ANALYSIS OF ARTIFACTS ON COMPUTED RADIOGRAPHY (CR) IMAGES AT AMINU KANO TEACHING HOSPITAL, KANO STATE , NIGERIA

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ABSTRACT

Background: Artefact has been known for years to likely lead to misdiagnosis, deteriorate image quality, which often results to repeat procedure and ultimate increase in total patient radiation dose.

Objectives: Was to determine different types of artefacts related to CR systems and their origins in Aminu Kano Teaching Hospital.

Materials and methods: A retrospective cross-sectional study was conducted reviewing two thousand seven hundred and fifty (2750) CR images that were produced over a period of five months using Agfa computed radiography system. Different types of artefacts were identified and recorded on a self-designed data capture sheet. Data was analyzed using Microsoft Excel 2013 and descriptive statistics such as frequencies and percentages were generated.

Results: Three hundred and twenty one images had artefact, which represents 11.6% of the total. Eight (8) different types of artefacts were identified with Crack artefact having the highest percentage 41.7 % (n=134) implying that majority of the artefact originated from the imaging plate. It was followed by artefact due to dust, dirt and scratches accounting for 17.7% (n=57). While foreign body was the least occurring artefact with 2.8% (n=9)

Conclusion: Different types of CR Artefacts have been identified with majority originating from the image plate (Crack, dust particles, dirt and scratches). They can be eliminated through careful handling of the equipment, performing scheduled cleaning and maintenance, replacement with newer ones where appropriate, routine quality control and use of appropriate image parameters.

Keywords: Artefacts, Computed radiography, Image, Crack.

INTRODUCTION

Computed radiography (CR) refers to a generic term for a large area of digital x-ray detector system (having different components) that uses photostimulable phosphor plate and a computer controlled optical or mechanical scanner to record and store radiographic image [1]. Since its introduction two decades ago, CR has now become a player in acquiring, processing and displaying digital images and the technology of CR continues to improve in concomitance with the development of digital technology [2]. Its images are acquired using the conventional imaging geometry, buckys and grids, and X-ray tables and tubes. CR Systems are replacing the standard analogue (conventional) systems in many parts of the world however, as in other diagnostic imaging modality, certain aspects of the technology produce artefacts

Artefacts are undesirable densities on the processed image other than those caused by scatter radiation and fog that lower image quality [3,4]. They are distracting, and can impair image quality which could ultimately compromise the accuracy of the diagnosis [3,4] . In view of this; a radiographer is left with no option than to repeat the procedure to produce yet another image devoid of artefact. This however, has implication of increased total patient radiation dose and thus increased radiation risk. Although most artefacts that occur in conventional radiography and other imaging modalities like computed tomography, magnetic resonance imaging have become familiar, CR produces a wide range of artefacts which, differ from those found on conventional radiography. Interestingly, these artefacts can be traced to various components of the CR imaging system [5].

In this sense, the elimination of possible artefacts on the image is a task that requires the identification of all processes involved in producing the image, from the acquisition until the display on a monitor

or medical radiographic film [3]. Also, to effectively reduce the amount of artefacts on CR, it is necessary to identify the common artefacts as well as their causes. Therefore, this study is aimed at identifying common artefacts associated with CR systems, their origin/causes and possible ways of resolving them.

MATERIALS AND METHODS

The study was a retrospective cross-sectional study and CR images acquired from Agfa CR system at Aminu Kano Teaching hospital for a period of five (5) months from January 2011 to May 2011. All the CR Images produced within that period were individually reviewed together with experienced radiographers. Images that presented with artefacts were identified, classified based on origins and recorded on a self-designed data capture sheets. Frequency distribution table was used to represent the data. Microsoft Excel 2013 was used to analyze and descriptive statistical tools such as mean and percentages were generated for the study. Ethical clearance was obtained from ethical committee of Aminu Kano Teaching Hospital.

RESULTS

Out of the two thousand seven hundred and fifty (2750) images reviewed, three hundred and twenty one (321) images had artefacts, which represent 11.6%. Eight (8) different types of artefacts were identified namely; cracks, dust particles, dirt and scratches, quantum mottle, double images, image processing artefacts, Moiré pattern, blank images and foreign body. Crack artefact (figure 1) was the most occurring artefact with a percentage of 41.7 % (n=134) while foreign body (figure 2) was the least occurring artefact with a percentage of 2.8% (n=9) (Table 1). The origins (causes) of the artefacts were traced according to various components of the CR system (the imaging plate, the plate reader), the operator related artefact and patient related artefact. Imaging plate is the leading origin of artefact (Table 1).

