

Evaluation of image quality of pelvis antero-posterior view radiographs

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Abstract

Introduction: Pelvic radiography is a common radiographic examination. Thus it is important to depict entire anatomical structure with an acceptable image quality. This study was done for quantitative evaluation of pelvis radiographs by depiction of the anatomical and physical details.

Methods: In this cross-sectional study, about 115 pelvis radiographs were selected over two months period. Eight image quality criteria i.e. anatomical coverage, sharp bony detail, rotation, collimation, artifact, beam centering, SI joint visibility and gonad protection were included.

Results: Out of the 115 radiographs, only about 13% fulfilled all the image quality criteria, the rest 87% lacked either one or more of the criteria.

Conclusions: To a great extent the quality of the pelvic radiographs depends on the skill of radiographer, equipment condition (x-ray machine, CR reader) and also co-operation of patients.

Key words: Conventional radiography, image quality, pelvic radiographs,

Introduction

Majority of the examination in the radiology department comprises of the conventional radiography. The radiographic image of the pelvis is one among them. The pelvic radiographs provide information about the pelvic bones, soft tissue and structure inside pelvic cavity. Pelvic radiography is indicated in trauma, foreign body evaluation, loin pain and lower urinary tract problem. With the advent of Computed Tomography (CT) / Magnetic Resonance Imaging (MRI) however, plain radiographs are losing their relevance as far as pelvis radiography is concerned. Even though CT scan provides improved resolution of soft tissues, it has the drawbacks like increased cost, higher radiation dose and less accessibility. The antero- posterior (AP) radiographic projection of the pelvis is the basic projection for radiography.¹

The usefulness of a diagnostic radiograph depends on the quality of the image. Image quality (IQ) refers to the accuracy with which the examined anatomic structures are reproduced on the image receptor. Regular quality

assurance (QA) testing has been recommended for sustaining good practice in diagnostic imaging.²⁻⁵

To ensure the desired standards of quality, image quality criteria recommended by the Commission of European Communities (CEC) have been used for the assessment of images globally. The adoption of and compliance of diagnostic radiography practice to these image criteria has been a major step towards ensuring satisfactory overall performance and standardization of procedures in radiographic examination of patients. Our objectives are to assess the different image quality criteria for pelvis radiographs, to find the degree of accuracy of radiographs in terms of image quality and to identify the frequency and causes of unsatisfactory radiographs.

Methods

The study was a cross-sectional study with study period of about 2 months [1st of July to 31st of August, 2015]. It was performed in Radiology Department of T.U.

Teaching Hospital (TUTH). Informed consent was obtained from the participants for the study.

A total of 115 pelvis radiographs were collected during the period of 2 months. Antero-posterior radiographs of pelvis were taken by using Hitachi x-ray machine with capacity 150 kV and 500 mA. The kV ranged from 90-110 with mAs of 40-60 for Computed Radiography image receptor (AGFA Company) of standard speed. The size of image receptor was 14"x17" with use of table bucky. These x-rays were processed in AGFA CR 30 readers. The age of the patients ranged 15 to 70 years. The quality of all the collected radiographs were evaluated under nine criteria as anatomical coverage , sharp bony outline (to check the penetration and exposure factor), artifacts , proper collimation (to check the tight collimation), rotation(proper positioning of the patient),beam centering(to assess the centering of the beam), SI joint visibility(to assess for positioning),gonad protection(to assess for radiation protection) and all correct (met all criteria). Each criterion was classified into yes and no category.

The dataset obtained were tabulated and analyzed using statistical analysis software, SPSS ver.20. Descriptive statistics was used to analyze the data.

Results

The minimum and the maximum age was 18 and 68 respectively with mean of 34.63. The standard deviation was 13.147. The sex wise distribution of the patients is shown below. (Figure.1; Table 1)

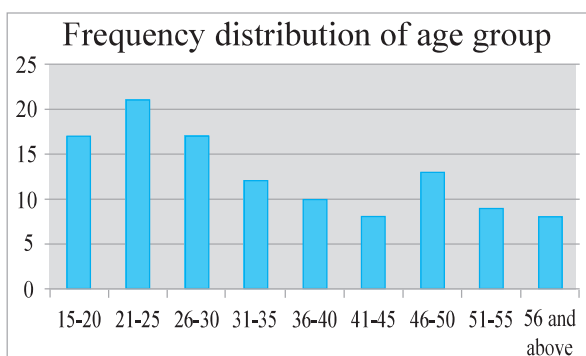


Figure 1. Frequency distribution according to age group

Table 1. Table showing gender distribution

	Frequency	Percentage
Male	47	40.9
Female	68	59.1
Total	115	100

For the criteria of anatomical coverage, the required anatomy of pelvis was covered in 100 radiographs (87%) and at least some part missed in 15 images (13%). Similarly the sharp details of bone were seen in 83 (72.2%) and not seen in 32 images (27.8%). The radiographs were free of artifacts in 94 (81.7%) and contained artifacts in 21 (18.3%). (Table 2a)

Table 2a. Table showing anatomical criteria

	Anatomical coverage	Sharp bony details	Free of image artifacts
Yes	100	83	94
No	15	32	21
Total	115	115	115

Centering of the beam is one of the determining factors for a quality radiograph. In this study beam centering was proper in 45 (39.1%) and not proper in 70 images (60.9%). The study found proper collimation in 48 (41.7%) and was either not done or improper in 67 images (58.3%). The examination showed either the rotation or improperly positioned in 70 cases (60.9%) and no rotation in 45 cases (39.1%). Sacro-iliac joint (SI Joint) was visible in 93 (80.91%) and not visible in 22 images (19.1%).

