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RESEARCH ARTICLE

REPEAT RADIOGRAPHY ANALYSIS AND CORRECTIVE MEASURES IN A PRIVATE MEDICAL COLLEGE AND TEACHING HOSPITAL

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Abstract

Aims and objectives: The primary goal of this study is to identify the body parts that undergorepeated radiographic examinations the most frequently and the prevalent causes of these examinations.

Materials and Methods: A prospective study was carried out in the Department of Radio-Diagnosis and Imaging to investigate the reasons behind repeated radiography in a private university hospital in India. A total of 6832 samples were evaluated between November 1, 2021, and April 30, 2022.

Discussion: Repetition of a patient's radiographic projection can be caused by several circumstances.

The common factors found in this study are collimation error, wrong centering, patient motion and incorrect positioning, appearance of artifacts owing to insufficient patient preparation at times and patient non-cooperation like patient motion. Repeat radiographs using the computed radiography technology are influenced by a plethora of circumstances. These variables include technical parameters chosen,the patient's Body Mass Index (BMI)and the patient's level of preparation.

Conclusion: Repeat radiography plays an important role as a key indicator in evaluating the quality of the service provided by the medical imaging department and gives us an insight on whether the dose rates are within the given guidelines or not.

Introduction:-

Studies done on animals and by early radiologists has so far established that ionizing radiation is a carcinogen. “Ionizing radiation refers to nuclear radiation consisting of subatomic particles or electromagnetic waves with sufficient energy to ionize atoms or molecules by stripping them of electrons. This category includes gamma rays, X-rays, and the more energetic ultraviolet part of the electromagnetic spectrum.”[1]. The discovery of x-ray, radium and radioactivity during the late 19th century has led to remarkable developments in the clinical, technological and experimental experiments in the medical imaging sector and has continued to benefit the field of medicine. However, a few years after the first x-ray exposures were made for imaging the human body, physicians, scientists and medical radiation workers started developing several adverse health conditions like dermatitis, cataracts, skin

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carcinomas, leukemia and others. Little was known during those early occurrences that those effects could have been due to the ionizing radiation with which they were working. It took around twenty five years to form radiation protection committees and to implement the first recommendations that were made to decrease the stray radiation and minimize the x-ray beam to the patient[8].The US population's exposure to medical radiation has increased by 600% since 1980, and there may be future cancer risks for these patients, despite the enormous benefits [10]. With the advent of radiation protective devices, dose rate monitoring and measuring equipment, the occupational dose rates have significantly lessened. However epidemiological studies done between 1956 to the present time have linked diagnostic x-rays with the increased number of cancer cases in patients [2] which includes occurrence of pediatric leukemia in offspring of mothers undergoing diagnostic x-rays during pregnancy and increased breast cancer risks in women with tuberculosis monitored using Fluoroscopy [3-6] and in women with scoliosis evaluated with repeated x-rays. [7]

Radiographs are repeated to obtain the diagnostic information required to diagnose, which is the primary motive of irradiating a patient. Radiation doses resulting from X-ray examinations depend on the X-ray imaging technology and the exposure setting employed for recording the images on these imaging devices [3,4]. However, X-ray imaging is the largest contributor to population dose because a large number of X-ray examinations areconducted every year globally[5].Diagnostic procedures accounts for more than 95% of medical exposure to radiation worldwide [6]. The main objective of an x-ray examination is to project radiographic features of anatomic detail of an examined body part with optimal exposure factors with the lowest possible radiation dose to the patient. Although at times, owing to many different factors such as technical errors, wrong exposure factors, non-complying patients, etc, radiographs needs to be repeated. This leads to the patients receiving an additional amount of radiation dose. Although justification is attained here but overall the principle of ALARA (as low as reasonably achievable) is not achieved. In addition to the imaging techniques exposing patients to ionizing radiation, probable danger of allergic reactions or complications from intravenous contrast agent use are also there [9]. Repeat radiographs are a sign of dearth of skilled professionals and reflects defectively on the technologists as well as the department. Retaking radiological exam images not only puts patients at greater danger of radiation exposure, but it also wastes medical resources and lowers hospital service quality [11]. Repeat analysis of radiographs is a subjective evaluation of the quality of x-ray image where the films considered to be of poor quality are categorized according to their cause. This study aims to find the rate of repeated radiographs for digital radiography, the most commonly repeated types of body parts and the causes of repetition for fixed radiography.

Materials and Methods:-

Ethics:

The Standing Committee for Scientific Research at the medical college granted an exemption from a comprehensive ethical assessment because all the data were gathered retrospectively and anonymized.For this investigation, written informed consent was obtained from each and every technician involved.

Design/Setting:

A retrospective longitudinal study of data was collected from November 2021 to April 2022. The data were collected (n = 6,832 x-ray images) for a period of six months.

