

# Development of a software for radiological breast mammography anatomy and technical procedures study

Desarrollo de un software para estudio de anatomía y procedimientos técnicos en mamografía radiológica de mama

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**OLIVEIRA, M.; MULLER, J.; BASTOS, M.; DA SILVA, C.; MITSUO, M. & MDLETSHE, S.** Development of a software for radiological breast mammography anatomy and technical procedures study. *J. health med. sci.*, 6(4):297-302, 2020.

**ABSTRACT:** The aim of this study was to develop a software for radiological breast mammography anatomy study. A descriptive and exploratory study was carried out using mammography images database. The software was created using well-known open source image J software. Eight mammographic images were selected including standard views: craniocaudal (CC) and mediolateral oblique (MLO) views, and supplementary views. The software was created as an image J plugin-in. The virtual environment presented multiple choice questions related to radiological breast anatomy and patient positioning criteria. The software launches by requiring the user to register their profile ( user ID) followed by the selection of mammography projection technique. As the second step, a screen with multiple choice questions opens according to the technique selected by the user. At the end of the evaluation, a report is presented containing date and time of evaluation, username and the score achieved. The report also provide feedback to the user and highlight where the user incorrectly identified the anatomy. The software allowed assist on multifactor mammography learning process for radiographers. However, It is necessary the improvement of software including high quality images and case study.

**PALABRAS CLAVES:** Mammography; anatomy; software; education.

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## INTRODUCTION

Mammography is a specialised imaging of the breast that plays a critical role in the early detection of breast cancer. Mammography training varies from country to country, either offered as part of the undergraduate curriculum or as a post-basic qualification / training . In addition, mammographers are generally expected to have current knowledge and training due to the dynamic nature of this field. In the Brazilian context, the Brazilian National Mammography Quality control program 2898/2013 prescribes that health professionals involved with mammography, including radiologic technologists, should improve their knowledge and skills on a regular basis and participate in continuing professional education (Brasil,2013).

One of the critical areas in mammography practice is the knowledge of breast anatomy. Teaching breast anatomy in the context of mammography can be achieved using various tools which need to focus on the anatomical structure, spatial resolution and morphology in general. These tools include the use of cadavers, synthetic anatomy models, radiology image review and iterative virtual environments (Mujika et. Al, 2018, Marreez *et al.*2010, Oliveira *et al.*2013).

The use of computer-based virtual teaching platforms in health sciences (including medical imaging) education has gained the upper hand in recent years since its use can reduce error rates, decrea-

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se administration time while increasing quality standards (Qpercom, 2020, Paiva & Prevedello, 2017). In addition, the use of virtual software allow iterative actions that create an user-friendly environment, where the users are able to practice repeatedly the recognition of radiologic anatomical landmarks (Oliveira, 2019), and also support the development of implicit skills that require repetitive stimulus (Chen et al, 2017). The use of virtual software can be considered an attractive didactic tool with great learning potential (Holanda et al, 2013).

Currently there is lack of widely available virtual teaching platforms for breast anatomy to enhance the teaching and learning quality in mammography (ngelo & Schiabel, 2002, Dianelys et al. 2014). In addition, it has been shown that there are several advantages of custom-designed software packages, including the fact that it allows for the creation of a tailor-made solution for the needs of that organisation. On the other hand, hospitals and clinics have an increased demand of up-to date mammographers who are able to relate basic image profile with important skills for professional practice (Santos, 2016).

In this study, we aimed to create an educational software for radiological breast mammography anatomy landmarks and patient positioning studies.

## MATERIAL AND METHOD

This descriptive and exploratory study was conducted by a Radiology technology research support group in Brazil. The software was developed as a plugin using ImageJ which is a free software accessible via the internet (National Institutes of Health, USA). This is an inexpensive method as it does not require a user license. Besides, it allows the development of macros, which assist to perform tasks automatically. The software design process that was followed is shown in Figure 1.

A sample of eight mammographic images were selected from database using the following criteria: 1) Good anatomy criteria (see Table I); and 2) correct technical positioning of the breast according to the mammographic projections. The images were digitalized and saved in TIFF format. The most common mammography projections were considered in

this study i.e. craniocaudal (CC), mediolateral (ML) and mediolateral oblique (MLO) views and supplementary projections (spot compression and Eklund views).