Table 2b. Table showing radiographic criteria

	Beam centring	Collimation	Rotation	SI Joint visibility
Yes	45	48	45	93
No	70	67	70	22
Total	115	115	115	115

Thus this study found that the pelvic radiographs were correct by all aspects in only 15 cases (13%) and were not correct by one or other criteria in 100 cases (87%). (Fig 2).

Radiographs which met all criteria

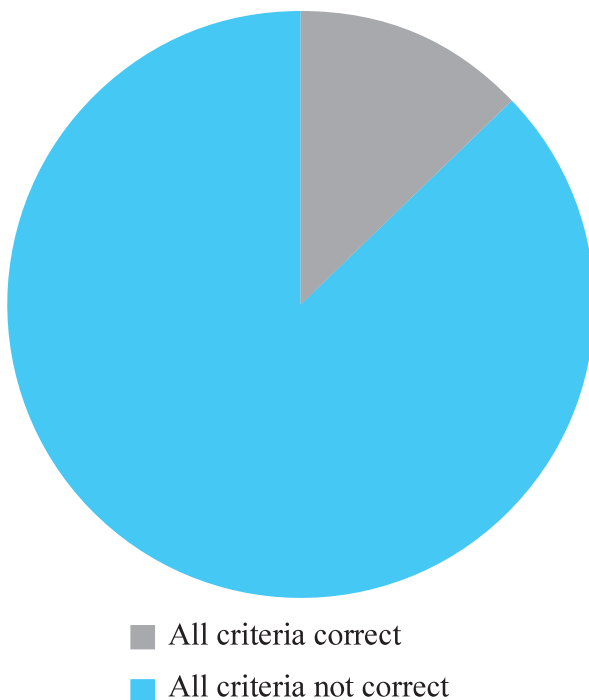


Figure 2 Chart showing distribution of radiographs meeting the criteria

Discussion

Radiographic quality control is important to reduce the adverse effect of expected patient outcomes. According to European guidelines, the radiographs of the pelvis should demonstrate symmetrical reproduction of the pelvis as judged by the imposition of the symphysis pubis over the midline of the sacrum. There should be sharp demonstration of sacrum and its intervertebral foramen along with visually sharp reproduction of the sacroiliac joints. The neck of the femur should be sharply visualized and should not be distorted by foreshortening or rotation.⁶⁻⁸

The use of gonad shield is necessary in pelvic radiograph unless it obscures the anatomy of interest. The gonad shield is different for male and female patient. This study showed no evidence of usage of gonad shield.⁹ Optimization of the technique is necessary in terms of ALARA [as low as reasonably achievable].¹⁰

These studies showed only 13% of the radiographs were correct from all of quality aspects. This represents a very serious condition in image quality consideration. The main causes of poor image quality were rotation, poor

collimation, improper beam centering and presence of artifacts.

Incorrect radiographs were unacceptable for reporting and further clinical evaluation and they had to be repeated. Repetition of radiographs poses a great impact on radiation dose to the patient, workload and economic loss to the department.

The causes of these errors were mainly due to lack of communication between the patient and radiographer and improper positioning due unavailability of different positioning aids. A small percentage of errors were due to patients' body habitus. Another cause of error was due to misjudgments in selection of exposure factors and the collimation done by the radiographer.

Good image quality of 68% showed in the study done by Inah GB et al. In his study 43% of the sampled radiographs were flawed with respect to optical density measurements. Only 13% images were satisfactory in our study. There is a need for optimization of radiographic technique to address the observed areas of deficiency. Quality control program should be strictly implemented.¹¹

Significant reductions in entrance surface dose and effective dose can be achieved without loss of image quality with a larger than normal source to image distance for antero-posterior projection of pelvis in direct digital radiography.¹²

Subsequent studies can be performed to focus on dose-image quality relationship using the current study as a baseline.

Conclusion

This study showed that only 13% of the pelvic radiographs were satisfactory by all aspect and remaining 87% of the radiographs did not meet either one or more of the criteria of good usage quality. The causes of unsatisfactory radiographs were patient rotation, improper beam centering and collimation. The quality of the pelvic radiographs depends upon skill of radiographer, equipment condition (x-ray machine, CR reader) and co-operation of patients to a great extent. However it becomes the sole responsibility of the radiographer/technologist to provide a good quality image to the patient. Thus, we should take steps towards improving the image quality of the radiographs to increase the diagnostic accuracy and promote better patient care.

Conflict of interest: None declared**References**

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