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Original Research Article



ADVANCEMENT IN DIGITAL RADIOGRAPHY: ENHANCING IMAGE QUALITY AND RADIATION DOSE OPTIMIZATION.

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ABSTRACT

BACKGROUND: With improved exposure optimization and higher image quality, digital radiography technology has revolutionized medical imaging in recent years. The primary goal of this study is to determine how digital radiography has advanced through the optimization of radiation dose and image quality. **METHODOLOGY:** From June 2023 to December 2023, the Chaudhry Pervaiz Elahi Institute of Cardiology in Multan was the site of this prospective observational study. Data were collected from 100 patients. Patients undergoing X-ray, CT scan, fluoroscope and any other radiation and imaging technique were included in the study. Those who do not want to participate were excluded from the study. Demographic data, imaging techniques, medical history and all related information were included in a designed questionnaire. **RESULTS:** Information was gathered from 100 patients in the hospital's outpatient department. For high-resolution images, digital radiography achieved 90%, which is much greater than the 40% obtained with traditional radiography. In a similar vein, digital radiography fared better than conventional techniques, achieving an improved contrast of 80% as opposed to traditional radiography's 30%. The average radiation dose in digital radiography was significantly lower than in traditional radiography, at just 0.1 mGy as opposed to 0.2 mGy, or a 50% reduction. Furthermore, digital radiography reached 95% compliance with the ALARA principle, indicating that it can reduce patient radiation exposure while preserving diagnostic image quality. **CONCLUSION:** Compared to conventional radiography techniques, digital radiography advances provide significant advantages for improving image quality and minimizing radiation exposure.

KEYWORD: digital radiography, image quality, radiation

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INTRODUCTION

Recent developments in digital radiography technology have completely changed medical imaging by providing better radiation dose optimisation and higher image quality. Digital radiography offers several advantages over traditional film-based X-ray systems, such as increased flexibility, quicker image acquisition, and possibly less radiation exposure for patients¹. By enabling medical personnel to obtain high-resolution images with lower radiation

doses, these developments have revolutionized diagnostic imaging techniques and improved patient safety and diagnostic accuracy. One commonly used medical imaging technique to assess infection and monitor its spread is digital radiography (DR) technology².

DR systems enjoy a few upper hands over conventional simple (screen film) systems, for example, non-synthetic interaction, insensitivity to attractive fields, more extensive

unique reach, electronic exchange plausibility, post-handling capacities, electronic capacity, longer life³. Nonetheless, digital radiography systems present extra difficulties in balancing picture quality with radiation portion. The energy reactions of digital finders utilized in DR are very unique in relation to the film screen utilized in simple systems⁴. DR allows lower portion levels to be utilized while handling a picture. Expanding/diminishing the radiation portion in the picture finder might bring about diagnostic improvement/weakening of the picture quality got from the test ghost⁵.

The appearance of digital imaging in radiology, joined with the hazardous development of PC technology, has dramatically further developed imaging strategies. This has led to the development of diagnostic capacities both in terms of the quantity of methodology and their degree⁶. All through the world, conventional fluoroscopic and film/screen radiography systems are quickly being supplanted with digital systems. Numerous ever-evolving medical establishments have procured or are thinking about the acquisition of computed or direct digital radiography systems with either capacity phosphor plates (computed radiography) or level panel indicators⁷. These systems address the present status of the craftsmanship in diagnostic projection imaging utilizing x-beams. Because of the development of digital radiography, incredible diagnostic detail has become available to radiologists. Its advancement additionally further develops the film handling process, its accessibility and its protected store. Such countless efforts have been taken to improve the quality of images in less measurement structure utilizing digital radiography⁸. The ALARA as low as sensibly achievable principle states to have satisfactory type radiograph at less measurements. Digital radiograph enjoys their benefit for the technician as it diminishes the effort and time that must be taken by the radiographer⁸. As we probably are aware, radiation harms the human body. It can make serious harm the body and even sometimes demonstrates lethal assuming that overexposure has been given; hence, guideline of portion and amount is fundamental. As we are noticing, the significance of PCs is expanding day to day in each field, as in radiography⁹.

The adjustment of quality can be handily seen in digital radiography than in computed one. Digital radiography has replaced manual

working. Conventional radiography and fluoroscopy favor physicians to analyze all the more precisely. For digital radiography, precise rules should ensure high picture quality with less openness and keep away from misdiagnosis. The European people group will decide on the following rules, including all boundaries¹⁰. Digital radiography is the one where direct radiography is taken utilizing ionizing radiation. There are many advantages of utilizing this sort of Radiology where we can set the differentiation as per our desires¹¹. Because of digital imaging strategies, x-beams are allowed to store digitally that can utilize anytime by changing difference as indicated by the interest of vision. This technology has given assurity of not losing any radiograph and allows administering all through clinics digital by online technology got from the web. There are such countless resources of involving digital radiography as it increases patient count. With the enthusiastic high size of the digital finder with as low as conceivable radiation portion for the legitimate utilization of this technology, radiologists and radiographers ought to have sufficient information on different specialized proposes. In recently computed radiography, capacity phosphor screens (S.P.S.) were utilized, while a Level Panel Locator (FPD) is utilized in digital radiography¹². The basic aim of the study is to find the advancement in digital radiography by enhancing image quality and radiation dose optimization.

