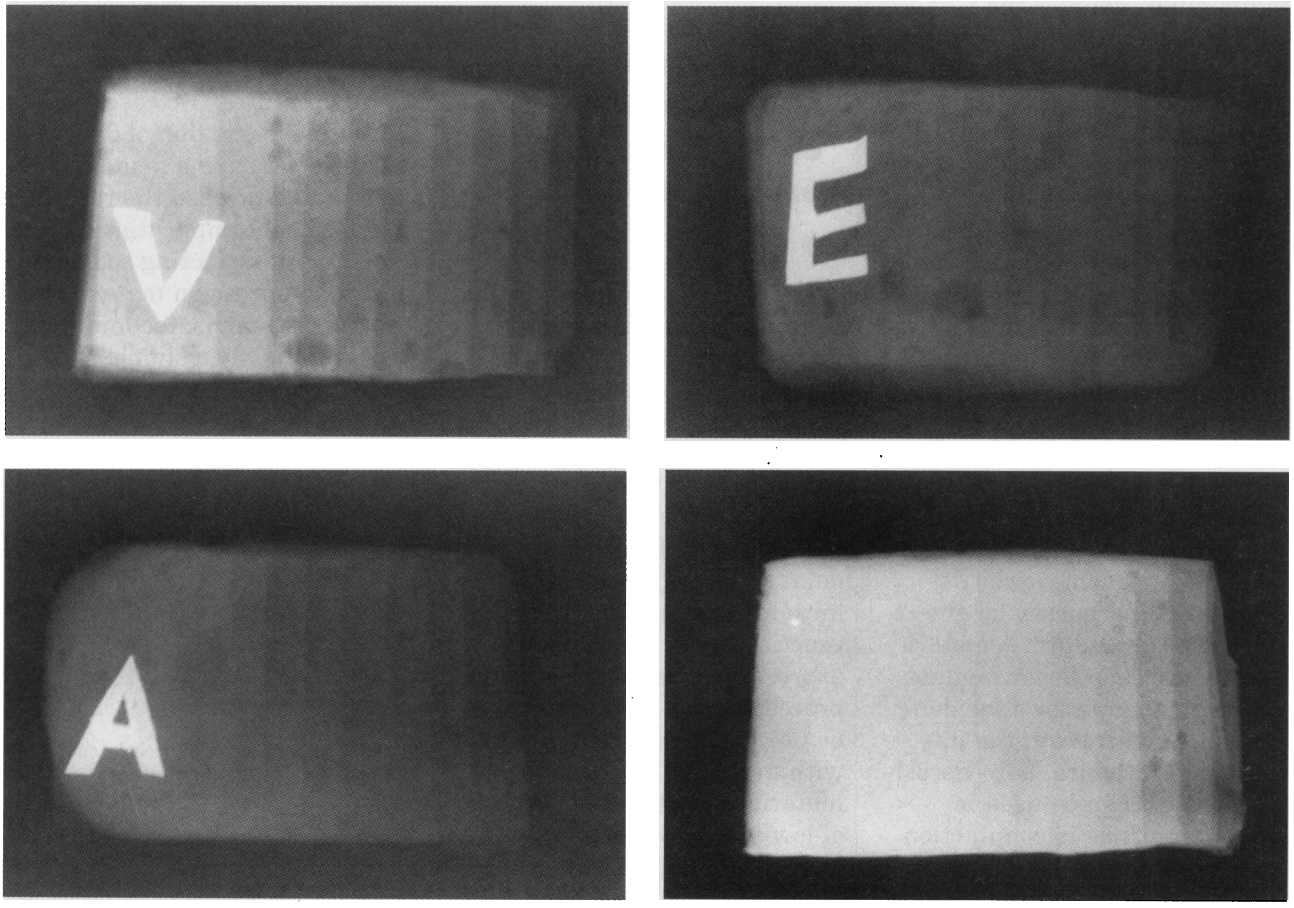

Figure 4. Radiographs showing polyvinylsiloxane impression material (top left), polyether impression material (top right), irreversible hydrocolloid impression material (bottom left) and polysulfide impression material (bottom right).

STRATEGIES TO PREVENT ASPIRATION.

ALL PROCEDURES

- Use a rubber dam.
- Use a gauze throat pack if a rubber dam is not possible.
- Use high-velocity evacuation.

IMPRESSION PROCEDURES

- Use a high-viscosity type of material.
- Use a custom tray, with an open-palate design for maxillary trays.
- Observe the entire impression procedure.
- Use a more upright position if possible.
- Provide thorough instructions to patients.

niques. As a result, dentists must rely on other techniques to prevent airway compromise. Open-mouth impression techniques, either maxillary or mandibular, depress the mandible, exposing the oropharynx to materials initially expelled from impression trays, and allow low-viscosity materials to drip or flow into the oropharynx. The closed-mouth, dual-arch impression technique allows the tongue to assume a normal position, fill the oropharynx and, in our subjective experiences, force the impression materials to the anterior of the mouth.

Viscosity of material. For all impression techniques, we recommend that dentists use the most viscous material available that will achieve the desired level of accuracy for the particular procedure. A material that ceases to flow when not under pressure allows the dentist more control over the impression procedure. Low-viscosity materials can be used in small quantities in conjunction with higher-viscosity putty materials to enhance surface reproduction and ease removal of the impression tray.

For all impression techniques, we recommend that dentists use the most viscous material available that will achieve the desired level of accuracy for the particular procedure.

Custom impression trays. Based on our experience, we also believe that a custom impression tray should be used instead of a stock impression tray. This minimizes the amount of impression material required and directs the material to the areas needed. Leaving the palate open on a custom maxillary impression tray allows the practitioner to see any excess expressed material early in the procedure. If a stock tray must be used, it should be modified with modeling plastic or a putty material to reduce the amount of low-viscosity material used.

When using open-mouth impression procedures, dentists should observe the entire impression procedure. This can be crucial for patients who have risk factors for aspiration. The dentist should be prepared to use suction, cotton-tipped applicators, a tongue blade, a mirror head or a finger to retrieve material from the oropharynx. Placing the patient in a more upright position and flexing the neck will also help. The dentist must also instruct the patient on what to expect and what to do if material begins to flow into the oropharynx and the gag reflex begins. Telling the patient to bend forward and place the chin on the chest is, in our experience, usually successful.

CONCLUSION

We have described the aspiration and ingestion hazards involved in dental practice, and suggested barrier techniques for different procedures. We also have presented two case reports involving aspiration of dental materials during a dental procedure and described the resulting medical complications. The difficulty in detecting some aspirated impression materials with radiographic techniques is underscored by a simple radiodensimetric study of four common impression materials. When possible, we recommend that dentists use high-viscosity impression materials in custom impression or dual arch trays. ■

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