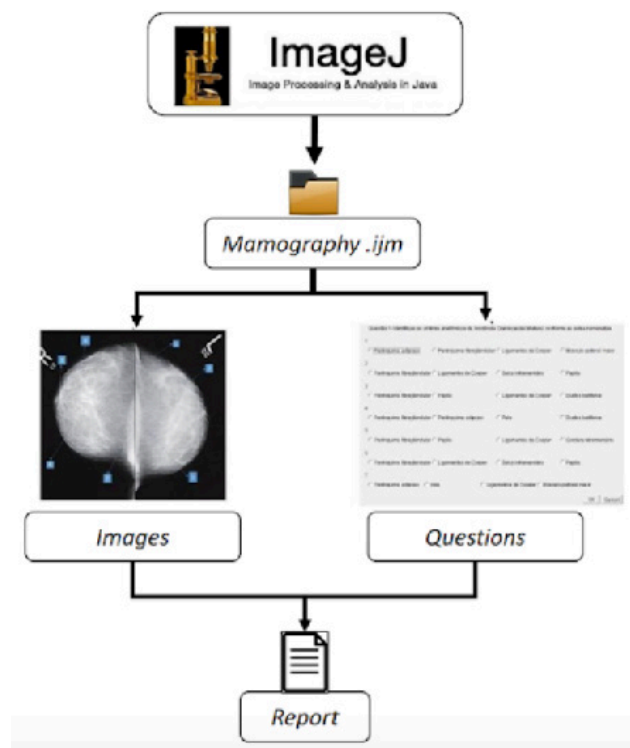


Fig. 1. Software design process.

Anatomy landmarks criteria for use on the images was established based on publications (Maierhofer, 2008, Lopes, 2000, Frank, 2015, Möller, 2011). This criteria indicated the following as important: 1) Anatomic landmark view, 2) Good patient position, 3) Good technique performance. In addition, the selected images anatomy landmarks were validated by three experienced (>five years) radiologic technology professors who are involved with teaching mammography. The creation of the software applied the same method performed by Oliveira et al.. Anatomical landmarks were marked and labelled with numbers on the images that were selected to be used for the development of the software. The labelling was done to create multiple-choice questions that the users of the software will be expected to answer as part of identifying anatomical structures. This software was done in Portuguese.

Ethical approval (3.941.172) to undertake the research study was granted by the Academic Ethics Committees.

Table 1. Mammographic projections and anatomic criteria

Mammographic Projections	Anatomy criteria
Craniocaudal bilateral	Adipose parenchyma; Fibroglandular parenchyma; Cooper's ligaments;
Mediolateral Obliqua bilateral	Pectoralis major muscle; Inframammary fold or groove; Papilla; Lactiferous ducts; Skin; Retromammary fat; Vein; Subcutaneous fat; Pectoralis minor muscle; Fibroadipose parenchyma; Pre-glandular fat; Retromammary space.
Mediolateral 90° (ML)	- Papilla parallel to the film - View of lower quadrants - Maximized breast tissue - Tube rotation 90 °
Spot compression	- Inclusion of the medial portion - Study of dense areas and nodule contour - Papilla parallel to the film - Spread the breast parenchyma
Eklund (EKL)	- Better visibility of the breast parenchyma - "Push" the implant against the chest and "pull" the breast - Use manual mode in the second acquisition - Make two acquisitions, CC and MLO, and CC -EKL and MLO- EKL.

## RESULTS

The software launches by requiring the user to register their profile ( user ID) followed by the selection of mammography projection technique (Figure 2).

As the second step, a screen with multiple choice questions opens according to the technique selected by the user (Figure 3).

At the end of the evaluation, a report is presented containing date and time of evaluation, user-name and the score achieved. The report also provide feedback to the user and highlight where the user incorrectly identified the anatomy (Figure 4).

