



## Endodontic fortuity: Ingestion of Endodontic file- A systematic review

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(Received: 16 September 2024

Revised: 11 November 2024

Accepted: 11 January 2025)

### KEYWORDS

Accidental file ingestion, Bronchoscopy, Endodontic file ingestion, file aspiration, foreign body ingestion, Root canal treatment.

### ABSTRACT:

Dental materials and instruments owing to their finer size are considered easily gullible if slipped into oral cavity. Endodontic file ingestion, is particularly traumatic if intestinal perforation occurs. Dental procedure using a foreign body carried out without the use of a rubber dam inherently carries the risk of being aspirated or swallowed by the patient. Boluses of food, bones, seeds, beans, batteries, and coins make up the majority of foreign things that are consumed. Accidental swallowing of dental equipment during dental operations is a rare but recognized and dangerous adverse occurrence. This systematic review's objective was to examine the literature on published case reports associated with accidental ingestion of an endodontic file during dental procedure and discuss its sequelae.

### Introduction:

It is rare for dental equipment to be accidentally swallowed or inhaled while receiving treatment. Impaction, perforation, and obstruction of the respiratory or digestive systems are all potential outcomes, albeit they are uncommon.<sup>[1]</sup> Certain devices, like endodontic files, have sharp tips and are much more likely to cause perforation. According to Grossman, 13% of the ingested foreign bodies pass through the pulmonary system and 87% pass through the gastrointestinal system.<sup>[2,3]</sup>

The majority of foreign objects that enter the digestive system pass away on their own. For treating the ingested body, treatment modalities adopted are surgical as well as non-surgical depending upon the need of case. Dental procedure using a foreign body carried out without the use of a rubber dam inherently carries the risk of being aspirated or

swallowed by the patient.<sup>[4]</sup> Boluses of food, bones, seeds, beans, batteries, and coins make up the majority of foreign things that are consumed. Accidental swallowing of dental equipment during dental operations is a rare but recognized and dangerous adverse occurrence.<sup>[5]</sup> The actual incidence of this condition is unclear, but prior research has estimated it to be between 0.00012% and 0.004%.<sup>[6,7]</sup> A variety of dental instruments including mirror heads, files, broaches, clamps, burs tools for implant, etc have been known to be ingested accidentally. Even though complications are uncommon, they can be dangerous and even lethal, so understanding these unfavourable outcomes and how to handle them is essential. The review draws attention to the unintentional ingestion of an endodontic file used during a standard root canal treatment. In addition to discussing problems, cases are chronicled in detail. The discussion has a strong emphasis on early diagnosis and treatment, with a



particular focus on prevention through the use of rubber dams, which are absolutely necessary during endodontic treatment.<sup>[8,9]</sup> Although there have been multiple case reports about unintentional endodontic file ingestion incidents published in dentistry journals, there haven't been many comprehensive reviews. In light of this, the authors thoroughly reviewed the information on these accidents that was available and carried out a systematic assessment of case reports that had been published during the previous 20 years.

## MATERIALS AND METHODS:

### Methodology

This study was conducted following the guidelines for Preferred Reporting Items for Systematic Review & Meta Analysis (PRISMA) and results were noted systematically.

### Search Strategies

A search was conducted using the search engines Google scholar, Research gate, Directory of Open Access Journals (DOAJ), Science Direct and PubMed Central. The keywords used were “Accidental file ingestion”, “bronchoscopy”, “endodontic file ingestion”, “endoscopy”, “file aspiration”, “foreign body ingestion” and “root canal treatment”

### Inclusion criteria

- Patients with ingested endodontic file
- Case reports published between 20-year period from 2004 to 2024
- Free full text reports
- Only English language reports

