

# Early Medical Assessment with Radiography Imaging Techniques – An Analysis with Pediatric Foreign Body Aspiration

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**Abstract** - In medical image processing radiography plays a significant role. The role of radiology is more important in case of pediatric foreign body aspiration for the localization of interested region extraction. The radiographic techniques such as X-ray, Computer Topography (CT), Magnetic Resonance Imaging (MRI), are most commonly used techniques to analyze the interested regions of the human body. In the medical image processing, the accuracy of the segmentation determines the early diagnosis, clinical studies and treatment planning of the radiotherapy. This paper presents review of various radiographic techniques which were used in pediatric foreign body aspiration. Based on the review the significant of radiographic techniques in medical image processing was observed, from the observation it is concluded that the identification of appropriate radiographic technique is very essential of localization of interested region and also a generic framework is proposed for fine tuning the radiography image to improve the accuracy of the diagnosis.

**Key Words:** Pediatric foreign body, Image segmentation, shape identification, location identification, X-ray, CT, MRI.

## 1. INTRODUCTION

Radiography techniques such as X-ray, computer topography (CT), Magnetic resonance imaging (MRI) are most commonly used in radiology techniques. It is become almost compulsory to use computers to assist doctors to address the issues like foreign body identification and removal with improved processing time and to achieve accurate result. In general children put anything in their mouth from time therefore accidental aspiration tends to occur. Sometimes, the symptoms of severe aspiration are very noticeable but the localization of chronic aspired foreign body needs radiography assessment. Hence, the role of radiography is more important in chronic cases of aspiration. Some of the pioneers who have contributed their work significantly in the past years have been discussed in related works.

## 2. RELATED WORKS

Foreign body aspiration is the common childhood problem. X-ray is an electromagnetic radiation, which creates images of these structures on photographic film or a fluorescent screen. Computed tomography (CT) is a technology that uses computer processed x-rays to produce tomography images of specific areas of the scanned area of the human body. Magnetic Resonance Image (MRI) is a technique of strong magnetic field and radio waves from images of the body. The commonly encountered foreign bodies vary geographically.

Sircar et al. (2019) presented a case study of accidental aspirations of sharp object and concluded that the early radiography assessment of the shape and anatomic location of the lodged foreign body helped to successful removal of the FB. Dhupar Puja et al. (2017) classified aspired foreign body based on their shape and size and also listed the common anatomic locations for foreign body trapped location by radiography assessment. Dr.SeikholetKuki et al. (2014) describes the most common pediatric foreign bodies ingested like coins, plastic toys or toy parts, sharp objects, button batteries, bones, and food. The size and thickness of radiological film determines the presents of objects in any X-ray image. The coins were identified by repeated pre and post X-ray examination. Rosaria De Ritis et al. (2014) discussed about the role of magnetic resonance imaging in diagnosing foreign bodies. Radio-opaque foreign body like metal can be seen on radiographs, but determining the location of radiolucent foreign bodies like wood which were requires MRI. Vijay G Yaliwal et al. (2014) presented a case study of a 21-year-old female accidental swallowing of double coin. X-ray radiographic before and after oesophagoscopy were made repeatedly to find the missing coin. Antonio pinto et al. (2013) demonstrated a diagnostic tool to assess the neck soft tissue FB with the help of radiography. The radiopacity of the aspired objects determines the visualization of a FB in radiography. Multi detector computed tomography (MDCT) is superior to plain radiography that identifies the FB with better accuracy than the plain radiography. Tariq O et al. (2013) discussed the clinical findings, sites and types of FBs and outcomes in children who undergone endoscopic management of ingested FBs. Z.M. Raahat et al. (2013) analyzed 83 children history of coin impaction. Repeated observation has been made by X-ray in every patient to see the latest location of impacted coin. Jeremy Fisher et al.(2013) has been made a study to determine the advantage of repeated chest radiography after removal of esophageal foreign bodies in pediatric population and conclude that the repeated chest radiography is not advisable for the treatment of children. Segun-Busari Segunet al. (2013), presented a review of multiple coins aspiration which were identified and removed by plain X-ray and endoscopy techniques. S. R. Mendes et al. (2012) discussed about the role of radiology in diagnosis and treatment management of foreign bodies in the gastrointestinal tract. They conclude that, it is very important for any radiologist to be aware of the typical imaging findings of foreign bodies to select the most appropriate imaging modality for their detection, depending on their nature. Lee JH et al. (2012) have discussed about the