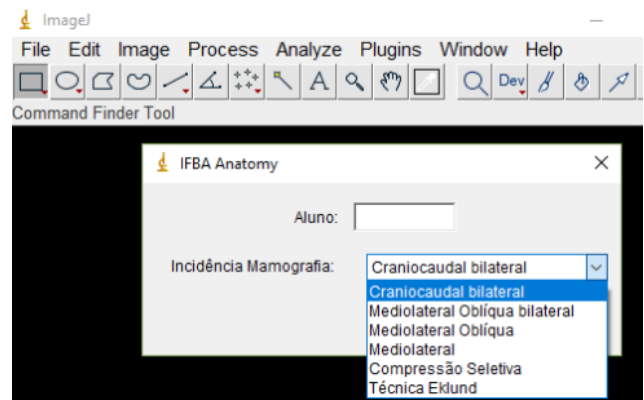


Fig. 2. Screen shot of software interface.

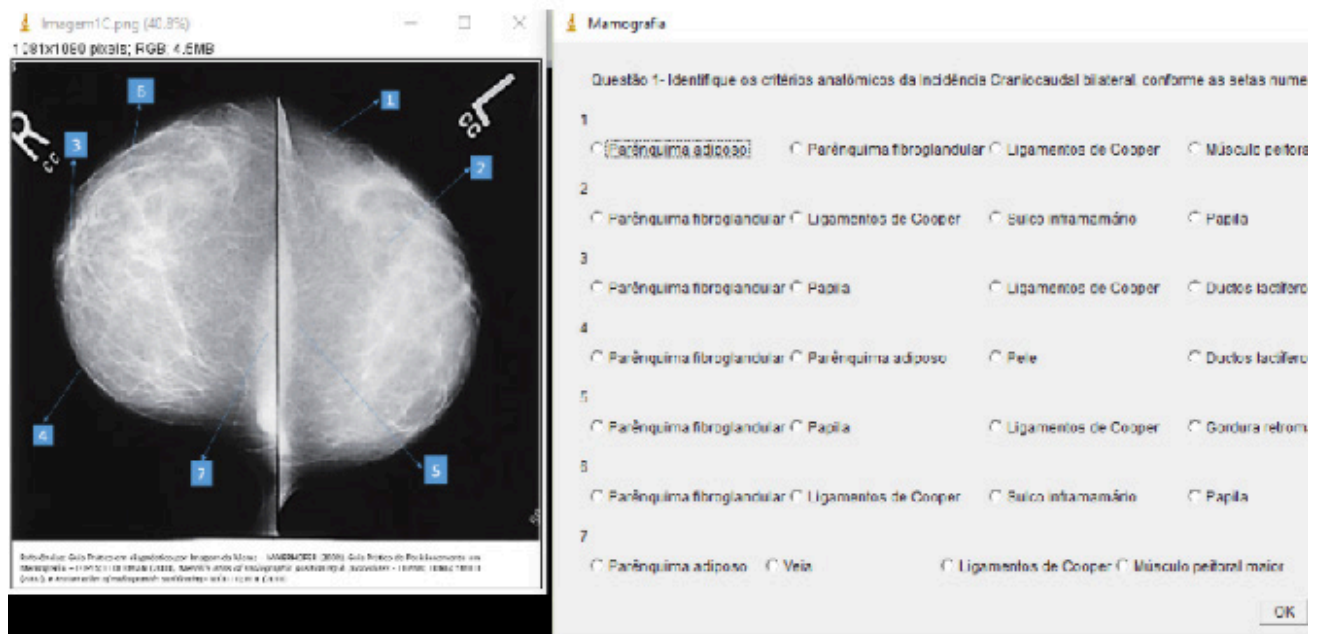


Fig. 3. Screen of multiple-choice questions for the CC view.

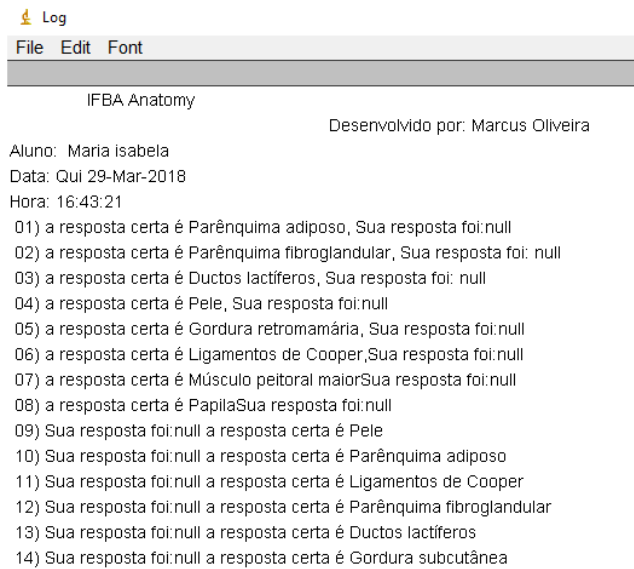


Fig. 4. Screen shot of final report from user test per projection specific.