### Exclusion criteria

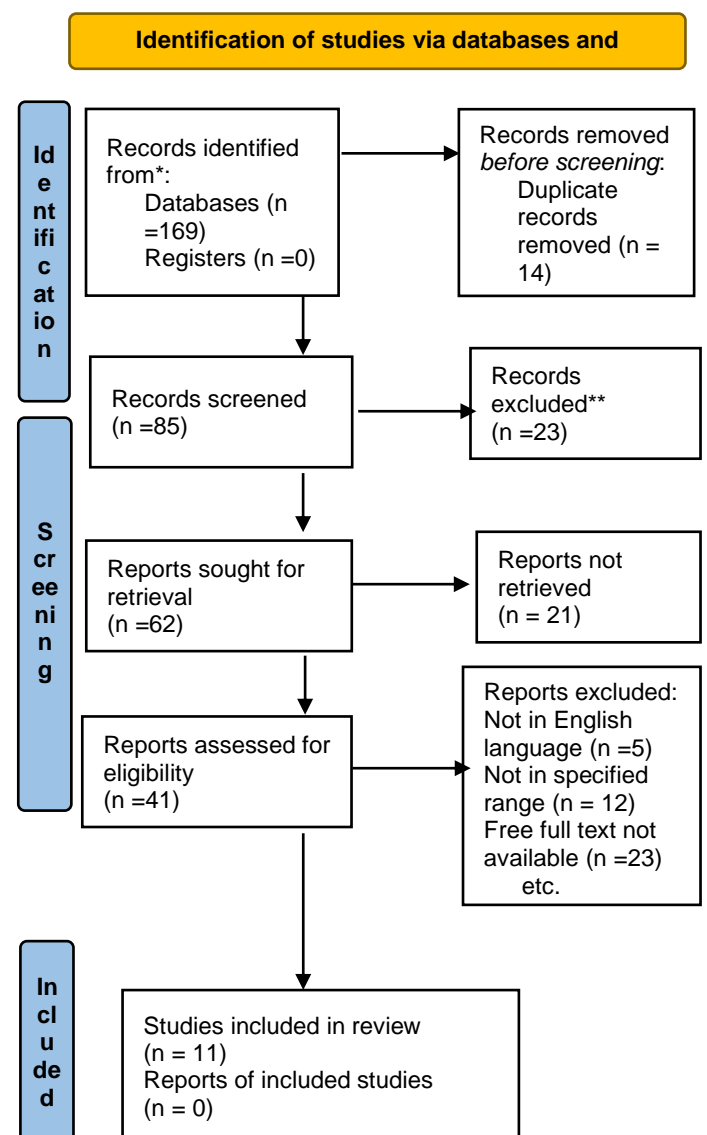
- Free full text not available
- Reviews, conference abstracts and case series
- Case reports in language other than English
- Case reports outside the 2004-2024 range

### Data collection and assessment

A Google Scholar search turned up 3 manuscripts, Researchgate search 90 manuscripts, DOAJ search 26 manuscripts, Science Direct search 42 manuscripts while the search on PubMed Central produced 8 articles. After removing common articles, non-English

articles, and articles outside the (2004-2024) range, 41 articles were finalized for analysis, of which 11 had free full text and ultimately 11 were available for final study analysis.

### PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only



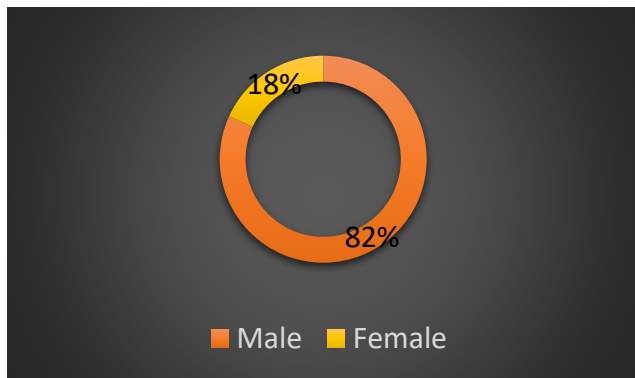
\*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).



