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Research Article

The Increased Source to Image-receptor Distance Technique: What Is Preventing Implementation in Clinical Practice?

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ABSTRACT

Evidence in the literature shows that increasing the source to image-receptor distance (SID) can optimize specific radiographic projections; yet, despite this evidence base, the technique is not commonly practiced within all radiology departments. The present work aimed to bridge the gap between evidence and practice by interviewing allied health professionals to investigate the feasibility of implementing the technique in clinical practice. Opinions were sought from multiple sources to triangulate the data including radiographers, medical physicists, professional body council members, and university lecturers. Data were collected via telephone and departmental surveys, self-administered questionnaires, focus groups, and individual interviews. Analysis via keywords and themes was undertaken. Tradition, the capacity to change practice, and radiographic equipment were perceived as the main obstacles against clinical implementation. Seventy-five percent of radiographers working with modern equipment did not perceive any disadvantage to the radiographer in extending the SID by 30–50 cm compared with 59% of radiographers working with older equipment. However, when radiographer perceptions of implementing the technique were analysed, 100% of radiographers responded positively to increased SID implementation, especially "if given more information." The key to effective clinical implementation is to adopt a multidisciplinary approach and to actively disseminate information among hospital management and radiographers. There are no insurmountable issues preventing the implementation of the increased SID technique in clinical practice, and encouraging radiographers to explore optimization strategies has the potential to advance evidence-based practice within the profession.

RÉSUMÉ

Bien que les données de recherche publiées démontrent que l'augmentation de la distance entre la source et le récepteur d'image peut permettre d'optimiser certaines projections radiographiques, cette technique n'est pas une pratique commune dans tous les services de radiologie. La présente étude vise à faire le pont entre les données probantes et la pratique par des entrevues avec des professionnels de la santé de différents domaines connexes afin d'étudier s'il est possible de mettre en œuvre la technique dans la pratique clinique. Les auteurs ont sollicité l'opinion de sources multiples, y compris des radiographes, des physiciens médicaux, des membres du conseil d'administration d'organisations professionnelles et des chargés de cours universitaires. Les données ont été recueillies au moyen d'entretiens par téléphone et dans les services, de questionnaires autoadministrés, de groupes de discussion et d'entrevues individuelles. Une analyse par mots-clés et par thèmes a été faite. La tradition, la capacité de faire évoluer la pratique et l'équipement radiographique ont été perçus comme les principaux obstacles à la mise en œuvre en milieu clinique. Soixante quinze pour cent des radiographes travaillant avec de l'équipement moderne ne voient aucun désavantage à augmenter la distance source-récepteur de 30-50 cm, alors que ce n'est le cas que de 59% des radiographes travaillant avec de l'équipement plus ancien. L'analyse des perceptions des radiographes démontre cependant que 100% d'entre eux se disent favorable à une augmentation de la distance source-récepteur, spécialement « si on leur donne davantage d'information ». La clé d'une mise en œuvre clinique efficace passe par l'adoption d'une approche multidisciplinaire et la dissémination active de l'information auprès de la direction de l'hôpital et des radiographes. Il n'existe pas d'obstacles insurmontables à la mise en œuvre de la technique de l'augmentation de la distance source-récepteur en pratique clinique, et le fait d'encourager les radiographes à explorer les stratégies d'optimisation a le potentiel de faire progresser la pratique fondée sur les données probantes au sein de la profession.

Keywords: Radiographic practice; increased source to image-receptor technique; evidence based radiography

Introduction

Increasing the source to image-receptor distance (SID) to reduce patient dose is not a new concept in diagnostic imaging. Numerous studies have investigated the merits of this