Procedure:

The data collection was achieved with the help of radiographers and medical imaging students of the radiology department. The data collectors were provided with basic training and has been briefed about the objectives of the study and in what way it will benefit the society at large. The repeated studies were discerned from the imaging software, which were then evaluated. The cause of rejecting those films and the errors made were compared to the repeated and accepted x-ray films to establish the reasons of repeat.

Data analysis:

Secondary analysis of the raw data was conducted using Microsoft Excel 2010. The average repetition rate was calculated by the total number of repeat exposure multiplied by 100and the product is divided by the total number of procedures performed. This formulae was recommended as per NABH 5th edition.

Table 1:-

Repeat rate for each examination type			
Examination type	**Repeated**	**Total images acquired**	**Repeat rate (%)**
CHEST AP	116	2865	4%
C-SPINE	24	286	8%
DL SPINE	7	220	3%
LS SPINE	57	480	12%
FINGER	2	68	3%
HAND	12	130	9%
WRIST	9	150	6%
FOREARM	4	99	4%
ELBOW	1	16	6%
ARM	0	20	0%
SHOULDER	19	27	70%
HIP	3	30	10%
THIGH	5	100	5%
KNEE	3	156	2%
LEG	2	56	4%
ANKLE	2	236	1%
FOOT	12	136	9%
ABDOMEN	17	700	2%
PELVIS/KUB	12	650	2%
Mastoid	1	235	0%
PNS	1	54	2%
KUB	3	118	3%
C: Cervical, DL: Dorso-lumbar, LS: Lumbo-Sacral, PNS: Paranasal sinus, KUB: Kidney Ureter Bladder			

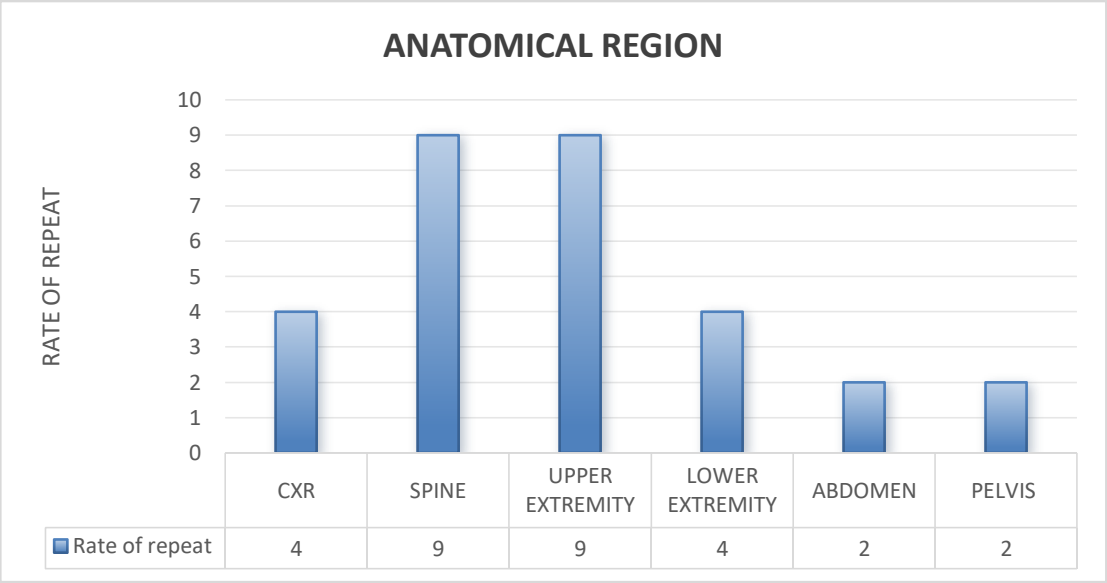

Figure 1:- Total number of repeated exposures according to body part.

Result:-

Table 1 and Figure 1shows the total number of repeated exposures and their repeat rates according to different anatomical regions. Figure 2 gives us an overview of the most frequently identified reasons of image repetition with the most common reason owing to collimation error, followed by wrong centering, patient motion and incorrect positioning. The other reason of repetition includes artifacts, anatomy cut-off, absence of marker and patient not holding breath during exposure.

