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Waseem Akhtar
Aga Khan University, waseem.akhtar@aku.edu

Mubashir Ahmad
mubashir888@gmail.com

syed arif ali Mr
Aga Khan University, arif.ali@aku.edu

Kashif Mirza

Nadeem Ahmad
Aga Khan University, nadeem.ahmad@aku.edu

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ORIGINAL ARTICLE

Film Retakes in Digital and Conventional Radiography

Waseem Akhtar[1], Mubashir Aslam[2], Arif Ali[2], Kashif Mirza[1] and Nadeem Ahmad[1]

ABSTRACT

Objective: To determine the film-retake rates and causes in digital radiography comparison to conventional X-rays method.

Study Design: Comparative study.

Place and Duration of Study: Radiology Department, Aga Khan University Hospital, Karachi, from January 2004 to December 2006.

Patients and Methods: X-rays of different body parts, conducted during the year 2004, with conventional radiography (n=170300), and in 2006 with digital radiography (n=174550), were included in this study. Measurements were done for number of X-rays re-take due to different quality control reasons for both the conventional and digital radiography. Quality control reasons included underexposure, overexposure, positioning errors, patient movements, portable X-rays, grid cut-off, and others (i.e. equipment related) due to which X-ray quality was questionable. Results were expressed in percentages.

Results: A total of 9423 X-rays (5.5%) were repeated in conventional radiography (n=170300) due to underexposure (38%), overexposure (28.5%), positioning errors (25%), portable procedures (4%), patient movement (2%), grid cut-off (0.5%), and others (2%). Underexposure was the most frequently responsible factor for the X-ray repetition as compared to other factors (p<0.001). In digital radiography (n=174550), 1464 X-rays (1%) needed to be repeated, which was significantly less in comparison to X-ray repetition in conventional method of radiography (5.5%) [p<0.001]. In digital radiography, the most frequent factor for X-ray re-take was positioning error (435, 30%).

Conclusion: Digital radiography is associated with significantly lesser number of re-take X-rays as compared to conventional radiography, hence minimizes the exposure of the patients to unnecessary radiations due to re-take X-rays. Positioning error remains a problem even in digital radiography, emphasizing training need for technologists.

Key words: *Digital. Conventional. Re-take. Radiography.*

INTRODUCTION

Worldwide, X-rays are one of the important diagnostic modalities used in the healthcare services despite being associated with some radiation exposure to the patients.[1] The practice of radiographic imaging has undergone several changes and some radiologist now consider digital radiography as the answer to many problems associated with conventional film-based radiography,[2-6] without considering the cost benefit analysis regarding this new technology, however, some has discussed cost benefit analysis and retakes issues in digital radiology.[7,8] On the other hand, some institutes do not accept the blind implementation of digital radiography and claim that the traditional conventional film-screen radiography systems provide good image quality, high spatial resolution, and generally low costs,[9,10] which is particularly an important factor in health care delivery services in developing countries.

There is a need to determine the balance between benefits among digital and conventional radiography not only in terms of cost but also relating to other factors like effectiveness of the procedure in terms of quality of X-ray, time expenditure in both system, feasibility of implementation and operation, public demand etc. Film reject analysis is a well-established indicator of quality control in radiology department.[11,12] Only few studies[8,13,14] have determined differences in patient care among the two radiography systems in clinical setting particularly with regard to reduced number of re-take. No data has been published from this part of the world and no study has compared the factors responsible for X-ray retakes among digital and conventional system.

The objective of this study was, therefore, to determine the number and causes of X-rays re-take in digital and conventional radiography system in a private tertiary care hospital.

PATIENTS AND METHODS

Data was collected in the Department of Radiology, Aga Khan University Hospital, Karachi from January 2004 to December 2004 and then January 2006 to December 2006 to include X-ray examinations of

[1] *Department of Radiology, The Aga Khan University Hospital, Karachi.*

[2] *Department of Community Health Sciences, The Aga Khan University Hospital, Karachi.*

Correspondence: *Dr. M. Nadeem Ahmad, Department of Radiology, The Aga Khan University Hospital, Stadium Road, P. O. Box: 3500. Karachi-74800.*
E-mail: nadeem.ahmad@aku.edu

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different body parts. From January 2004 to December 2004, X-rays performed with a conventional screen-film system were included. Twenty thousand radiological examinations were performed in 2005 with both conventional and digital system due to its pilot testing and installation phase; therefore, those patients' X-rays conducted during that period were excluded. From January 2006 onwards, conventional system was totally replaced by computer-based film–less radiography and radiographic examinations performed upto 31st December 2006 were then included in the study. Patients undergoing more than one body part X-rays simultaneously were also excluded from this study. All radiographs were performed on clinicians' written request and no radiation exposure was given unless justified clinically. Standard radiation protection measures were given to all patients.

Image evaluation was performed under similar conditions of room light and temperature. Conventional X-ray images were evaluated on viewing boxes while digital images were evaluated in prespecified display monitors with facility of postprocessing. A panel of two experienced radiographers, supervised by certified radiologist, checked the image quality and, if needed, repeat exposure was given. Data collectors were trained and were given predefined data collection sheet for number and factors responsible for re-take X-rays. Data was entered in Microsoft Excel. Analysis was done in SPSS version 15. Pearson Chi-square testing was done to test the statistical differences at 95% confidence level. P-value less than 0.05 were considered significant.