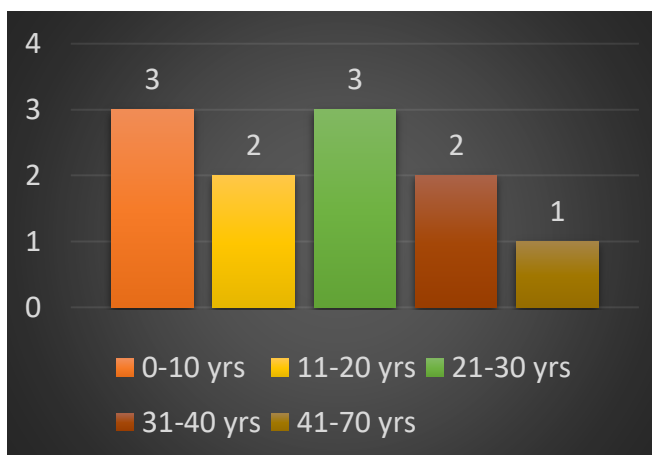
\*\*If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

**RESULT**

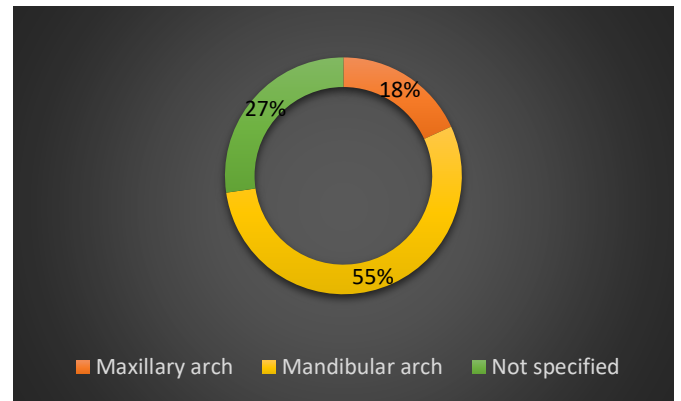
11 separate case reports were assessed using a variety of criteria (Table 1). 9 cases were reported in male patients and 2 cases in female patients (Graph 1) when the distribution of genders was taken into consideration. The oldest patient was 62 years old, and the youngest was 4 years old (Graph 2). Two cases had occurred in the maxilla, six in the mandible, and two case report did not specify the tooth that was undergoing treatment during the accidental file ingestion occurred (Graph 3). The majority of the files consumed were ProTaper(Dentsply) followed by endodontic hand k files (Graph 4). Retrieval of ingested file by various interventions were carried out which are mentioned accordingly (Graph 5).



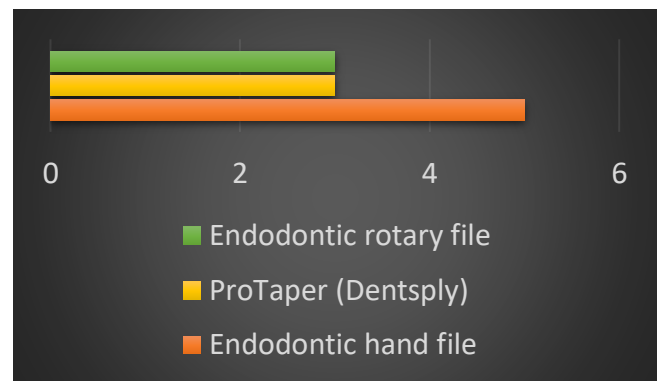
**Fig.1: Gender predilection amongst the case reports**