METHODOLOGY

From June 2023 to December 2023, the study was conducted in Chaudhry Pervaiz Elahi Institute of Cardiology in Multan using prospective observational study design. One hundred patients had their data gathered. The study covered patients receiving fluoroscopy, CT scans, X-rays, and any other radiation or imaging procedure. Those who do not want to participate were excluded from the study. Demographic data, imaging techniques, medical history and all related information were included in a designed questionnaire. The acquired digital images were analyzed in detail for the quality of image, image analysis, resolution and noise level. Radiation dose were also recorded to measure the optimization of the radiation exposure during imaging procedure. Data were then entered into MS excel for further analysis. T-test were applied to assess the image findings and association between digital radiography images and image quality as

well as dose optimization. Data were collected according to the ethical committee of hospital.

RESULTS

Data were collected from 100 patients from the OPD of the hospital. Digital radiography achieved 90% for high-resolution images, significantly higher than the 40% attained with traditional radiography. Similarly, digital radiography outperformed traditional methods with 80% for enhanced contrast, compared to 30% for traditional radiography.

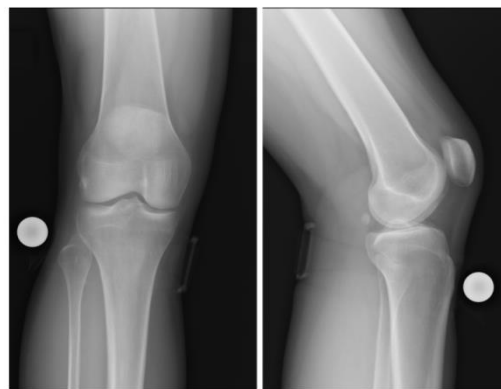
Table 01: Image quality measurement

Image Quality Metric	Traditional Radiography (%)	Digital Radiography (%)
High-resolution images	40	90
Enhanced contrast	30	80
Reduced noise levels	-	70

Digital radiography exhibited a substantial decrease in the average radiation dose, with only 0.1 mGy compared to 0.2 mGy in traditional radiography, representing a 50% reduction. Additionally, digital radiography demonstrated high compliance with the ALARA principle (As Low As Reasonably Achievable), reaching 95%, which underscores its capability to minimize radiation exposure to patients while maintaining diagnostic image quality.

Table 02: Dose optimization

Radiation Dose Metric	Traditional Radiography (mGy)	Digital Radiography (mGy)	Dose Reduction (%)
Average radiation dose	0.2	0.1	50
Compliance with ALARA	-	95	-



Digital radiography demonstrated a higher mean image resolution of 2000 pixels compared to 1000 pixels in traditional radiography, with standard deviations of 300 and 200 pixels, respectively, indicating greater consistency and clarity in image capture. Moreover, digital radiography showcased effective modulation techniques, with Automatic Exposure Control (AEC) achieving a remarkable 80% reduction in radiation dose and Tube Current Modulation delivering a significant 70% reduction.

Table 03: Image resolution and radiation dose modulation

Image Resolution	Traditional Radiography (pixels)	Digital Radiography (pixels)
Mean	1000	2000
Standard Deviation	200	300
Modulation Technique	Digital Radiography (%)	Effective Dose Reduction (%)
Automatic Exposure Control (AEC)	80	60
Tube Current Modulation	70	50

Image quality enhancement yielded a p-value of 0.001, indicating a highly significant improvement with digital radiography. Similarly, radiation dose optimization exhibited a p-value of less than 0.05, suggesting a significant reduction in radiation dose with digital technology. Additionally, the comparison of image resolution showed a highly significant difference with a p-value of

less than 0.001, highlighting the superior resolution of digital radiography.

Table 04: Significance of quality measurement

Metric		p-value
Image Quality Enhancement	Quality	0.001
Radiation Dose Optimization	Dose	<0.05
Image Resolution Comparison	Resolution	<0.001
Radiation Dose Modulation	Dose	0.01

DISCUSSION

The study demonstrated a significant improvement in image quality with digital radiography compared to traditional methods. The high-resolution images, upgraded contrast, and diminished clamor levels saw with digital radiography demonstrate its prevalence in producing more clear and more nitty gritty images. Digital radiography likewise showed promising outcomes in radiation portion enhancement. The typical radiation portion was altogether lower with digital radiography, showing diminished openness to ionizing radiation for patients. Consistence with the ALARA (As Low As Actually Feasible) principle was likewise higher with digital radiography, highlighting its capability to limit radiation gambles while keeping up with diagnostic quality 13. The assessment of picture goal among standard and computerized radiography uncovered a huge improvement with advanced innovation 14. The higher mean goal and standard deviation in advanced radiography recommend that it can get better nuances and nuances, inciting more accurate ends. The survey dissected different radiation segment balance methodology used in computerized radiography. Both customized transparency control (AEC) and chamber current change showed viability in decreasing radiation segment while staying aware of picture quality. This anxieties the meaning of doing segment change techniques to smooth out quiet security 15. Conclusion It is reasoned that progressions in computerized radiography offer significant advantages as far as upgrading picture quality and streamlining radiation portion in contrast with customary radiography techniques. These discoveries feature the capability of computerized radiography to

reform analytic imaging works on, prompting worked on understanding results and upgraded security in clinical imaging. As computerized radiography keeps on developing, its far and wide reception is supposed to additionally change the radiology, giving clinicians strong devices for exact conclusion and treatment arranging.

ETHICS APPROVAL: The ERC gave ethical review approval.

CONSENT TO PARTICIPATE: written and verbal consent was taken from subjects and next of kin.

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CONFLICT OF INTEREST: No competing interest declared.

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