RESULTS

A total of 9423 X-rays (5.5%) were repeated in conventional radiography (n=170300), 3565 (38%) due to underexposure, 2689 (28.5%) because of over-exposure, 2405 (25%) due to positioning errors, portable equipment 392 (4%), patient movement 168 (2%), grid cut-off 27 (0.5%), and 47 (2%) due to other reasons, which included film rejections due to fogging, processing errors and requests for ret-ake by physicians and radiologist. In conventional radiography underexposure was the most frequent factor responsible for the re-take X-rays as compared to the other factors (p-valu<0.001).

Data was quarterly segregated for analysis purpose and quarterwise comparison was done to determine the statistical significance for each factor responsible for X-ray re-take in conventional and digital radiography (Table I). In digital radiography (n=174550), overall number of retakes was 1464 (1%), which indicated a decline in re-take rates in 2006, when digital radiography method was fully implemented. There was marked reduction in each of the factors responsible for X-ray re-take when the procedure was performed by digital radiography method. In digital radiography, the most frequent factor responsible for re-take X-ray was positioning error noted in 435 (30%). Other factors responsible for re-take X-rays included underexposure 406 (28%), overexposure 389 (26%), patient movements 87 (6%), portable procedure 12 (1%), grid cut-off 7 (0.5%), and others 124 (8.5%). Others included film rejections due to fogging, processing errors and requests for re-take by physicians and radiologist.

Table I: Comparison of different factors responsible for X-ray re-take in conventional and digital radiography.

Factors responsible for X-ray re-take	Quarters				X^2	p-value
	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec		
Underexposure					16.9	0.001
Digital	135	119	76	76	-	-
Conventional	955	922	733	955	-	-
Overexposure					7.9	0.04
Digital	89	123	77	100	-	-
Conventional	744	691	510	744	-	-
Positioning error					57.4	<0.001
Digital	156	109	118	52	-	-
Conventional	488	748	681	488	-	-
Patient movement					8.7	0.03
Digital	24	28	18	17	-	-
Conventional	44	29	51	44	-	-
Portable equipment					NA	
Digital	4	8	-	-	-	-
Conventional	99	117	77	99	-	-
Grid cut off					NA	
Digital	1	4	-	2	-	-
Conventional	1	6	19	1	-	

NA=Expected value in a cell < 5 hence chi-square test is not applicable.

DISCUSSION

In the near future, digital radiography system is proposed to be more important in clinical practice because of advancement in computer technology and expansion of storage capacities in these devices. Different postprocessing tools, possibility for multimodality image display, use of computer-aided diagnosis software and tele-radiology are just some examples of the possibilities of digital image usage. The variable quality seen in conventional radiographs that is caused by the process of developing the X-ray films is eliminated with the use of digital radiography. In addition, radiological reporting of images on the display screen eliminates the cost of film material and X-ray film archiving as well as reducing cost due to least number of retakes in this technology. However, large longitudinal studies are required to analyze its overall cost effectiveness due to high initial equipment/installation price, particularly in poor resource developing countries like Pakistan.

Digital radiography images can be transmitted via the Internet for consultation or case referral throughout the hospital and to other units, making a process very fast and accurate.[15] Hence, it can play an important role in

telemedicine and could be a major component. It has been shown to be the second most commonly used specialty in telemedicine.[16] Digital radiography will play an important role in this evolution because plain X-rays are the most frequently obtained images in medical imaging towards patient care. A limitation of digital radiography, hindering its implantation in a unit, is its high initial cost, which is only justified in the hospitals where the volume of patient care is high, and the technology is in regular use.[13] However, in large secondary and tertiary hospitals in our country, which are dealing with the bulk of patients, this technology can prove effective both in terms of economy and time computation.[9,10]

This study clearly demonstrated the advantage of digital system for decreased X-ray re-take (1%) as compared to conventional system (5.5%). Film repeats rate of conventional system described in literature range from 3.2%[8] to 11.6%.[17] The film repeat rate of both systems in this study was within known limits. Peer *et al.* showed 2.3% films repeat rate in digital system, which was higher than the re-take rates in this study.[14] Another study showed that digital radiography resulted in less number of errors related to overexposure or underexposure, hence, reducing the overall re-take rate[9] and the results are consistent with the presented findings. A German study showed that digital radiography provided the best quality chest X-ray in comparison to conventional techniques for obtaining chest X-rays.[18] In conventional radiography, re-take were mostly due to either underexposure or overexposure that seems to be minimized in digital radiography, which has advantage of postexposure processing.

Nevertheless, in digital radiography, positioning error was the main factor responsible for the highest re-take examination, which highlights the importance of advanced training requirement for radiographic technician.

CONCLUSION

Digital radiography resulted in marked reduction of retake X-rays as compared to conventional radiography; hence, it can be recommended to replace conventional radiography systems in radiological units. Positioning error remained a problem for retake X-rays even in digital radiography indicating the need for improvement in training for X-ray technicians.

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