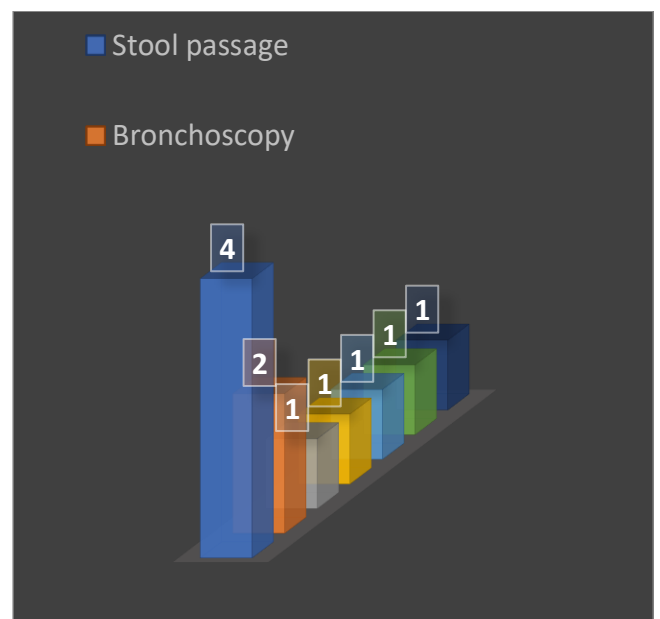
**Fig.2 Number of patients in the specific age range in the case reports**



**Fig.3: Tooth belonged to following arch when file ingestion occurred**



**Fig.4: Type of ingested Endodontic file**



**Fig.5: Intervention for the retrieval of ingested instrument**

**TABLE 1- Case reports assessed and their detailed description**

Author	Yr. of Publication	Type of endodontic instrument ingested	Age/Gender of patient	Case details and follow-up
Karthik Venkataravan, A.Anantharaj, P.Praveen, S.Prathibha Rani, B.MuraliKrishnan <sup>[1]</sup>	2010	Endodontic 6 no. hand K-file 21mm length	5year-old boy	While files were inserted, patient had bout of cough leading to file ingestion. An endoscopy was scheduled and a chest X-ray was done. The gastroenterologist proposed that the instrument might have penetrated the intestinal mucosa and entered other tissue planes. Thus, a CT scan was scheduled for the next day. In addition to being prescribed medication to increase stomach motility, the kid was instructed to remain under surveillance for the next 48 hours. The unbroken instrument was eventually recovered from the stool the child passed on the third day. <sup>[1]</sup>
Hrushikesh P. Saraf, Pradnya P. Nikhade, Manoj G.Chandak <sup>[2]</sup>	2012	Endodontic 15 no. hand K-file	38-years-old female	A radiologist confirmed the presence of a file in the lower gastrointestinal tract at the lumbosacral level by detecting it in an abdominal radiograph. To aid in the passage of the instrument through the intestinal tract, a diet high in roughage was prescribed. On the third day, the abdominal radiograph was clear with no evidence of the file, indicating that the file

Mahesh R, Vishnu Prasad, Padma A. Menon <sup>[3]</sup>	2013	Pro Tape 1 hand file, Dent sply	8 year old boy	Since the patient had Attention Deficient Hyperactive Disorder (ADHD), sedation was used as part of the treatment plan. A rapid head movement by the patient during the biomechanical preparation caused an endodontic instrument to slide out of the dentist's hand and be swallowed by the patient. PA radiograph followed by CT scan showed the file in the left major bronchi. Bronchoscopy indicated it was entrenched in the bronchial wall. The endodontic instrument's handle was gradually pulled out of the mucosal fold using a bronchoscopic grasper. The mucosal puncture site was examined for perforation and hemorrhage. After that, the bronchoscope was withdrawn and the endodontic instrument was retrieved, all of which were visible during the procedure. After that, the patient was released with no complaints. <sup>[3]</sup>
Capt Ankur Thakral, Col Subrato Senb, Lt Col V.P. Singh c, Maj N. Ramakrishn	2013	Protaper Sx endodontic hand file (Dentsply Ltd, UK)	32-year-old male	The patient's abrupt movement during the file removal process caused slippage. Both the Heimlich maneuver and the aspirator failed to recover the file. A CT scan and PA chest X-ray showed a file in the left bronchus. The file was successfully recovered using C-arm fluoroscopy after a rigid bronchoscopy under general anesthesia. <sup>[4]</sup>