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optimization technique for various projections using film-screen, computed radiography (CR), and direct digital radiography (dDR) technologies, and all have established that increasing the SID reduces the radiation dose while maintaining image quality, albeit with varying degrees of dose reduction [1–7]. This underlines that increasing the SID has long been an accepted strategy in dose limitation, which is based entirely on the inverse square law and is independent of the film/image receptor. The SID and the inverse square law are inextricably linked, and their exclusive interdependence is paramount when investigating the optimization capabilities of the increased SID technique. In accordance with the inverse square law, if a radiograph is acquired at a longer SID, then there is the potential to reduce the dose by a factor of four. In terms of image quality, this would result in a radiograph with increased noise unless the automatic exposure control device of the x-ray set compensates for this by increasing the exposure time (mA) or the exposure factors are manually adjusted by the radiographer [1]. This highlights the importance of keeping the dose at the image receptor constant when increasing the SID because it provides a means of ensuring that all radiographs have a comparable signal-to-noise ratio [8]. However, despite the research on both old and new radiographic systems, the increased SID technique does not appear to be a commonplace optimization tool in many radiology departments, and this requires investigation. Hafslund et al [9] believe that radiographers should adopt the evidence-based radiography (EBR) approach and be responsive to the continuous technological development within their field. The aim of the current study was to investigate why the increased SID technique is not more prevalent in the clinical environment and to explore the feasibility of implementing this technique in practice. Three main areas were investigated to address this: (1) the physical limitations of the x-ray imaging equipment, (2) the radiographers' physical limitations, and (3) the logistics involved in implementing an increased SID in imaging departments.

Equipment Physical Limitations

The area and layout of the x-ray room are important factors to consider when assessing the feasibility of increasing the distance between the x-ray tube and the patient because the physical dimensions of the examination room need to be spacious enough so that the x-ray tube carriage can extend the additional distance in both the vertical and horizontal planes. The availability of grids focused to the newly recommended SID equally may be viewed by some as a physical limitation to the implementation of the increased SID technique in clinical practice; however, a review of the literature and product catalogues from radiographic equipment specialists reveals that focused radiographic grids are available with focal distances ranging from 100–180 cm; each of these focal distances has an associated focal range, thus increasing the flexibility of using each grid for a range of SIDs. The effect of this SID alteration on machine calibration and quality assurance testing must be considered when proposing to increase the SID by 30–50 cm for routine examinations. A number of protocols have been compiled by King's Centre for the Assessment of Radiological Equipment for commissioning and annual and routine testing of CR and dDR systems [10], which are based on documentation from the American Association of Physicists in Medicine [11] and the Institute of Physicists and Engineers in Medicine [12]. The experimental requirement for both commissioning and annual testing of CR and dDR systems is to set the SID to 150 cm or greater depending on the test. The King's Centre for the Assessment of Radiological Equipment protocols maintain that they "have data from performing tests on many manufacturers' dDR systems," all using a minimum SID of 150 cm, thus illustrating that calibration of the equipment during commissioning and annual testing should remain valid if the SID is increased by 30–50 cm during image acquisition. This is similar to the American Association of Physicists in Medicine documentation, which specifies that the SID should be at least 180 cm during testing to minimize beam divergence and the anode heel effect [11]. Therefore, each of the physical limitations of both room and equipment can be overcome by using scientific evidence from literature and guidance documentation when considering SID as a method for decreasing patient radiation dose. It should be noted that the height of the examination room is a potential limitation for increased SID because it limits the distance the telescopic arm of the x-ray tube can be extended in the vertical position.

Radiographer/Operator Physical Limitations

When investigating the use of increased SID as a potential dose reduction technique, it is vital to consider how the operators (mainly radiographers) would apply this practice in the clinical setting. Goyal et al [13] emphasized the importance of maintaining adequate work practices and ensuring that ergonomic conditions are considered when any new optimization technique is implemented within the radiology department. The primary basis for this is to avoid fatigue and/or injury to the radiographer or clinician because the newly implemented procedure may need to be performed several times a day. In the normal population, there are many variations in height and body habitus, and for the proposed change in practice, operators would need to adapt their technique on an individual basis.

In the United Kingdom, the National Health Service website [14] lists back pain as the second most common cause of long-term illness in the general public. The National Health Service estimated that approximately 7.6 million working days were lost from 2010–2011 because of work-related back pain and other musculoskeletal disorders. The majority of imaging systems require the operator to manually raise the x-ray tube or lower the detector (or radiographic table) when increasing the SID for supine patients, thus necessitating consideration of the impact of these actions on operators during clinical implementation. Kumar et al [15] interviewed radiographers working with CR systems; the three