role of radiography in the gastrointestinal tract with foreign bodies. Computer Tomography (CT) is useful when radiolucent materials which were unable to detect with plain X-rays. CT can also be useful in determining, treatment options and complications. H. Rizk et al. (2011) presented a review to assess the incidence of foreign body aspiration in pediatric population to improve prevention and early diagnosis and suggested that the physician and especially parental education are more important to reduce this pathology. Kenton L et al. (2011) discussed about the management strategies for impacted FBs in the several regions of the gastrointestinal tract. Anderson KL et al. (2011) has been discussed the types of foreign bodies are observed in the gastrointestinal tract. During childhood, swallowed coins, small toys, crayons or batteries are observed, whereas during adulthood, food, bones and dental-related foreign bodies are more common. Mohammed H et al. (2010) presented an analytical study of 62 patient's records with different age group. The age of the patients plays major role for initial radiography image diagnosis. Eti V Upadhyaya et al. (2009) discussed the rare case of multiple coins swallowing with its diagnosis and removal technique. The X-ray radiographic technique was used for the diagnosis and the treatment was given by esophagoscopy. M M Shaariyah et al. (2009) were presented a review of surgical management of foreign body ingestion and conclude that the plain radiograph is helpful to determine surgical removal. Turcker I et al. (2006) were described that the radiograph is a valuable investigation in finding foreign body. A plain film will easily demonstrate foreign body such as metal, glass and gravel. But it is difficult to detect radiolucent object such as rubber, meat, chicken bones and wood. Endican.S et al.(2006) were analyzed various types of diagnostic techniques at upper aero digestive tract that is ear, nose and throat foreign bodies and concluded that sound knowledge of radiography technique is required to avoid unnecessary investigation and management. A. M. Shivakumar et al. (2006) reviewed 152 patients (104 children and 48 adults) history with ingested foreign body. X-ray radiological examination was helped for all the patients to find the location of foreign body and removed using the endoscopic for all cases. Gerbaka B et al. (1997) were reviewed and presented a report says that, foreign body aspiration (FBA) remains a significant issue and for every hour eight persons die worldwide from foreign body aspiration. From the survey, it is evident that the coin ingestion seems to be the most common problem in occur in pediatric population. Other commonly used objects such as school stationery, balloons, batteries, wood and toys and the food items like fish and chicken bones. From the literature, it is clear that the radiography plays major role in the early diagnosis of foreign bodies. The significance of various radiography techniques used in pediatric foreign body aspiration specified in Table 1.

**Table -1:** Existing work observations

Author(s)	Application Domain	Radiography Technique	Observation
H. Rizk et al.		X-ray	A review to assess the incidence of foreign body aspiration in pediatric population to improve prevention and early diagnosis
Eti V Upadhyaya et al.	Esophagus	X-ray	Discussed the rare case of multiple coin swallowing with its diagnosis and removal technique.
Segun-Busari Segun et al.	Esophagus	X-ray	A review of multiple coins aspiration which were identified and removed by plain X-ray and endoscopy techniques
Z.M. Raahat et al.	Esophagus	X-ray	Analyzed 83 children history of coin impaction. Repeated observation has been made by X-ray in every patient to see the latest location of impacted coin
Jeremy Fisher et al.	Esophagus, Chest	CT	The repeated chest radiography is not good for children
Endican,S et al.	Aero digestive tract ,Ear, nose and throat	X-ray	The sound knowledge of radiography technique is required to avoid

			unnecessary investigation and management.
S. R. Mendes et al.	Gastrointestinal tract	X-ray, ct, MRI	It is very important for any radiologist to be aware of the typical imaging findings of foreign bodies to select the most appropriate imaging modality
M. M. Shaariyah et al.		X-ray	The plain radiograph is helpful to determine surgical removal
Kenton L et al.	Gastrointestinal tract	X-ray	The management strategies for impacted FBs in the several regions of the gastrointestinal tract.
Mohammed H et al.	Esophagus	X-ray	The age of the patients plays major role for initial radiography image diagnosis.
A. M. Shivakumar et al.	Neck and chest	X-ray	X-ray radiological examination was helped for all the patients to find the location of foreign body and removed using the endoscopic for all cases
Vijay G Yaliwal et al.	esophagus	X-ray	X-ray radiographic before and after oesophagoscopy were made repeatedly to find the