Table 1. Showing different types of artefact and their origins

	ORIGIN			
ARTEFACT	**IMAGING PLATE**	**PLATE READER**	**OPERATORS ERROR**	**TOTAL**
1.Cracks	134			134
2.Dust, dirts and scratches	51			51
3.Quantum mottle			37	37
4 foreign body			9	9
5.Double Images			20	20
6.Moire pattern			25	25
7.Blank images		19		19
8.Image processing artefacts		26		26
TOTAL	**185**	**45**	**91**	**321**

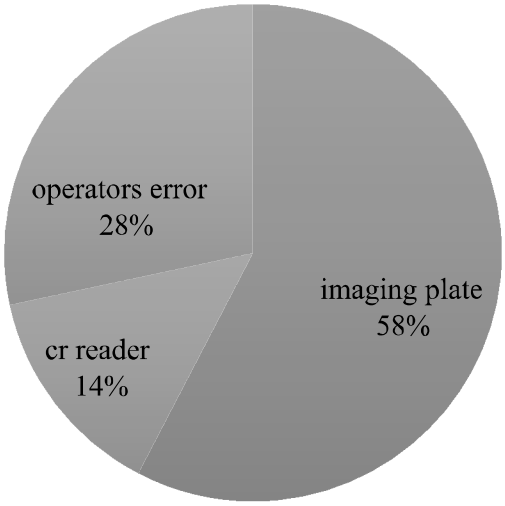

Fig 1: pie chart showing the origin of artefact

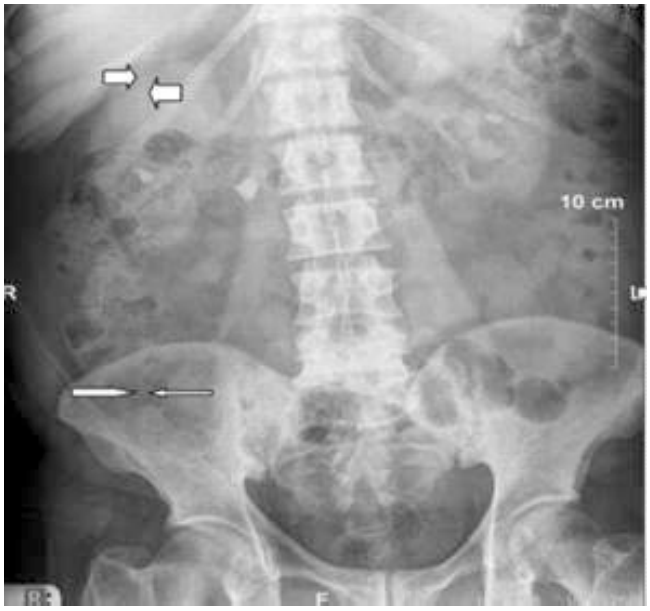

Figure 2: Crack Artefact (White ArrowF)

Figure 3: Foreign Body Artefact (White Arrow)

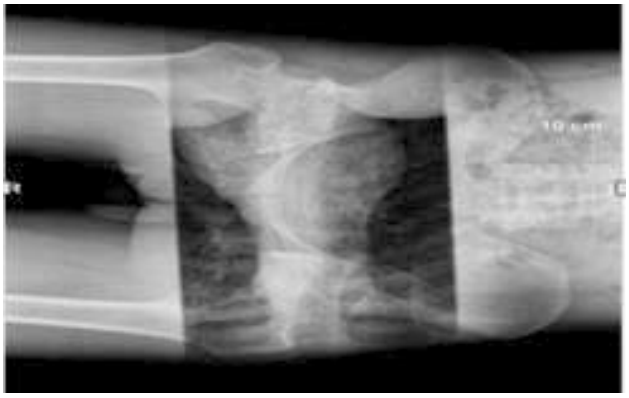

Figure 4: Double Image Artefact

DISCUSSION

Artefact may be commonly encountered when using any of the currently available digital radiography systems. CR implements a greater number of steps in the image acquisition process that are susceptible to artefacts [5,6].

Results from this study show seven (7) different types of artefact namely; Crack artefact, Artefact from dust, dirt and scratches, Moiré pattern artefact, Quantum mottle, blank images, double images, Foreign body artefact, These findings are similar to those reported by [5,6,7,8,9&10]. Majority of the artefact originated from the image plate with crack artefact been the most common. This could be attributed to the rigorous stress the image plate undergoes in and out of the image reader in addition to unfavorable weather condition it is exposed to. Kano, being a state in northern Nigeria is characterized by high temperatures of 33.0C^0 (maximum temperature) and 24.7^{0}C (minimum average temperature) with an annual average temperature of 28.6^{0}C.

Cesar et al [5] and Requi et al [3] in their studies classified CR artefacts into those related to the system component namely; imaging plate, the plate reader, soft copy display or the printers those related to patient or operator's mistakes alone which is the most common. This is in accord with the classification made in the present study.

Most of the artefacts could be remedied through careful handling of the equipment, performing scheduled cleaning and maintenance. Replacement with newer ones where appropriate and use of appropriate image parameters and routine quality control.

CONCLUSION

Computed Radiography(CR) systems employ a greater number of steps in image acquisition that may be bring about different types of artefacts which if not remedied can lead to image quality degradation, misdiagnosis, repeat exposure and ultimately increase patient dose. These artefacts can be traced to the component parts of the equipment, operators and/or patient Different types of CR Artefacts have been identified with majority originating from the image plate (Crack, dust particles, dirt and scratches). They can be eliminated through careful handling of the equipment, performing scheduled cleaning and maintenance, replacement with newer ones where appropriate, routine quality control and use of appropriate image parameters

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