Radiography xxx (2017) 1–7

Contents lists available at ScienceDirect

Radiography

journal homepage: www.elsevier.com/locate/radi

# A pilot study to determine the effect of radiographer training on radiostereometric analysis imaging technique

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A R T I C L E I N F O

*Article history:*
Received 3 August 2017
Received in revised form
21 November 2017
Accepted 2 December 2017
Available online xxx

*Keywords:*
Radiostereometric analysis
RSA
Imaging
Radiography
Radiographer
Professional training

A B S T R A C T

*Introduction:* Producing x-ray images for radiostereometric analysis (RSA) is a demanding technique. Suboptimal examinations result in a high percentage of exposure repetition. The aim of this pilot study was to use an experiential training approach to sharpen the skills of radiographers in acquiring images of an optimal quality.
*Methods:* A controlled trial using action research strategy was used. The study entailed a two phased approach. Radiographers were purposefully recruited and trained to perform the required investigations. Each phase included 12 examinations of a total knee arthroplasty phantom followed by 10 patient examinations. The quality of all x-ray images performed during the two phases was characterized by measuring the number of visible beads, the center position of the prosthesis (CP) compared to the center of calibration field (CCF). The number of re-exposures used to obtain a usable image during patient examinations was also recorded.
*Results:* The radiographers undergoing the training resulted in a significant improvement in the quality of images produced and visualization of the beads. That is, the ability to move the CP on average 36.1 mm closer to the CCF ($p < 0.001$), the number of visible beads increased by 3.1 ($p < 0.001$) and radiographers needed 2.1–2.9 exposures less to obtain RSA images of sufficient qualities during patient examinations in phase 2 ($p < 0.001$).
*Conclusion:* This study illustrates the value of experiential method of teaching and learning with minimal compromise on patient safety but a significant contribution in terms of establishing quality of RSA images.


## Introduction

Even the small amount of radiation to which patients are exposed during an x-ray examination can cause stochastic damage later in their lives.[1–4] During the production of x-ray images for radiostereometric analysis (RSA), patients are simultaneously exposed to radiation from two different x-ray tubes on opposite sides (Fig. 1). Consequently, the patient receives double the amount of radiation during RSA imaging compared with a conventional x-ray examination.

RSA is a highly accurate three-dimensional method of quantifying the migration of the implant inside the host bone, for the assessment of motion between bony structures that have been fixed, and for measuring implant wear. Detecting micro motion between implants and bone or that of bone against bone is crucial in predicting premature failure of an orthopedic implant or surgical method.[5–8] To accomplish this, up to eighteen tantalum beads are inserted in the bone next to an orthopedic implant during surgery. RSA images are then produced by two angled exposures simultaneously on two separate image receptors through a standardized grid of beads in a calibration cage placed beneath the patient. To increase the precision of these calculations, as many tantalum beads as possible placed in the bone must be visualized on both paired x-ray images.[5–13]

Producing x-ray images for RSA is a demanding radiography technique wherein parameters such as source to image receptor distance, source to object distance, x-ray tube angle, x-ray beam centering, positioning of the patient relative to the calibration cage,

*Abbreviations:* RSA, radiostereometric analysis; NB, number of beads visible; CP, centre position of prosthesis; CCF, centre of calibration field.

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https://doi.org/10.1016/j.radi.2017.12.003
1078-8174/

