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## **Study of proper technique to avoid repeat radiography with proper instructions and positioning**

**Neeru Kapur<sup>1</sup>, Natasha Nargotra<sup>2</sup>, Tanu Singh<sup>3</sup>, Ritu Dhaka<sup>4</sup>, Ram Shankar Rajak<sup>5</sup>, Nitish Virmani<sup>6</sup>, BB Sharma<sup>7</sup>**

<sup>1</sup> Assistant Professor, Dept. of Radio-diagnosis, SGT Medical College Budhera, Gurgaon, Haryana, India

<sup>2,3</sup> Senior Resident, Dept. of Radio-diagnosis, SGT Medical College Budhera, Gurgaon, Haryana, India

<sup>4</sup> PG Resident, Dept. of Radio-diagnosis, SGT Medical College Budhera, Gurgaon, Haryana, India

<sup>5</sup> MSc Fellow, Faculty of Allied Health Sciences, SGT University, Gurgaon, Haryana, India

<sup>6</sup> Associate Professor, Faculty of Allied Health Sciences, SGT University, Gurgaon, Haryana, India

<sup>7</sup> Professor & HOD, Dept. of Radiodiagnosis, SGT Medical College Budhera, Gurgaon, Haryana, India

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### **Abstract**

**Background:** The quality of a radiographic image plays an important role in the accuracy of the diagnostic process. The aim of radiology is to obtain images which are adequate for the clinical purpose with minimum radiation dose to the patient. If optimum performance is to be achieved, assessment of image quality must be made to balance against patient dose. X-Rays are known to cause malignancies, skin damage and other side effects and therefore are potentially dangerous. It is therefore essential and mandatory to reduce the radiation dose to patient in diagnostic radiology to the barest minimum.

**Materials and Methods:** The study population included patients of both gender and all age group whose radiographic study were repeated. The total number of the patients was 40. The overall data was collected on daily basis. Patients whose radiographic studies were repeated were collected as primary data along with demographic data and reason for repetition from date 1st October, 2018 to date 30th March, 2019.

**Results:** The total number of repeat radiograph (in computed radiography) was 40 within 6 months. Repetition was mostly for examination of Chest Radiographs 11, Lumbar Spine 8, Cervical spine 6, Pelvis 3 Abdomen 2, Upper Extremities 4, Lower Extremities 4 and Skull 2.

**Conclusion:** The main cause of repetitions for chest X-Ray was foreign object especially found in female population. They either refused to remove it or in many cases they miss guided radiographer that jewellery and inner garments which contained metal clips had been removed while changing into hospital gown but in fact it had not been. Repetition due to wrong positioning, wrong marker, collimation fault, incorrect exposure factor occurred due to lack of skill within radiographer. Most of the repetitions of radiographs were observed during peak rush hour generally in the morning.

**Keywords:** shoulder apophysis, painful shoulder, athlete, sports, cricket, acromion, paediatric

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### **Introduction**

Diagnostic imaging provides information about the internal anatomy and physiology of the human body [1, 2]. The quality of a radiographic image plays an important role in the accuracy of the diagnostic process. Some radiographs obtained are discarded because they have no diagnostic value. A reject image is described as an image that does not add to diagnostic information to clinical questions because of poor image quality and thus the image has to be retaken [3, 4]. This repetition of radiographs presents various concerns, including unnecessary radiation exposure to the patient, increased cost, longer patient waiting time, additional workload for radiographers and reduced x-ray tube life. Diagnostic images should be of sufficient quality and should consistently provide adequate diagnostic information. This should be achieved at the lowest possible cost and with the

least patient exposure [5, 6, 7].

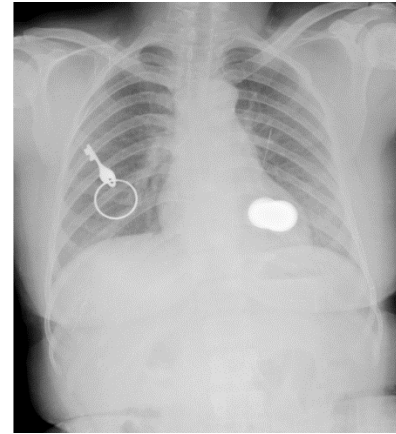
### **Material and Methods and Results**

The aim of this report is to provide radiography services to ensure reduction in the factors responsible for rejects and thus to reduce the cost, workload and radiation exposure to patients and personnel. This will also bring the best out of image quality for better diagnostic services in the institute. All the subjects taken for the study had complete privacy and none of any personal declaration has been made by anywhere in this research. This prospective study was based on repeat radiograph examination. This study was designed to be observational and descriptive about the frequency of occurrence of repeat radiographs All the radiography was carried out on 800 mA Allengers Xray machine (Fig 1)