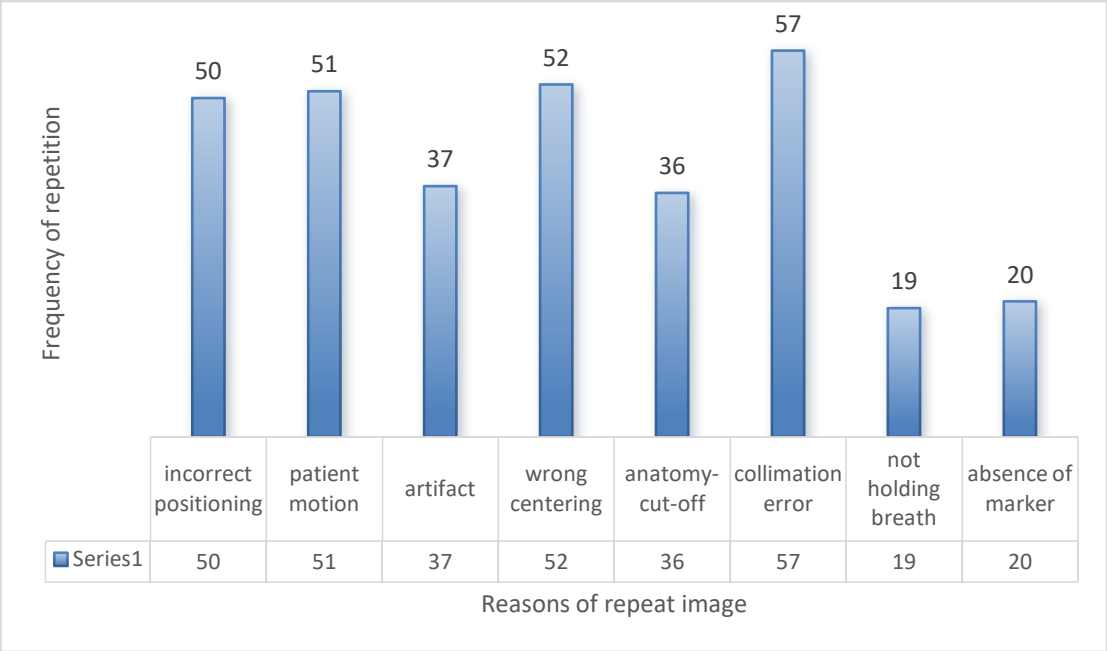

Figure 2:- The identified reasons for repeat images and the number of repetition.

The overall repetition rate was 7.55% which includes all the investigations gathered during this study. For chest x-ray (both PA and AP views), a total of 116 out of 2865 were found to be repeated. In case of upper and lower extremities, the repetition rates were 9% and 4% respectively. The repetition rate in case of spine was found to be 9% as well and 2% rate was found for both abdomen and pelvis. Out of the commonly identified reasons of repeat, the most common cause was collimation error and wrong centering, followed by patient motion and incorrect positioning. Other identified reasons were artifact, anatomy cut-off, absence of marker and patient not holding breath properly during exposure.

Discussion:-

The purpose of this study was to look into the rates of diagnostic medical image repetition and to identify areas that needed improvement in the medical imaging departments.There are a number of reasons which contributed to the 7.55% of repetition. After evaluation, it was found that some of the anatomical parts had repeat rate as high as 70% (shoulder) and some as low as 1% (ankle). Also it was found that for arm, there was no repetition. This only suggests that some anatomical parts are more commonly repeated than others owing to many factors which may include complex patient position, tube angulation, technician skill level etc. In a similar study, the overall reject rate was found to be 8.96%, with hip recording the highest percentage of reject (20%), followed by elbow (15.2%) [13]. Yet in another study, the repeat rate was only found to be 1.87% with Pelvis recording the highest percentage of repeat (12.50%), followed by chest (1.40%) [14]. It has been noticed that the reject rates were greater than the average procedure for several anatomical areas and found to vary in different research studies. The variation in the number of repeat rates could be attributed to a multitude of factors such as technologist's level of expertise, their clinical experience, how well the machines were calibrated, quality control and assessment, etc. Thus, prioritizing internal training on equipment maintenance,quality control, workshops and training programs in these specific anatomical areaswhich need to be optimized by assessing the rejection ratesis crucial for each examination and projection, and find out ways to make the projection easier to expose thereby improving the quality of radiographs and reducing the overall exposure to the patients as well as staff.

Conclusion:-

The objectives of the study have been met, and during the course of its 5-month duration, an average reject rate of 7.55% was discovered.The department's performance could not be accurately represented by a single percentage, and a deeper analysis of individual projections and radiographer reject rates need to be determined and an effective way to lower reject rates and patient dose is to be established. Reject analysis changes the workflow, lowers patient dose, increases departmental efficiency and helps in directing the staff education and training [12]. The authors

recommend that for internal education programs, the medical imaging department may implement more uniform image quality standards and a feedback system.To monitor and lower patient exposure to ionizing radiation, exposure index data collection would be beneficial for future investigations into reject analysis. It should also be kept in mind to incorporate the radiation principles like ALARA (As Low As Reasonably Achievable) and TDS (Time Distant Shielding) while working with patients in the medical imaging department.

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Conflicts of Interest:
No conflict of interest has been declared by any author.

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