## DISCUSSION

The purpose of the software development was to provide a tool that can be used to enhance the radiology breast anatomy knowledge while enhancing the implicit skills of the mammographers. The use of mammographic breast images on this platform is justified since it enables the users to deepen their knowledge in image quality, pattern recognition and positioning criteria.

The developed software has direct application in Mammography teaching, where the user can identify the breast anatomical criteria and quality of patient positioning according to the routine and supplementary mammographic views. The software enhances the teaching strategies and the user's knowledge, while contributing to continuing education.

Several software with breast mammography images obtained from simulators or phantoms have been developed, however, the radiologic technologists are not encouraged to only use this kind of software ( Pires, 2008). Other authors have presented on software they developed, like the one developed in the current study. For example, authors ( ngelo & Schiabel, 2002) developed a similar software which presents a simple and easy navigation system, allowing a greater interactivity for the user. The use of interactive software

has been shown to be an important tool in the teaching of radiological anatomy when applied with the appropriate configuration and real images (Alvarez,2006 ).

It is important to highlight that the patient position mistakes can compromise the diagnosis and can lead to repeats. This is the reason why the radiologic technologists should receive continuous education (Xavier, 2015). In this context, both the undergraduate radiologic technology students and radiologic technologists must be committed to taking advantage of learning opportunities using such user friendly tools(Moreira et. al,2015, Santos et. al,2017 ).

Owing to the radiologic anatomy content as part of the course plan in mammography classes, authors(Prando *et al.*,2014 ) suggest software usage as valuable tool to be applied. In addition, authors (Elias *et al.*,2009) considered software usage as an important multifactorial learning method applied for mammography training. The interactive system that monitors the educational process achieving in the classroom turns the teaching-learning process easiest. However, this strategy does not replace the classroom methodology (Prando *et al.*, 2014, Miziara *et al.*, 2011).

## CONCLUSION

In this study, an inexpensive software was presented. This software can be applied as a multifactor mammography enhancing learning tool for mammographers. However, It is necessary the improvement of software including high quality images and case study.

## ACKNOWLEDGEMENTS

The authors thank the Federal Institute of Bahia and GTecRad (Grupo de Pesquisa em tecnologia em Radiologia), Brazil; Federal Institute of Santa Catarina for their support in conducting this study.

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**RESUMEN:** El objetivo de este estudio fue de el desarrollo de un software para estudio de anatomía y procedimientos en mamografía de mama. Se realizó un estudio descriptivo y exploratorio utilizando una base de datos de imágenes mamográficas. La aplicación se creó utilizando un conocido software (imagen J) de código abierto. Se seleccionaron ocho imágenes mamográficas que incluían proyecciones estándar: proyecciones craneocaudal (CC) y mediolateral oblicua (MLO) y proyecciones complementarias. El software fue creado como un complemento de imagen J. El entorno virtual presentó preguntas de múltiple opción relacionadas con la anatomía radiológica de la mama y los criterios de posicionamiento del paciente. El software se inicia solicitando al usuario que registre su perfil (ID de usuario) seguido de la selección de la técnica de proyección de mamografía. Como segundo paso, se abre una pantalla con preguntas de opción múltiple según la técnica seleccionada por el usuario. Al final de la evaluación, se presenta un informe que contiene la fecha y hora de la evaluación, el nombre de usuario y la puntuación obtenida. El informe también proporciona comentarios al usuario y destaca dónde el usuario identificó incorrectamente la anatomía. El software permitió asistir en el proceso de aprendizaje de mamografías multifactoriales para radiólogos. Sin embargo lo es necesaria la mejora del software, incluidas imágenes de alta calidad y estudios de casos.

**PALABRAS CLAVES:** Mamografía, anatomía, programa, educación.

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Recibido: 04-05-2020  
Aceptado: 14-08-2020