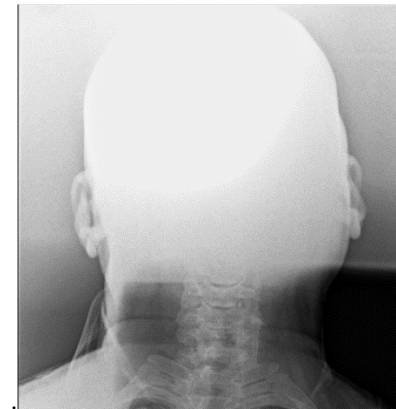


**Fig 1:** Photograph of 800 mA X-ray machine where all the radiography was carried out to maintain the same quality of the exposures.

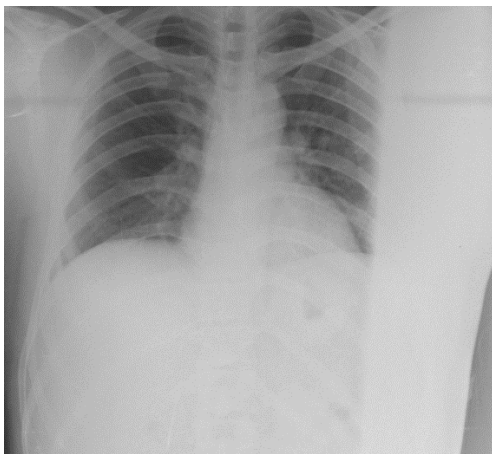
The cause of each and every repeat radiograph was noted along with the view, frequency and part which was repeated. These data were taken as primary data and later on compiled according to different variables. Patient coming to SGT Hospital at the Department of Radio-Imaging and diagnosis for X-Ray Imaging of patients from different part of Haryana and neighboring state were including in this study. This prospective and quantitative study was carried out for the time period of six months from 1<sup>st</sup> October 2018 to 30th march 2019 at SGT Medical College, Hospital & Research Institute. Gurugram, Haryana. Study population included patients of both gender and all age group whose radiographic study were repeated. In our study, we have taken sample of 40 patients with repeated radiographs among which 19 patients were of males (47%) and 21 patients were females (53%). The overall data was collected with the help of Radio-Technologist of SGT University. The data was collected in daily wages. Patients whose radiographic studies were repeated were collected as primary data along with demographic data and reason for repetition. This data comprised of Digital Computerized X-Rays (Figures 2 to 6).



**Fig 2:** Radiograph of the chest shows foreign objects seen in the image



**Fig 3:** Radiograph is overexposed. There is no delineation of the bony parts of the skull.



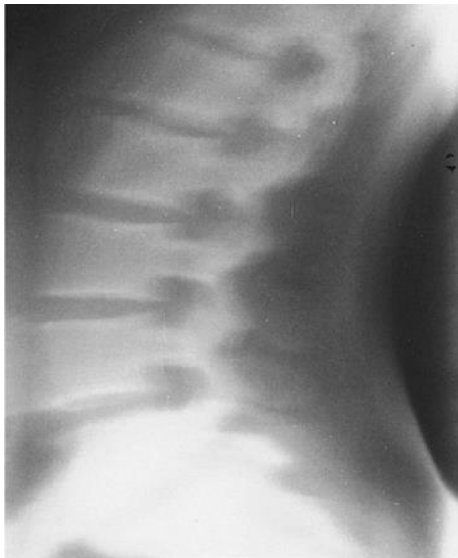
**Fig 2:** Radiograph of the chest shows miss collimation for the purpose of repetition. There is a big artifact on left side without inclusion of complete ipsilateral hemi thorax.



**Fig 4:** Radiograph shows under exposed because of the fault in equipment. This can be avoided if there is proper calibration of the equipment.



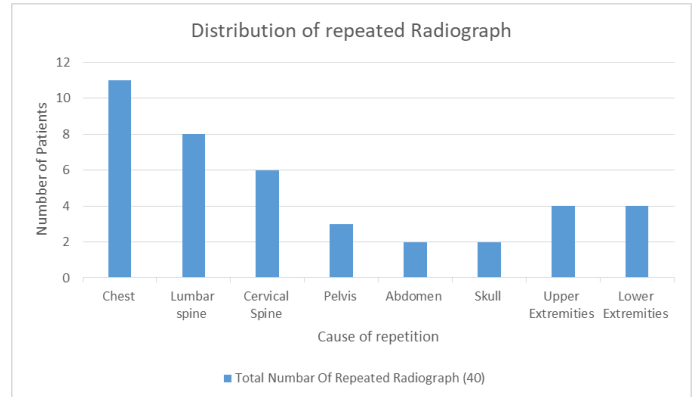
**Fig 5:** Radiograph shows overlapping hand with malposition and focusing. These types of radiographs are not accepted at all.