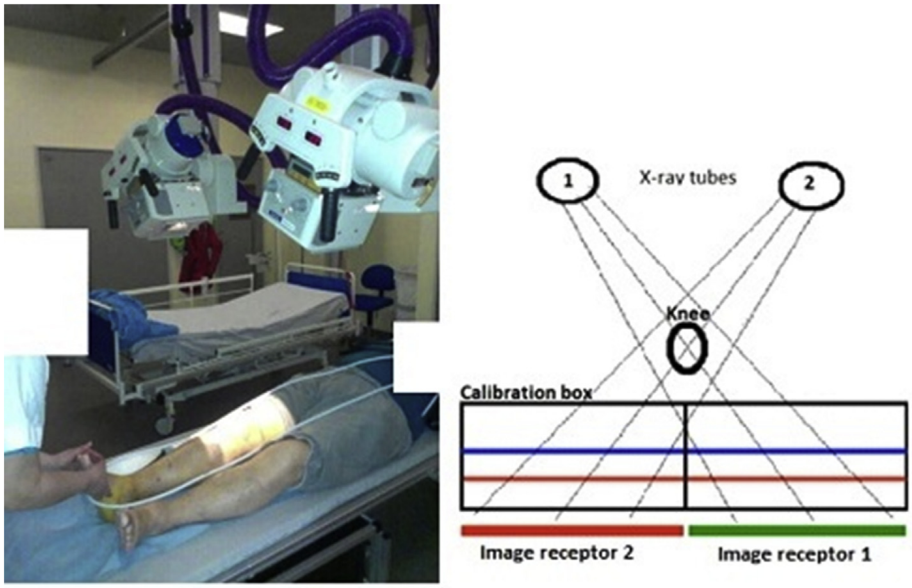


**Figure 1.** The RSA set-up consists of two synchronized roentgen tubes and a calibration box. The roentgen films are positioned underneath this box.

and distribution and distinction of beads in the images are crucial to the accuracy of the method.[14–17] An internal review demonstrated that a high percentage of RSA images were rejected in order to obtain a usable image. Based on this review and our experience, we believe that at least every second RSA examination has been repeated, which has led to excessive patient radiation. Repetition of imaging is primarily due to a lack of understanding by radiographers of which and how many implanted tantalum beads are needed to be identifiable on the images.

Training of radiographers thorough patient examination alone can be questionable due to the issue of X-ray radiation associated risk. Training where health professionals have opportunity to develop their skills in simulated clinical reality is in progress. Through practice workshops and hands-on training radiographers can increase their competencies without risk to patients.[18,19] Design and construction of different forms of phantoms depending on the body part of interest is commonly used in radiography mostly for radiation dose measurements. These phantoms can be used with advantage in simulation training of the staff in new and more complicated x-ray study setups.[20,21]

Producing quality images are crucial for early diagnostic in number of life-threatening diseases such as cancer.[22] Experiential learning of radiographers organized in a clinical setting can assure best practice in performing and acquiring optimal images and then increase public safety. In the absence of formal training programs experiential learning can be of the great value at the workplace. It offers approach to education and learning as a lifelong process and strengthening linkages among education, work and personal development. Experiential learning takes the workplace as a learning environment that can supplement formal education and can foster personal development through meaningful work.[23]

The aim of this pilot study was to investigate the influence of experiential learning approach on development of radiographers' skills in performing RSA examinations and improve the quality of RSA x-ray images.

## Methods

In order to establish a suitable research methodological approach both radiography and orthopedic scientific publications were consulted. An action research project using a randomized trial was decided upon based on the complexity of producing real time images without the compromise of image quality and radiation dose.

### *The radiographer participants*

The sample entailed recruiting purposefully 4 radiographers out of a total of seven. The eligibility criteria were that participants did not have prior experience with RSA imaging and that the group consists of the same number of experienced and inexperienced radiographers. Inexperienced radiographers had less than five years seniority and experienced radiographers had beyond twenty years seniority (Table 1). This was to investigate if seniority had influence on training outcomes. Three participant candidates with less than one year of work experience were excluded from the participation since they took the part in department's standard introduction training program as the radiographer novices. Four radiographers were selected for the study group, two experienced and two inexperienced. Because only four radiographers were evaluated this should be considered as a pilot study.

Radiographers were invited by the letter containing information about study emphasizing voluntary participation and possibility to withdraw at any point.

The study was performed during a period of six months and consisted of two phases separated by a workshop course. In total 80 patient RSA examinations were performed, each radiographer performed 10 examinations in each phase.

### *Phase 1*

Phase 1 was completed during a period of three months. Twelve phantom RSA examinations of 2 h duration for each radiographer

**Table 1**
Seniority was defined as years of qualification as a radiographer.

| Radiographer participants | Seniority |
|---|---|
| Radiographer 1 | 34 years |
| Radiographer 2 | 4 years |
| Radiographer 3 | 3 years |
| Radiographer 4 | 33 years |