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Anatomic Site Markers: Evaluation of Their Use among Maltese Radiographers

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ABSTRACT

Purpose: To evaluate the perception and 5-year application of anatomic side markers (ASMs) by radiographers in Malta.

Methods and materials: Phase 1 involved a longitudinal, retrospective observation of a stratified sample of radiographs over 5 years, using a self-designed data record sheet to record features of the placement of ASMs. Phase 2 consisted of a cross-sectional, prospective self-designed questionnaire evaluating the radiographers' perception on the use of ASMs in professional practice.

Results: In phase 1, radiographs ($n = 500$) were selected from 234,105 taken over the 5-year period (error: $\pm 4.38\%$; 95% confidence level). Four hundred thirty radiographs (86%) had evidence of markers, of which 110 (25.6%) had a pre-exposure marker and 320 (74.4%) had a postprocessed marker. The remaining 14% had no evidence of any markers. Two hundred eighty two (56.4%) of the radiographs had ASMs placed according to recommended guidelines by Ballinger, Frank, and Merrill. In phase 2, most radiographers (84.6%) preferred using postprocessing markers, with 15.4% preferring pre-exposure markers (76.6% of radiographers found applying pre-exposure markers time consuming). Sixty percent (60.5%) of radiographers gave correct answers on use of markers as recommended in the guidelines.

Conclusions: Radiographer preference in using postprocessing markers was evident, while the use of pre-exposure markers was seen to be influenced by time of examination, projection executed, and patient positioning. Radiographer awareness and continuous training are recommended.

RÉSUMÉ

But : Évaluer les perceptions et l'application sur une période de cinq ans des marqueurs anatomiques latéraux (ASM) par les radiographes à Malte.

Méthodologie et matériel : La méthodologie comprend deux phases. La phase 1 a pris la forme d'une étude d'observation longitudinale rétrospective d'un échantillon stratifié de radiographies sur une période de cinq ans, à l'aide d'une fiche d'enregistrement conçue par les auteurs afin d'enregistrer les caractéristiques de positionnement des ASM. La phase 2 a pris la forme d'un questionnaire prospectif transversal conçu par les auteurs afin d'évaluer la perception des radiographes à propos de l'utilisation des ASM dans la pratique professionnelle.

Résultats : Dans la phase 1, 500 radiographies ($n=500$) ont été sélectionnées parmi les 234 105 prises au cours de la période de cinq ans (erreur: $\pm 4,38\%$; intervalle de confiance 95%). Quarante cent trente radiographies (86%) présentaient des preuves de marqueurs, dont 110 (25,6%) avaient un marqueur pré-exposition et 320 (74,4%) un marqueur de post-traitement. Les 14% restants ne présentaient aucune indication de marqueurs. Deux cent quatre-vingt deux radiographies (56,4%) présentaient des marqueurs placés selon les recommandations des lignes directrices de Ballinger, Frank et Merrill. Dans la phase 2, la majorité des radiographes (84,6%) ont dit préférer utiliser des marqueurs post-traitement, et 15,4% des marqueurs pré-exposition, alors que 76,6% des radiographes ont dit trouver que l'application des marqueurs avant l'exposition demandait trop de temps. Soixante pour cent (60,5%) des radiographes ont donné des réponses correctes sur l'utilisation des marqueurs selon les recommandations des lignes directrices.

Conclusion : La préférence des radiographes pour l'utilisation des marqueurs post-traitement apparaît clairement, tandis que l'utilisation des marqueurs pré-exposition semble influencée par le moment de l'examen, la projection exécutée et le positionnement du patient. Les auteurs recommandent la sensibilisation et la formation continue des radiographes.

Keywords: Anatomic side markers; x-ray marker; lead markers; image quality labeling; best practice

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Introduction

Anatomic side markers (ASMs) are radiopaque markers used in radiography, containing the letters “R” and “L” to indicate the side of anatomy imaged on radiographs [1]. ASMs can be added on the receptor before x-ray emission using pre-exposure ASMs [2] or else be inserted afterward using post-processing ASMs [3].