**Fig 6:** Radiograph depicts motion blur for which the repeat X-ray was done.

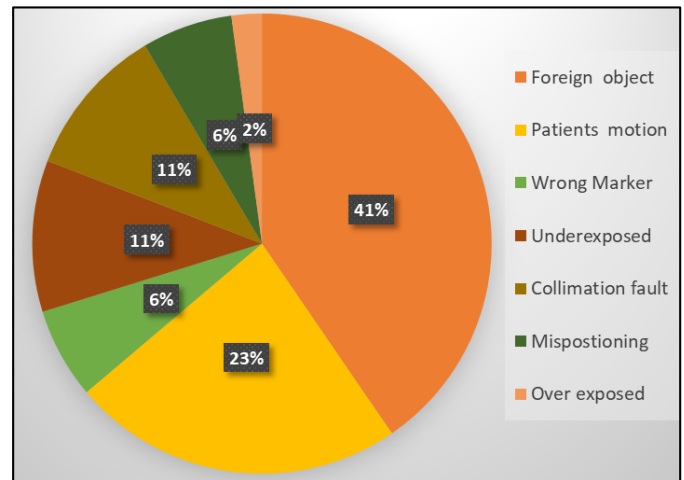
Following were the repetition of the radiographs as per the area under examination was performed : Chest Radiographs 11,

Lumbar Spine 8, Cervical spine 6, Pelvis 3, Abdomen 2, Upper Extremities 4, Lower Extremities 4 and Skull 2. These had been depicted in the form of graph (Figure 7)

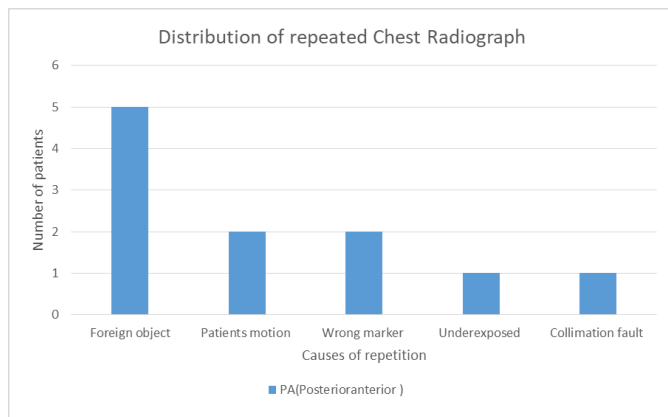


**Fig 7:** Bar chart showing the distribution of the repeat radiographs done as per the part. The frequency of repetition according to body parts is also shown in Y-axis and the body parts involved in repetition is shown in X-axis.

There were various reasons for which repeat radiographs were done. All these reasons have been depicted in the form of chart (Figure 8 and 9)

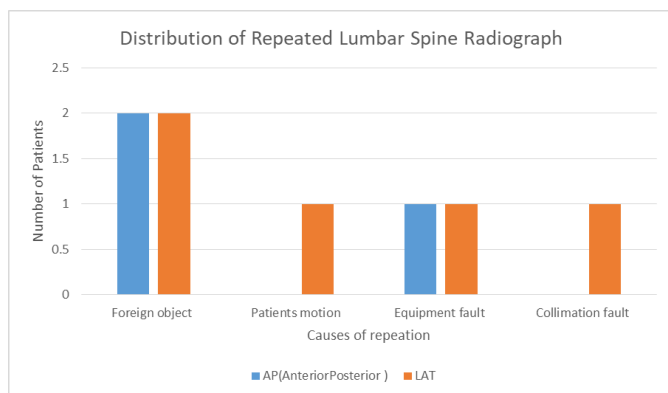


**Fig 8:** Shows the total number of repetition in percentage with cause of repetition.



**Fig 9:** Total number of repetition in percentage with cause of repetition.

There are various reasons depicted for which lumbar spine is repeated. This is also the most common radiograph done like chest x-ray (Figure 10)



**Fig 10:** Distribution of repeated lumbar spine radiographs. Plotted bar diagram for the information about cause and frequency of repetition of radiograph. Graph shows the repetition reason for the foreign object, motion, equipment fault and collimation fault. The frequency of repetition has varied between two radiographic positions AP and Lateral.

