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DEVELOPMENT OF A PMMA-BASED RADIOGRAPHIC SKULL POSITIONER FOR USE IN DOGS AND CATS

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ABSTRACT

The material for the manufacture of radiographic positioning accessories, available on the market, are basically foams and non-radiopaque fabrics. The objective of this work is to present skull positioners made with non-radiopaque polymeric materials that facilitate cleaning, asepsis, and visualization of the symmetrical positioning of the studied structure. Adding veterinary skull radiographic positioners to the market is something of interest to radiologists and professionals in the veterinary radiological area because they guarantee a reliable position to the structure studied, favoring the accuracy of the report. The cost is low and the material is easily accessible, which increases the benefits of the positioner. The skull positioner made of polymethylmethacrylate has a transparent appearance close to that of glass and is safe and resistant to falling. When there is a need for anesthesia, the skull positioner will also be efficient, considering that the animal, even anesthetized, needs to be positioned correctly, presenting the structures to be radiographed, and symmetrical in the image. The simulator produced in a 3D printer with characteristics of the bone structure of the dog served as a simulator for the standardization of the work in relation to the creation of the positioner.
Keywords: *radiographic positioner, veterinary radiology, PMMA, simulator*.

INTRODUCTION

Veterinary radiology requires some special care, the most important of which is to keep the animal contained in a technical and safe way, so that at the time of the radiographic examination it does not move, causing inadequate images for the realization of reports [(1)]. The care in relation to work accidents caused by bites and deep scratches will depend on updates and adaptations of the professional Technician and Technologist in radiology to working in the veterinary area. Therefore, the professional will depend on efficient accessories for protection and containment, for example, for dogs and cats [(2)].
The trend is that quality will increasingly become the main factor when we work with Veterinary Radiology. Customers, increasingly demanding and aware of their rights, are

choosing diagnostic centers that have digital X-ray equipment, quality of care, quality of examination, and animal care [3].

Prioritizing appropriate techniques, performing effective positioning to highlight specific pathologies, and using appropriate accessories for the positioning of choice are primary ideas for acquiring quality radiographic examinations [3].

The pet market is constantly growing and the great development implies the use of increasingly powerful and current equipment to obtain accurate diagnoses and quick treatments. In the diagnostic imaging center, more precisely in the X-ray sector, adequate positioning accessories are required that do not cause artifacts in the image, thus impairing the radiographic report [4].

Animals that require anesthesia can be kept in position with simpler techniques, thus facilitating the acquisition of the radiographic image. However, in order for the animal to be in the correct position, inappropriate ways are used, such as the professional's own hands or various resources, as shown in figures 1 and 2 [5]. Animals that do not require anesthesia will need accessory materials for a good restraint, being these adapted in a way to keep the animal correctly positioned and preventing that they will have some kind of injury due to inadequate restraint [6].

Figure 1 – Positioning with the hands [5].

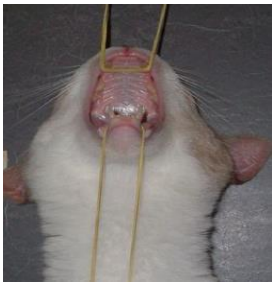

Figure 2 – Positioning with Elastic [5].

The materials for manufacturing radiographic positioning accessories on the market are basically foams and non-radiopaque fabrics. The lines used must be positioned laterally so as not to form radiographic artifacts in the image.

The accessories needed to take radiographs today are padded rail (figure 3) and angled foams (figure 4).

Figure 3 – Padded Veterinary Gutter. Source: http://www.primorvet.com.br/product.php?id_product=684 (Accessed on 07/05/2016)

Figure 4 – Angulation Foam. Source: http://www.fisioarbauru.com.br/vendas.html (Accessed on 07/05/2016)

In some cases, sandbags are used, so that you can make weight, trying to help the animal not get out of position when it is anesthetized, as shown in figure 5.

Figure 5 – Immobilization with sandbags. Source: http://radiologia.blog.br/thiago-rubens/tag/radiologia%20veterinaria?limit=10&start=10 (Accessed on 12/01/2016)

MATERIALS AND METHODS

Positioners manufacturing project

Basic models of the anatomical composition of the skull of dogs and cats were established, simulating three specific sizes, considering the sizes of the animals most attended in the small animal veterinary laboratory. Figures 6 to 8 technically show the shape and dimensions of the parts of the already standardized positioners.

