DEVELOPMENT AND LIVER OF PHANTOM ANTHROPOMORPHIC APPLICATION FOR USE IN RADIOLOGY

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ABSTRACT

The use of artificial ionizing radiation has also been employed in several areas, namely: medicine, agriculture, industry, ink curing etc. However, the use of radiation for medical purposes of diagnosis or therapy is being treated with more attention due to its increased use and the use of simulators object for quality control and training of professionals. The phantoms and are used to aid radiographic procedures, they may simulate a part of the body, both in its form as mass, density, and attenuation. The objective of this work was the development and application of liver anthropomorphic phantom for use in diagnostic radiology and training professionals. The construction of the liver anthropomorphic phantom was through literature and it was noticed that the use of phantoms are relatively low. For the construction of the mold of the phantom was used an adult human liver with early cirrhosis that was preserved in formalin for teaching demonstrations in Prof. Human Anatomy Museum collection Osvaldo Cruz of milk from the Federal University of Sergipe. With this work, we emphasize the need for the control program and quality assurance in radiology doctor to ensure image quality and low exposure of patients and professionals, since the radiological examinations are extremely important, because its contribution decisively in medical diagnosis.

1. INTRODUCTION

Currently, the use of artificial ionizing radiation has been used in several areas, namely: medicine, agriculture, and industry, ink curing and other. However, the use of radiation for medical purposes of diagnosis or therapy is being treated with more attention due to its increased use. And within this application, exposure of patients, professionals and the general public by means of radiological surveys show most relevant, since it supports decisively in medical diagnosis. This gives easily due to the emergence of increasingly sophisticated digital devices and the significant number in recent year's diagnostic services [1-3].

Thus, with the use of ionizing radiation the International Commission on Radiation Units and Measurements (ICRU) has an extremely important role in respect to radiological protection and are intended to establish quantities and physical units of radiation, including the criteria and measures comparison methods. In Brazil, the Health Surveillance Secretariat of the Ministry of Health on June 1, 1998, published Ordinance No. 453 "Basic Guidelines on Radiological Protection in Medical and Dental Radiology", which determines the protocols that must be followed for the use, sale and the setting of radiological equipment [4, 5]

From the international and national standards, can improve and ensure the quality of images through the control program and quality assurance in radio diagnosis medical, dental and nuclear medicine. In addition to setting, as a set of procedures that aims at ensuring that the X-rays produced images present high quality, lower exposure of patients and professionals involved and with relatively low financial cost. Such procedures are considered extremely

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important, among them, the tests that are performed at the intervals established by Ordinance 453/98 and are also used of the phantoms anthropomorphic or physical or bodies. However, it is not allowed to be used for patient achievement of quality control tests, an unacceptable practice in diagnostic radiology services and recommendations of national standards [4].

According to ICRU n. 46, phantom physical or virtual are used to assist in the assessment of radiation interaction with matter and determine assessments of the quality of medical and dental images. Are also used for calibration and prevention of diagnostic radiology equipment, dose estimates absorbed in the patient and the professional that make the use of radiation. The use of phantoms was the alternative to this evaluative radiological procedure of image acquisition devices. The phantoms are used to aid radiographic procedures; they may simulate a part of the body, both in its form as mass, density and attenuation [4-7]. These phantoms are called anthropomorphic phantoms. The objective of this work was the development and application of liver anthropomorphic phantom for use in diagnostic radiology and training professionals.

2. METHODOLOGY

The construction of the liver anthropomorphic phantom was through literature and it was noticed that the use of phantoms are relatively low. Namely: as the number of tests that are performed in the acquisition of equipment in Brazil, in a study of radiographic images and the training of professionals in the medical. For the construction of the mold phantom was used an adult human liver with early cirrhosis that was preserved in formalin for demonstrations in teacher Osvaldo Cruz in Human Anatomy Museum in the collection of the Federal University of Sergipe.

The materials used in the construction of the liver phantom were selected from characterization of powder and liquid acrylic autopolymerized in relation to the properties of the human body. It is noteworthy that the attenuation phenomenon is important in the formation of radiographic images.