			missing coin
Tariq O. Abbas et al.		X-ray	Presented a clinical findings, sites and types of FBs, and outcomes in children who underwent endoscopic management of ingested FBs
Dr. SeikholetKuki et al.		X-ray	The most common pediatric foreign bodies ingested are coins, plastic toys or toy parts, sharp objects, button batteries, bones, and food.
Rosaria De Ritis et al.		MRI	Radio-opaque foreign body like metal can be seen on radiographs, but determining the location of radiolucent foreign bodies like wood which were requires MRI.
Antonio pinto et al.	Neck soft tissue	MDCT [Multidetector computed tomography]	The radiopacity of the aspired objects determines the visualization of a FB in radiography.
Gerbaka B et al.		X-ray	Foreign body aspiration (FBA) remains a significant issue and for every hour eight persons die worldwide from foreign

			body aspiration.
Anderson KL et al.	Gastrointestinal tract	X-ray	During childhood, swallowed coins, small toys, crayons or batteries are observed, whereas during adulthood, food, bones and dental-related foreign bodies are more common
Lee JH et al.	Chest	Plain radiography and X-ray	Computer Tomography (CT) is useful when radiolucent materials which were unable to detect with plain X-rays. CT can also be useful in determining, treatment options and complications
Turcker I et al.	Neck soft tissue	Plain film radiography, X-ray	A plain film will easily demonstrate foreign body such as metal, glass and gravel. But it is difficult to detect radiolucent object such as rubber, meat, chicken bones and wood

Based on the review it was observed, most of the researchers have been used X-ray radiography techniques in pediatric foreign body localization in the early diagnosis. As a conclusion of study of various radiography technique in pediatric foreign aspiration, it was identified X-ray is the most preferred radiography technique. A generic framework for fine tuning the X-ray radiography image to improve the accuracy of the diagnosis discussed in the below section

### 3. FRAMEWORK AND DISCUSSIONS

In general radiography images are prone to noise, irrelevant information, intensity problems and partial volume effect which makes the task of locating and analyzing suspicious area difficult by the doctor. It leads misinterpretation results. To improve interpretation accuracy it is important to determine whether the aspired foreign body is radio-opaque or not and also this process requires better visualization of interested object region. Therefore adapting image processing key stages in this stage will provide best diagnosis results. Hence the generic framework is proposed for pediatric foreign body identification and classification.

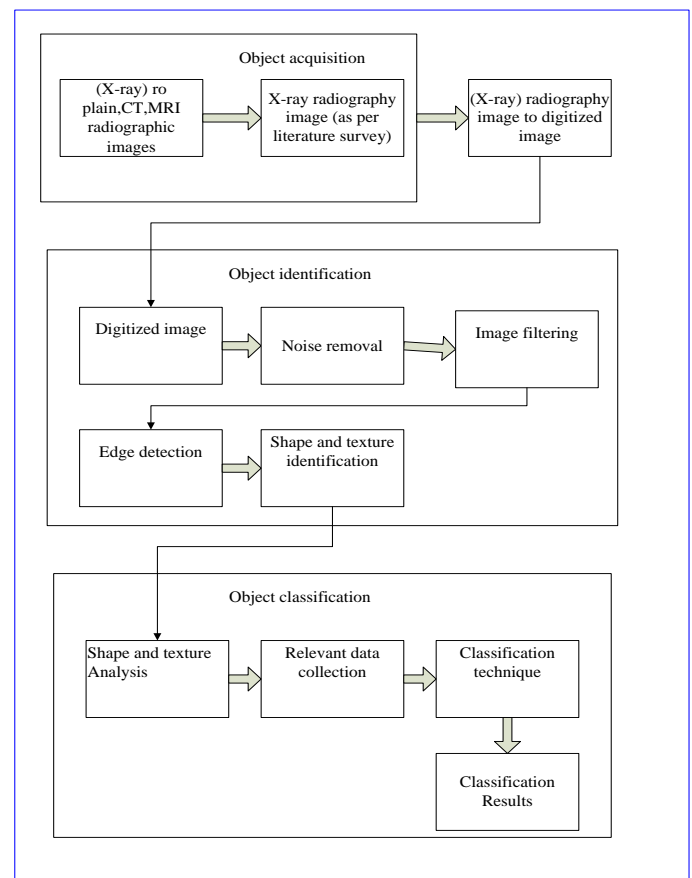


Fig -1: framework for pediatric foreign body identification and classification.

### 4. SAMPLE EXPERIMENTAL RESULTS

Experimental test uses 60 radiographic images from various public medical databases like gopix database. The sample experimental results for rule based and influenced feature based foreign body shape and location determination is presented in Figure 2(a) and Figure 2(b).