<b>ad, Col V.B. Mandl ike<sup>[4]</sup></b>				
<b>Prashant Bhandarkar, Anishri Naik, Sudha Patil, Parth H Shah<sup>[5]</sup></b>	2014	Pro Taper Sx endodontic hand file, Dent sply	4-year-old male	The patient abruptly moved his head during the BMP of the root canal, causing the file to slip and be swallowed. Four to five thrusts were applied to the patient's back in the prone position, with the head lower than the limb, in the hopes of forcing the instrument out, but this did not work. At level L2-L3, immediately below the diaphragm's shadow, a sharp foreign item was visible on the PA chest X-ray. The parents who were with the child gave their high-risk agreement, the patient was kept on a high-fiber diet, and syrup chremaffin was provided to facilitate the instrument's quick passage through the digestive system. The file was eventually discovered in the feces 41 hours after it was ingested. <sup>[5]</sup>
Joana Cotrima, Susana Corujeira, Joana Jardim, Hélder Cardoso, Eunice Trindade, Jorge Amil	2014	Dental rotary file	13-year-old girl	After accidentally ingesting a file, the girl was brought to the emergency department. A metallic object that appeared to be on the stomach/duodenal arch was discovered by the X-rays. The precise location of the dental file was ascertained by an abdominal CT scan, which indicated that it was lodged in the proximal jejunum/distal duodenum. The foreign body was discovered
<b>Dias<sup>[6]</sup></b>				embedded in the mucosa of the second section of the duodenum and had to be removed via balloon enteroscopy. Using a tiny cover to avoid damaging the mucosa, a 4 cm long dental file was carefully removed to the intestinal lumen and then to the outside. Following the object's removal, a little lesion in the duodenal mucosa was visible. <sup>[6]</sup>
<b>Muthahir Almutthahin, Abdulah Aljahdali, Mohammad Alzahrani, Bader Alhusain, Yousef Algamdi<sup>[7]</sup></b>	2017	Endodontic hand file	22-year-old male	The patient reported having something lodged in their throat. He had previously consumed an endodontic file during root canal treatment that same day. The file was discovered to be in the stomach fundus during endoscopy. Forceps were used to extract it through the over-tube without any issues. <sup>[7]</sup>
<b>Kerem Kökoğlu, Tuğrul Aslan, İmdat Yüce, Sedat Çağlı<sup>[8]</sup></b>	2019	Ni-Ti rotary instrument	20-year-old male	During RC treatment, an endodontic file accidentally slipped into the throat. A foreign body was discovered in the epiglottis upon endoscopic inspection. The file was likely to go from the vallecula to the epiglottis since the plain graph was acquired earlier. In order to be ready for any emergency, it was decided to remove the root canal file in the operating room. In the absence of sedation, retrieval of file by curved forceps was attempted. Unfortunately, though, the file unintentionally