For the modeling of the anthropomorphic phantom liver, alginate was used, for dental use. Firstly, the mixtures made of alginate in water, forming slurry and rapid curing. The human liver was immersed in texture and with a few minutes, the type of the mold found himself ready. For the construction of the anthropomorphic phantom liver format was used autopolimerized acrylic. Mixing each gram of powder for ½ liquid was obtained a homogeneous mixture, and to the use of a spatula, passed around the alginate mold to form a "shell" type "easter egg".

After the first phantom designed developed a second with the same size, shape and materials. In the first phantom, stood in the structure of the phantom eight balls made of dental wax number 7, to simulate the nodes with different dimensions ranging from 2 cm to 6 cm. After that, came together randomly within the object. Moreover, if two small holes opened position and covers (open and close) to that before the test, were filled with water and in the case of nuclear medicine image, the exemption of the radioactive material with water. The water, in turn, has density of 999.97 kg/m^3, and is used to simulate soft tissue. In Figure 1, you can display the object open simulator and with the fixed balls.

Figure 1. Representation the dental phantom with wax balls number 7.

The second phantom liver was filled with colorless gel conductor with yellow dye eight Styrofoam balls and placed on the gel to simulate the nodules. The balls have a dimension of 0.35 cm to 1.4 cm. In Figure 2, the second phantom filled with gel positioned at the nodes. Note that, the gel colorless conductor used in the construction of the phantom is the same used for ultrasound examinations with pH 6.5 to 7.0 (neutral) and chemical composition carboxyvinylpolymer, imidazolidil urea, methyl paraben, 2 amino, 2-methyl, 1-propanol (AMP) and deionized water.

Figure 2. Representation the phantom with conductive gel and Styrofoam balls.

The tests were performed in two hospitals in the city Maraba, in Para state in northern Brazil. To preserve the image of hospitals, was called H1 visited the first hospital and the second hospital of H2. In H1, the two liver anthropomorphic phantoms were positioned side by side, whereas in the H2, the images were separated, as shown in Figure 3, respectively.

Figure 3. Representation the phantom positioned in CT scanners.

In both hospitals, examination started with the CT and X-ray of the area to be studied, as it was defined in the monitor the dimensions of the field, the type of cut and the number of slices that would be realized. The percentage of kV used in the studies was the same 120 kV.

3. RESULTS

In diagnostic radiology, the quality control is done by the evaluation of the images, positioned the patient, inter-physical parameters and the reproducibility of the results obtained with the anthropomorphic phantom, physical and computational. In H1, the dimensions were equivalent to a computerized tomography, with axial and 31 slices, and these slices, 15 are related to liver phantom filled with water and 16 refer to the phantom liver filled with gel. The simulator filled with water showed some of the nodules that were simulated. In figure 4, we can observe the display of the twelve (12) images, with a red circle, the nodes that could be visualized was marked. The eight simulated nodes, only seven were visualized.

Figure 4. Representation the phantom test using with water in H1.

The anthropomorphic phantom liver filled with gel yellow conductor presented image blur that caused difficulty in the simulated nodules view. Of the nine simulated nodes, only six appeared in the image. In Figure 5 can be seen. From this identification, it was observed that the conductive gel without preparation or pure conductive gel does not provide satisfactory results. Figure 5 shows the test simulator filled with a conductive gel.

Figure 5. Test the phantom with gel in H1.

In H2, the dimensions were equivalent to a computerized tomography, with axial and 60 slices for each simulator, both filled with water as filled with conductive gel. In Figure 6, we can observe the display of the 20 images of 60 sections. This number was chosen due to the presence of the test conducted in simulated nodes, while in some images did not show any node. The eight simulated nodes, the eight were visualized accurately.