## Discussion

In this study, some information about the rejection of radiographic films using repeat analysis program (RAP) was obtained during six months. RAP is a common technique to provide useful information about reject or retake rate as well as the sources of error. There are many reports that have used RAP technique in different countries, such as Austria, Belgium, Germany and USA [8, 9]. This can also play an important role for quality assurance and quality management of radiographic imaging. The repetition of radiograph is not done intentionally but it occurs due to many reasons. The major reasons for repetition are human error and technical error. In this study we found that most of the radiographs were repeated due to human error [10, 11].

David H. Foos et.al had conducted a study to evaluate reject analysis that was performed on 288,000 computed radiography (CR) image record collected from at University Hospital (HU) and a large community Hospital (CH). Each record contained image information, such as body part and view position, exposure

level, technologist identifier, and if the image was rejected the reason for rejection. They found the reject rate for CR across all departments and across all exam types was 4.4% at UH and 4.9% at CH [12, 13, 14]. The most frequently occurring exam types with reject rates of 8% or greater were found to be common to both institutions (skull/facial bones, shoulder, hip, spines, in department chest, pelvis). Positioning errors and anatomy cut-off were the most frequently occurring reasons for rejection, accounting for 45% of rejects at CH and 56% at HU. Proper exposure was the next most frequently occurring reject reason (14% of rejects at CH and 13% at HU), followed by patient motion (11% of rejects at CH and 7% at HU). Based on the finding of this study it was concluded that the highest repetition rate was of chest exams at both institutions (26% at HU and 45% at CH).

In our study the most frequently occurring exam types with reject rates were found to be in this institution for chest, lumbar spine, cervical spine, abdomen, pelvis, skull, upper extremities and lower extremities. When radiographs were analyzed we found the similar pattern of repetition. The major causes of repetition were due to foreign object; fault during collimation, wrong radiographic positioning, wrong radiographic marker, movement artifact and over or under exposure. Foreign object was major cause for most repetition (41%) whereas over exposure was least contributor (2%). Similarly, movement artifact (23%), under exposure (11%), collimation fault (11%), wrong radiographic marker (6%), and wrong radiographic positioning (6%) body part whose radiographs were repeated more frequently was chest and less repeated body part was lower extremities.

In these both studies, they had found highest repetition rates of chest radiographs the main reason being of positioning error. In our study, we had found the foreign object as the highest rate of repetition for chest radiographs [15, 16].

Although, it seems that the main reason for repeat radiograph is a function of multiple parameters such as working experience of the personnel, workload of the department, cooperation of patient etc. but none of these parameters can be taken lightly when it comes to patient's safety [17]. Although when compared with other imaging modalities like CT scan, Fluoroscopy the amount of radiation given to patient during computed radiography seems to be less. This fact cannot be taken as excuse for repeating radiograph and delivering unnecessary radiation to the patient. In publication No. 60 of the ICRP (1990), it is recommended to limit the annual dose of 1 mSv for the general population. It is responsibility of a radiographer to follow this instruction of ICRP and use ALARA principle to minimize the patient dose.

## Conclusion

The main cause of repetition for chest X-Ray was foreign object especially found in female population. During the study we noticed that most of the female from rural area of Gurugram came for radiography wearing ornaments and jewellery. They either refused to remove it or in many cases they miss guided the radiographer that jewellery and inner garments with metal clips had been removed while changing into hospital gown. This was due to lack of awareness and communication between radiographers and female patients. Unawareness of patient towards radiographic study they are undergoing and lack of proper instruction of breathing was the major second reason for

movement artifact. Repetition due to wrong positioning, wrong marker, collimation fault, incorrect exposure factor occurred to due lack of skill among radiographers. Most of the repetition of radiographs was observed during peak rush hour generally in the morning. Repetition delivers unnecessary radiation to the patient as well as radiographer This will increases the work load and shortens the life of X-Ray tube and Imaging plate. All these factors cost financial loss and degrade the reputation of an institute. In order to minimize the repetition, radiographer has to develop imaging and communication skill. Emphasis for awareness and proper instructions are must for the patients undergoing study, ALARA principle must be followed and maintenance of radiography instrument must be conducted routinely.

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#### Consent of the patient

The written consent of the patients were taken before conducting the study.

#### Conflict of interest

There was no conflict of interest

Ethical issue

No ethical issue was involved.

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