				made its way to the hypopharynx. Thankfully, it was taken out on the second try. <sup>[8]</sup>					
<b>AshkunNaderian, Hooman Baghaie and Vysheki Satchithanandhan<sup>[9]</sup></b>	2022	Endodontic rotary file 27mm	62-year-old male	He had two instances of severe coughing and dyspnea during RCT, after which the dentist discovered a file was missing. The endodontic file in the duodenum was identified by frontal chest and abdominal radiographic imaging as a 27-mm linear radiopaque foreign body situated to the right of the abdomen's midline, roughly at the level of the L2/3 disc. The endodontic file had migrated to the distal ileum/ascending colon, beyond the reach of endoscopic recovery, according to a recent abdominal radiograph. On the 2 <sup>nd</sup> day of ingestion, it was assumed that file passed through stool as it was invisible on X-ray. The patient was released after showing no symptoms. <sup>[9]</sup>					and beginning a clear liquid diet, the patient had a colonoscopy that afternoon. The ascending colon was used to retrieve the foreign body. The mucosa was being superficially punctured by the pointed end. Rat tooth forceps were used to remove the dental file, which was done with a Roth net. To reduce damage to the anal canal, this was carefully removed after being extracted into the rectum. <sup>[10]</sup>
<b>Devon Marta Ptak Julia Tassinari, Elinor Alon, Robert Bruce Amato, Adrian Velasquez<sup>[1]</sup></b>	2023	Endodontic hand K-file of 25mm length	30-year-old male						A hand file fell and was inadvertently consumed during the RCT. The existence of the file in the distal portion of the stomach, which approximates the exit to the small bowel, was revealed by a kidney, ureter, and bladder (KUB) radiograph. A computed tomography (CT) scan of the abdomen was later performed as well. It was discovered that the file had stalled after three days of hospital observation. The next morning (Day 4), the patient had an exploratory laparotomy. A file thought to be connected to an extra-abdominal adhesion was discovered during the laparoscopy. Following dissociation, the surgery went well and the file was successfully extracted from the small intestine. <sup>[11]</sup>
<b>Arian R. Tagliaferri, MD, Gabriel Melki, MD, Crystal Feghali, BS, Yana Cavanagh, MD<sup>[10]</sup></b>	2022	Endodontic hand K-file	22-year-old male	During a procedure, the patient inadvertently swallows a dental file. Mild discomfort in epigastric region was experienced. A 4 mm linear radiopaque foreign body was found covering the midline of the upper abdomen, most likely in the gastric antrum, on an X-ray film of the neck, chest, and abdomen. In order to remove the foreign body, an enteroscopy was chosen because the dental file's sharp edge was in the stomach antrum. After receiving a bowel prep					



## DISCUSSION:

Finding a foreign substance that has been aspirated or consumed early on makes it easier to manage therapy and refer patients in a timely and suitable manner. Clinical symptoms and indicators should be continuously observed until the ingested body is eliminated or expelled whenever it enters the gastrointestinal system. It is recommended to acquire clinical follow-ups using serial abdominal radiographs.<sup>[10,9]</sup> Back blows for babies, the Heimlich manoeuvre, abdominal or chest thrusts for expecting or obese patients, and finger sweeps if the object is in the cavity of the mouth are non-invasive methods for treating airway obstruction.<sup>[11,12]</sup> During treatment, every object that comes loose should be picked up right once and checked for any possible missing parts. The physician may try to remove the object by putting the patient in a reverse Trendelenburg posture and inducing coughing if it was inadvertently swallowed and cannot be recovered with haemostats or high-pressure suction.<sup>[13, 3-5]</sup> When an airway blockage occurs, the healthcare provider should additionally try to reestablish the airway by using the Heimlich manoeuvre and/or repeated back blows. Depending on the patient's symptoms, emergency medical services should be called as needed.<sup>[14]</sup> While endoscopic removal is the best method for removing foreign bodies stuck in the oesophagus, bougienage or a Foley catheter may be used to push small, blunt objects into the stomach. If an endoscope can reach large or pointy foreign things once they have passed the oesophagus, they should be immediately retrieved.<sup>[15,7]</sup> Periodic stool inspections and radiographic surveillance are important components of conservative management. In the event that the patient's condition worsens or if the object slides and moves through the GI tract, endoscopic or surgical intervention is recommended. Any routine root canal procedure should take into account thorough isolation using a rubber dam and any adjustments that are required.<sup>[16-18]</sup> Early evaluation of the patient's cooperation is necessary, as is the use of a treatment plan. To ensure that the swallowed instrument has been eliminated or expelled, a post-operative radiograph ought to be done. In the case reports included in this review, majority of incidents of accidental ingestion of file occurred in male patients compared to female patients.<sup>[19-21,4-5]</sup> Also, the instance of file ingestion pointed more towards during the treatment of mandibular arch teeth rather than maxillary arch. The slippage of files during treatment of posterior

mandibular teeth can be attributed to the closeness of the teeth to the posterior most part of tongue leading to involuntary deglutition.<sup>[22]</sup>