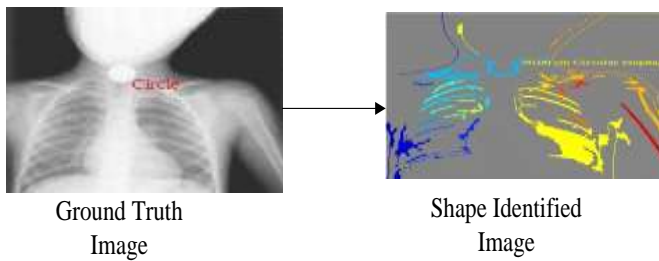


Fig -2(a): Sample experimental results for foreign body shape determination

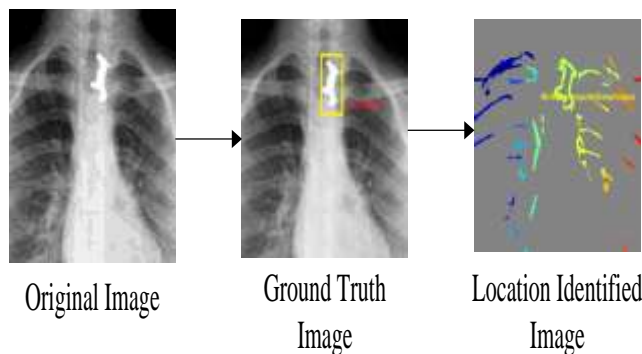


Fig -2(b): Sample experimental results of automatic anatomic location identification

#### 4.1 Performance analysis of shape and location determination

The developed automated shape determination approach is tested on several foreign body aspired radiography images and able to achieve significant classification accuracy with minimal error rate which are shown in chart 1 and chart 2.

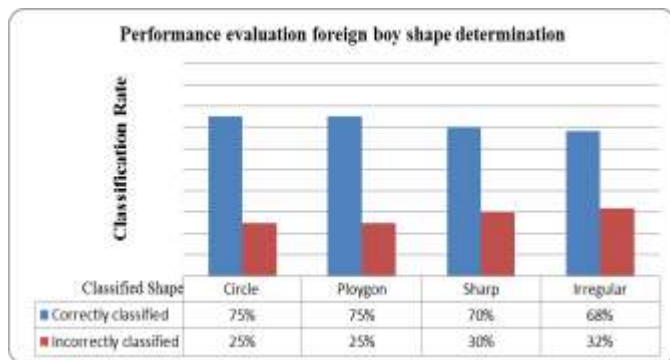


Chart -1: Classification accuracy of foreign body shape determination

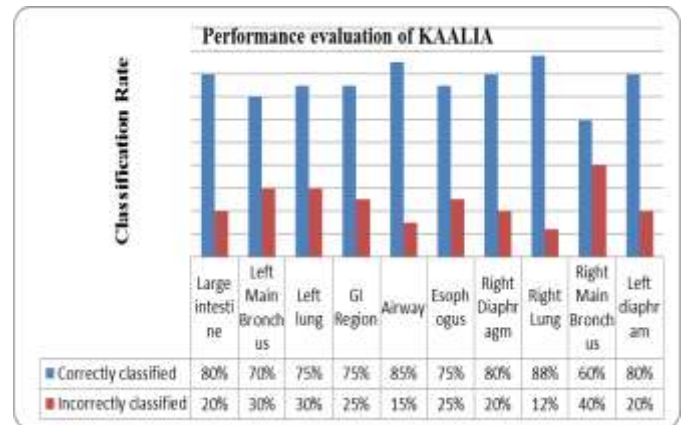


Chart -2: Classification accuracy of foreign body location determination

Chart 1 and Chart 2 illustrates that, the foreign body shape and location determination approach results achieve 72% of correct classification accuracy in determining the shape as circle, polygon, sharp and irregular. Based on the result observation, the classification accuracy is desirable for foreign body shape determination on foreign body aspired pediatric radiography images. The location identification approach achieves 88% of classification accuracy. The classification accuracy is desirable in location identification on foreign body aspired pediatric radiography images.

#### 5. CONCLUSIONS AND FUTURE WORK

This paper describes the role of radiographic techniques in pediatric foreign body aspiration and discussed a general framework for foreign body identification and classification. One of the most preferred scan for the early detection of foreign body is X-ray scan. X-ray is painless, inexpensive, and required less time to generate image. The future work aims to develop the proposed framework with knowledge based shape and location determination. The developed system is efficient for foreign body determination on pediatric foreign body radiography images which ultimately helps the doctors and medical practitioners in the early diagnosis and treatment management process of pediatric foreign body aspiration incident.

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