Small Dog:

Figure 6 shows the parts of the "small" positioner that, after cutting the PMMA, were glued on the dotted lines. The parts are: A – superior; B - lateral (right); C - lower e D - lateral (left).

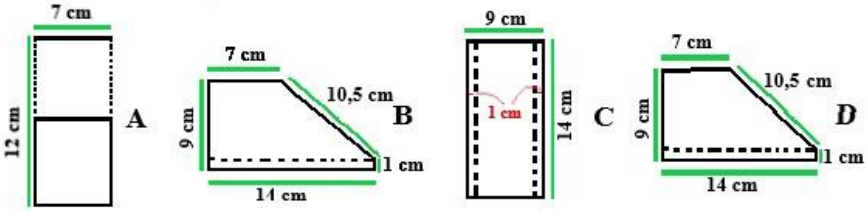

Figure 6: Small dog head positioner design. Source: author.

Medium dog:

Figure 7 shows the parts of the "medium" positioner that, after cutting the PMMA, were glued on the dotted lines. The parts are: A – superior; B – lateral (right); C – lower e D - lateral (left).

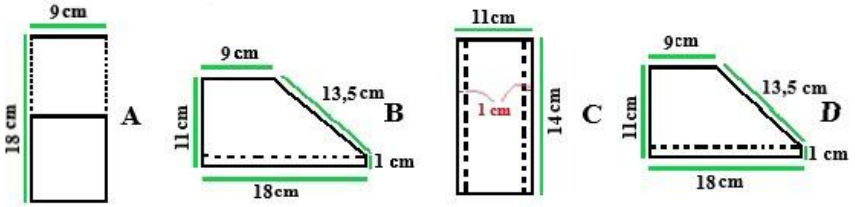

Figure 7: Medium dog head positioner design. Source: author.

Big dog:

Figure 8 shows the parts of the "big" positioner that, after cutting the PMMA, were glued on the dotted lines. The parts are: A – superior; B – lateral (right); C – lower e D – lateral (left).

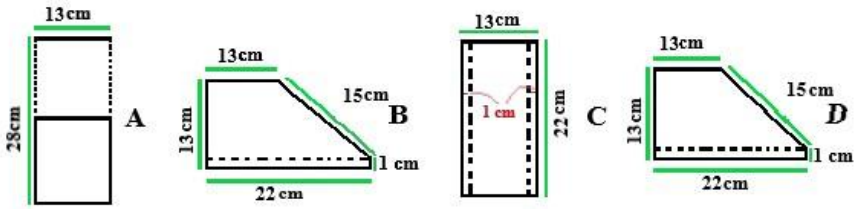

Figure 8: Big dog head positioner design. Source: author.

Irradiation using Positioners

To verify the possible scattering of radiation with the use of the positioner, first, without the presence of the animal, the PMMA positioners were used, following the assembly project of this work, with different sizes (S, A, B). To perform the tests, the dosimeter holders were positioned inside and outside the positioner (Figure 9), following the irradiation times of 0.03s, 0.05s, 0.08s, 0.1s, and 0.2s, maintaining 100mA and respecting the technique used by the laboratory in skull study. In this test the voltage (in kV) was changed, respecting the techniques used by the laboratory to study the skull of small, average, and big animals (small animals: 55 kV, medium animals: 70 kV, and big animals: 75 kV).

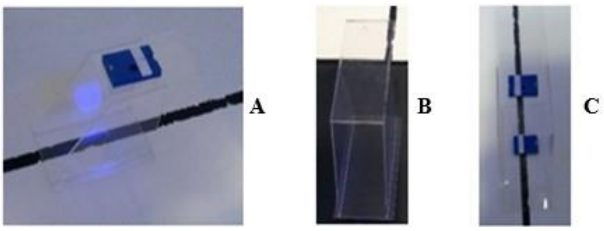

Figure 9: Evaluation test of possible radiation scattering using the positioners, without the animals. A – small; B – medium; C – big. Source: author.