Early onset symptoms of file ingestion range from mild symptoms like coughing and slight throat pain to severe symptoms like gagging. Irrespective of early symptoms the patients were admitted to the emergency departments of hospital as spontaneous intervention with careful monitoring is extremely essential.<sup>[23-25]</sup>

The patient must be sent right away to a medical emergency room for additional clinical as well as radiographic examination if an object cannot be found and verified to be intact. Other imaging, such as PA chest/ KUB radiographs, can be taken into consideration for determining the niche of ingested object and henceforth its treatment can be planned. Roughly 13% of inadvertently swallowed objects will enter the respiratory tract, requiring bronchoscopy and other surgical procedures to retrieve the object; however, the majority of objects will enter the gastrointestinal tract and pass through it without any problems, but there is still a chance of complications like impaction, perforation, or obstruction.<sup>[26-28]</sup>

With only 1% or less of accidental ingestions requiring surgical ingestion and surgical retrieval of a file removal, endoscopic retrieval or surgical intervention may be necessary if the object's progression through the gastrointestinal tract appears stalled or if it does not pass within a reasonable amount of time (usually within 2 days). This circumstance poses a significant risk of perforation of the intestinal tract and necessitates intervention.<sup>[9,10]</sup> A medical emergency may arise from inhaling a foreign body as opposed to swallowing one. Possible side effects include cardiac arrest, laryngeal edema, asphyxia, and acute dyspnoea. Pneumothorax and perforation are other hazards associated with thin, pointed endodontic devices. When an aspirated object occurs, prompt bronchoscopy retrieval is advised, with fluoroscopic guidance if the object is hard to locate. With a 90% retrieval success rate, flexible bronchoscopy has replaced rigid bronchoscopy as the first method for assessing and treating aspirated foreign bodies.<sup>[29,30]</sup> Because granulation tissue or inflammatory polyps can restrict airways, persistent retention of things in the lungs can make removal more difficult.

A physical barrier like a rubber dam, repositioning chairs, attaching tools to string or floss, or using a magnetic clip retractor are examples of preventative



measures.<sup>[10-12]</sup> According to a New Zealand retrospective survey, just 44% of dental treatments involved the use of physical barriers. Increased awareness is crucial because, albeit being rare, swallowing of foreign materials during dental operations can be potentially fatal.<sup>[31]</sup>

It is imperative that all endodontic procedures be performed under rubber dam isolation. When treating paediatric patients with endodontics, rotary files are better than manual files. To make it easier to retrieve the instrument, if hand files are being used, the floss should be tied to the handle of the files that is at least 18 inches long.<sup>[32]</sup> To reduce the possibility of instrument slippage, dentists should always operate in dry environments as opposed to moist ones.<sup>[20]</sup>

The cases discussed highlight the importance of proper treatment and how “prevention is better than cure”. Negligence on the clinician’s side leads to massive complications which are preventable by a simple rubber dam technique. These kinds of incidents come at a high financial, as well as in terms of diminished productivity, recuperation time, and psychological distress, burden to the patient, provider, and the medical industry.<sup>[11]</sup>

## CONCLUSION :

Dentists should know how to handle these kinds of circumstances since limiting the harmful effects of unintentional ingestions and aspirations requires early evaluation and treatment.<sup>[7]</sup> Additionally, the overall delivery of endodontic therapy can be improved and the frequency of these adverse occurrences can be significantly decreased by taking preventive measures such using a rubber dam. This systematic review aims to improve clinician understanding during treatment by stressing the significance of appropriate isolation measures through the compilation of case reports from the last 20 years.<sup>[18]</sup> The aforementioned cases highlight the possible seriousness of adverse outcomes linked to departing from the endodontic standard of care and ought to act as a reminder to all doctors doing endodontic treatment that a rubber dam is necessary.

## FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

## CONFLICT OF INTEREST

There was no conflict of interest.

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