Incorrect use of pre-exposure ASMs is classified as one of the most common sources of error in radiography [4, 5]. Improperly marked radiographs result in confusion, wasted time and effort. It can also lead to unnecessary radiation dose to patients, due to repeats in exposure [6]. Omission of ASMs is seen as such a risk that radiologists may refuse to report the radiograph [7]. Postprocessing ASMs may be inserted in digital radiography or hand-written with a permanent marker in the case of film radiography [3]. However, postexposure ASMs should not be an acceptable substitute for pre-exposure ASMs, and the use of pre-exposure ASMs is considered “best practice” [8] because they form a part of the original image. Placing postprocessing ASMs on radiographs may increase potential mismarking, resulting in serious implications; after exposure, a double check should be made to confirm that the placement of postexposure ASM corresponds to the anatomic side imaged [9], and in turn, matches with the referring clinician’s request [10]. Medicolegal issues associated with nonuse or misuse of pre-exposure ASMs may arise and radiographers and other health care professionals have been held responsible and disciplined due to such errors [11, 12].

Specific guidelines exist that should be followed by all radiographers when using ASMs [6, 13–16]. Ballinger, Frank, and Merrill [1] provide such guidelines (Table 1) on how ASMs are to be placed during planar x-ray imaging and are found in their textbook, which is recommended to radiographers locally during their undergraduate studies. Thus, these guidelines were followed in this study.

Whilst use of pre-exposure ASMs has many benefits and is the method of choice, a disadvantage to using such markers is the possibility of being a source for cross-contamination when using the same marker for multiple studies, because hospital environments are a potential reservoir of infection [17]. However, this can be alleviated by proper infection-control measures, including routine cleaning [18].

Pre-exposure ASMs are ideally placed within the collimated area, to ensure their presence on the radiograph [8]. However, it may not always be possible to place a pre-exposure ASM within the primary beam without obscuring anatomy. Therefore, collimation may be compromised to include pre-exposure ASMs [19]. However, researchers have demonstrated that placement of pre-exposure ASM in the primary beam does not offer any superiority to pre-exposure ASMs placed in the secondary beam since these were still clear and aesthetically similar to those in the primary beam [20].

Ever since the advent of digital radiography, marking radiographs with ASMs after exposure has been made easier.

Nonetheless, it is still strongly recommended that pre-exposure ASMs be used the same way that they were used in conventional film systems [21]. If a pre-exposure ASM has not been placed, it may not be possible to accurately determine the orientation of the radiograph because it is not common for a radiograph to be flipped or rotated during postprocessing without the radiographers’ knowledge [11].

Therefore, the aim of this study was to evaluate the application of ASMs in accordance to the guidelines stipulated above and determine the radiographers’ perception on the use of such markers in a hospital in Malta.

Methodology

Institutional ethical approval (UREC reference number: 165/2014) was obtained before undertaking any data collection. The study involved two nonexperimental phases.

Phase 1 was longitudinal and retrospective gathering quantitative data, involving the evaluation of ASM use from archived radiographs ($n = 500$) performed over the last 5 years (2010–2014 inclusive) collected from the Picture Archiving and Communication System (PACS) in a public general hospital in Malta. Evaluation was conducted following the guidelines provided by Ballinger and Frank. Stratified random sampling was used to ensure representation of radiographs from all five consecutive years. Cluster sampling was then applied to each year separately, selecting radiographs randomly from one particular week from each year [22]. The margin of error was calculated, showing that a sample of 500 selected from a population of 234,105 radiographs guarantees a maximum margin of error of $\pm 4.38\%$, assuming a 95% confidence level [23]. A data record sheet was used to record the required parameters, which included the year and time of the examination, the type of examination performed, the type of projection performed, patient position, and evidence of ASM on the image. Analysis of data recorded in this phase was performed using Pearson’s correlation and the chi-square test to produce cross tabulations [24] using the “IBM Statistical Package of Social Sciences Statistics 20” (IBM SPSS Statistics 20).

Phase 2 involved a cross-sectional, prospective data collection of both quantitative and qualitative data. In phase 2, all radiographers ($n = 35$) working day and/or night shifts in planar x-ray imaging in the same public general hospital were invited to participate in the study. The sample included both male and female radiographers, with work experience varying from 1 to 30 years and education level ranging from a diploma up to a master’s degree in radiography. A self-designed questionnaire divided into three sections was distributed, containing both closed and open-ended questions. The sections related to: (1) radiographer perception of the use of ASMs in clinical practice; (2) education/training resources; and (3) knowledge of stipulated guidelines of ASM use by Ballinger and Frank. The questionnaire response rate was 74.3% ($n = 26$). Descriptive statistics were used in the analysis and presentation of the findings in this phase.

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