RESULTS AND DISCUSSION

Evaluation of the Veterinary Radiologist in relation to the radiographic image of the skull simulator inside and outside the positioner

After the positioner project has been completed and tested to evaluate X-ray scattering at the entrance and exit of the skull using only the simulator and later the simulator inside the positioner, we move on to the medical evaluation of the project, that is, critical analysis by the Doctor Veterinary Radiologist in relation to the use of the positioner.

In this way, two radiographs were taken of a skull simulator built on a 3D printer that exactly simulates the bone composition of a small dog (Figures 10 to 12). The purpose of this test was to simulate the symmetry of the skull and if there was any change in the image when the positioner was used (Figures 13 and 14).

Figure 10 – Canine skull simulator made in a 3D printer (caudocranial view). Source: author.

Figure 11 – Canine skull simulator made on a 3D printer (craniocaudal view). Source: author.

Figure 12 – Canine skull simulator made in a 3D printer (side view). Source: author.

Figure 13 – Canine skull simulator made in a 3D printer, placed inside the positioner. Source: author.

Figure 14 – Canine skull simulator made in a 3D printer, placed inside the positioner. Source: author.

Four images were sent to the veterinary radiologists from different locations and companies, namely: a photo of the simulator in the positioner (Figure 14), a photo of the positioner (Figure 15), radiography of the canine skull simulator (Figure 16) and radiography of the simulator of the canine skull in the positioner (Figure 17).

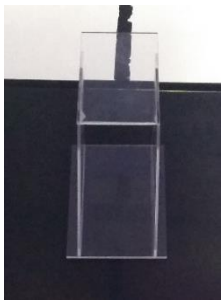

Figure 15 – Medium-sized canine skull positioner. Source: author.

Figure 16 – Radiograph of the simulator outside the positioner. Source: author.

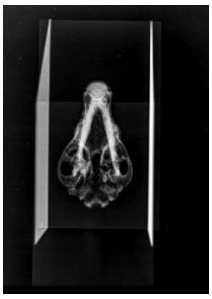

Figure 17 – Radiograph of the simulator inside the positioner. Source: author.

Answers were requested to the following questions:
1st. Does the canine skull positioner change the simulator view?
2nd. Does the canine skull positioner allow for proper simulator symmetry?
3rd. Does the material use to produce the canine skull positioner (PMMA) somehow change the image of the simulator?
The answers provided by the invited Veterinary Radiologists were:

Specialist Veterinary Doctor Ana Luiza Galli – CRMV: 31508 – São Paulo/SP:
"I received 4 images for evaluation regarding a radiographic skull positioner project for dogs and cats, I observed the figures and I understand that it is just a skull simulator, so there is no possibility of a report, however, in this observation made by me, my conclusions. Although the Positioner causes a slight artifact due to its edges, it did not interfere with the image quality.

The positioner provides a clear, distortion-free image and can be used for radiographic evaluation".

Specialist Veterinary Doctor Luiz Carlos Gracioli Vieira – CRMV: 13077 – Cascavel/PR:

"I received 4 images for evaluation, not for issuing a radiographic report. Thus, I understand that the simulator used is not the purpose, but the positioner. Looking at the photos, I realize that despite having noticed an increase in the homogeneous radiopacity of the image with PMMA, I can say that it does not influence the diagnosis. In the positioning, I did not observe any difference, only, therefore, the increased radiopacity with PMMA".

Specialist Veterinary Doctor Mirella Noronha Alegri – CRMV: 21661 – São Paulo/SP

"I received 4 images for observations related to the construction of a skull positioner for dogs and cats, considering that the simulator is not made of real bones but a 3D print. In my opinion, there was no damage to the quality of the image presented. I believe that a quality radiographic examination can be performed using the PMMA positioner".

CONCLUSIONS

The material used to make the positioners, 0.3mm PMMA (polymethylmethacrylate) sheets, proved to be effective in several aspects studied in this work, such as sharpness, ease of cleaning, and scratch resistance. The observations of the invited veterinary radiologists confirmed that PMMA causes little interference in the image, not compromising the diagnosis, therefore, the image can receive a report without problems.

In this way, it is understood that the use of PMMA positioners is effective in offering the tutor the possibility of containing the pet with good symmetry of the skull, facilitating the analysis in the preparation of the radiographic report offered by the veterinary radiologist, thus avoiding, unnecessary exposure of the radiology professional.

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