ORIGINAL ARTICLE

RADIATION PROTECTION PRACTICE ON PAEDIATRIC CHEST RADIOGRAPHS USING BEAM COLLIMATION AS A CRITERION

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ABSTRACT

OBJECTIVE: To assess the adequacy of x-ray beam collimation as a parameter for radiation protection in paediatric plain chest radiographs. **METHOD:** A total of 200 paediatric chest radiographs (= 18 years) were retrospectively assessed for good collimation practice as a means of radiation protection. Parameters assessed on the technique of collimation were the presence of silver lining as an evidence of x-ray beam collimation according to the European guideline on quality criteria for diagnostic radiographic images. **RESULT:** Of the 200 radiographs assessed for adequacy of x-ray beam collimation, 79.0% (n=158) showed evidence of adequate beam collimation while, 21.0% (n=42) were inadequately collimated. The results of the study showed adequate beam collimation practice in the Radiology department of the centre studied. **CONCLUSION:** The adequacy of x-ray beam collimation as parameter for radiation protection in paediatric plain chest radiographs was assessed. Majority of the paediatric plain chest radiographs were adequately collimated while some few radiographs reveal inadequacy of beam collimation.

Key words: Radiation protection, paediatric chest radiograph, beam collimation, beam restriction, ALARA.

Introduction

Radiation protection in the context of medical exposure is an effective measure employed by radiation workers to safeguard patients from unnecessary and unintentional exposure to ionizing radiation[1] which could possibly result in negative biological effects. This is of more importance in paediatric radiography due to greater radiosensitivity of tissues and longer life expectancy in children with possible manifestation of stochastic effects of radiation later in life.[2-4]

Beam collimation in paediatric examination is an essential parameter in dose reduction to patients. Collimation is the restriction of radiation to the area under examination by confining the beam with metal diaphragms or shutters with high radiation absorption power.[5]

Collimator is a device that filters a stream of X-rays so that only those travelling parallel to a specified direction are allowed through, while others will be absorbed by hitting the metallic plate surface or the size of a hole. Beam collimation is an important tool in reducing radiation dose to a patient and it protects the patient from scattered or unnecessary radiation.[3] Plain chest x-ray examination is the oldest radiographic technique and remains the most common radiological examination performed in the world today.[6] It is estimated that approximately 25 percent of all radiographic examinations are chest x-rays. The long standing use of chest x-ray could be attributed to the advantages

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it offers. It is easy to perform and widely available[6,7] radiograph provides instant information about the lung, the heart, the large vessels that brings blood to and from the heart (great vessels) and the chest wall. It also involves low radiation dose and is relatively inexpensive.[7,8]

Despite the numerous advantages of chest x-ray examination as highlighted above, performing chest x-ray examination in children could be plagued with numerous challenges due to peculiarities in children age, size, presenting pathologies, age-specific psychology of children and increased radiosensitivity of tissues[2,9] could make collimation a daunting task. Sometimes the paediatric patients do not cooperate with the procedure of plain x-ray examination of the chest. As a result less attention is paid to the adequacy of beam collimation on the chest x-ray which could be detrimental to the paediatric patient. However, the uses of immobilization devices have been found to improve collimation practice in children.[9,10]

Collimator is the best x-ray beam restrictor. It defines the size and shape of the x-ray field that emerges from the x-ray tube. The collimator assembly is attached to the tube housing at the tube port. A collimator consists of two sets of shutters which can be moved independently. Each shutter consists of four or more lead plates which can absorb x-rays completely to provide a well-defined x-ray field. When the shutters are closed, they meet at the centre of the x-ray tube. The collimator has a light arrangement to illuminate the x-ray field. The light bulb is positioned laterally and the mirror is mounted in the path of the x-ray beam at an angle 45°.