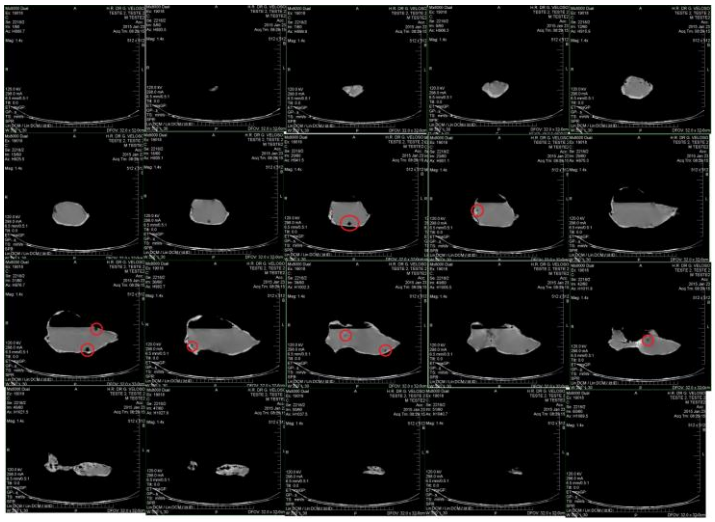

Figure 6. Test the phantom with water in H2

In Figure 7, the tests conducted with the conductive gel phantom with no additional preparation of the acrylic showed the nine (9) simulated nodes, only six (6) were visualized. Furthermore, it was observed that some images obtained with the phantom do not show satisfactory results due to incomplete filling of the simulator.

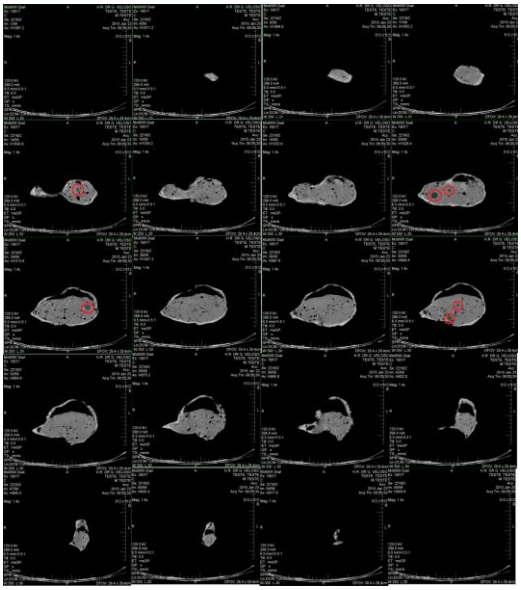

Figura 7. Test the phantom with conductive gel in H2.

To solve the air bubbles in the gel which caused the driver before and after the manipulation, was used a mixture of the autopolymerized acrylic powder in the ratio of ½ powders with the conductive gel. This enabled the gel inserted in the phantom stay denser and without air bubbles. Thus presenting excellent results for simulating the body being studied.

4. CONCLUSION

The purpose of this work was the development and evaluation of the liver phantom for use in radio diagnosis. It has been observed that there are differences in the images obtained in each hospital, as well as the material inserted in the simulator, such as water and gel. It was also observed that the number of test slices is related to quality of radiology equipment. The CT scanner used in H1 was one o'clock CT Helical GE 1 Channel brand ProSpeed Fast of 2002 that a test conducted with the greatest number of cuts has not been possible because it caused full basement in the image. Thus, it was decided that 31 cuts for the phantoms, which is often used in normal examinations. In H2, the scanner used was of the Philips 8000 MX 2004 has a larger variety of cuts that can be performed without any distortion in the images, so it cuts 60 have been defined for each simulation object.

Finally, it is concluded that the CT images showed that the liver anthropomorphic object with water can be considered of great benefit in the aid of the test image acquisition protocols, and may thus be used in quality control testing of images and the training of professionals, without exposing patients to unnecessary radiation and giving a location and size of liver abnormalities accurately. However, it is clear that this difference in the number of cuts caused the impossibility of full view of the nodules in the simulator filled with water in the hospital H1, which may cause a possible submission of patients to new tests or failures in the correct number of anomalies, different tests H2 performed at the hospital, all nodules were visualized simulated accurately.

Moreover, computed tomography of the liver anthropomorphic phantoms gel images were not satisfactory, presenting air bubbles which make it difficult to locate and identify abnormalities in both hospitals. These air bubbles appeared due to handling of the conductive

gel and also evaporation, since the gel is not switched during the production interval until the completion of the tests.

With this work, we emphasize the need for control and quality assurance program in radio diagnosis doctor to ensure image quality and low patient exposure and professionals, since the radiological examinations are of paramount importance, because its contribution decisively in medical diagnosis.

5. REFERENCES

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