The International Commission on Radiological Protection (ICRP) recommends that exposure of the patient particularly that of children must be kept to the lowest practicable value, consistent with clinical objectives and without loss of essential diagnostic information.[11]

Collimation of x-ray beam is an important factor in optimization.[3] A good collimation will both minimize the dose to the patient and improve image quality, because the amount of scattered radiation will increase if a large volume of tissue is irradiated. Collimation is particularly important in paediatric radiography since the organs are closer together and larger fields are more likely to include additional radiosensitive organs.[2,3]

A study conducted in Southeast Nigerian teaching and specialist hospitals assessed x-ray beam collimation practice among radiographers.[12] A total of 500 radiographs from 5 hospitals in southeast Nigeria were assessed and the findings showed that 52% of the radiographs evaluated in the teaching hospitals had inadequate collimation while, 59% of the radiographs evaluated in the specialist hospitals had inadequate collimation. Though, the researchers did not state whether paediatric radiographs were included in their study. Beam collimation practice in paediatric chest radiographs are rarely reported and most errors and poor collimation practice go unnoticed hence, resulting in unnecessary radiation dose to children because they are highly under represented in most research surveys.[2] Therefore, this study intends to assess the adequacy of beam collimation in paediatric plain chest radiographs in a major tertiary hospital.

Materials and Methods

A total of 200 paediatric chest radiographs (= 18 years) were retrospectively assessed for good collimation practice as a means of radiation protection. Parameters assessed on the technique of collimation were the presence of silver lining as an evidence of x-ray beam collimation according to the European commission guideline.[13] Where; (0) silver line, connotes very poor collimation; one (1) silver line, connotes poor collimation; two (2) silver lines, connote good collimation; three (3) silver lines, connote very good collimation and four (4) silver lines, connote excellent collimation. Only paediatric plain chest radiographs were included in the study. Radiographs of other body parts and adult chest radiographs were excluded from the study.

Resuls

Of the 200 paediatric plain chest radiographs that were evaluated based on the visualization of silver lines; 6.0% (n=12) had very poor collimation, 15.0% (n=30) had poor collimation, 27.5% (n=55) had good collimation, 24% (n=48) had Very Good collimation

and 27.5% (n=55) had an excellent collimation having all the four (4) sides with clear edge silver lines as shown in (Tab. 1).

Degree of collimation	Frequency	Percentage
Very poor	12	6.00
Poor	30	15.00
Good	55	27.50
Very Good	48	24.00
Excellent	55	27.5
Total	200	100.00

Table 1: Quality of beam collimation on paediatric plain chest radiographs

For adequacy of beam collimation, out of 200 radiographs, 79.0 % (n=158) were adequate while, 21.0% (n=42) were inadequate as shown in (Tab. 2).

Overall beam collimation	Frequency	Percentage
Adequate	158	79
Inadequate	42	21
Total	200	100.00

Table 2: Frequency distribution of adequate and inadequate beam collimation on paediatric plain chest radiographs

Discussion

Beam collimation is an important tool in radiation protection because it helps to reduce unnecessary patient exposure and increase image quality by eliminating scatter radiation.[2] Paediatric plain chest radiographs were evaluated in the present study based on visualisation of silver lines on the edges of the radiographs with reference to the European Commission guidelines.[13] Out of the 200 paediatric chest radiographs that were evaluated for adequacy of beam collimation, 79% showed adequate beam collimation while, 21% showed inadequate beam collimation. These findings are at variance to the study conducted on the assessment of x-ray beam collimation practice among radiographers in Southeast Nigeria,[12] which indicated that, 52% of the radiographs evaluated in teaching hospitals showed inadequate beam collimation and 59% of the radiographs evaluated in specialist hospitals also showed inadequate collimation. This reveals that there is adequate beam collimation practice among the radiographers in this present study. However, the authors acknowledge the fact that while the present study showed an excellent beam collimation practice, it was a single centre study with a sample size of 200 radiographs, as against 500 radiographs that were studied by Okeji et al[12] in multiple centres in south eastern Nigeria. This does not in any way negate the findings of this study but rather serves as a baseline for further research with a larger sample size and more centres in order to guarantee wider generalization of findings.

Conclusion

The adequacy of beam collimation as a parameter for radiation protection in paediatric plain chest radiographs has been assessed. Majority of the paediatric plain chest radiographs are adequately collimated while some radiographs reveals inadequacy of beam collimation. It is therefore recommended that radiographers and internee radiographers should intensify efforts to achieve complete adequacy of beam collimation in paediatric radiography.

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