

Intraoral Microfocus X-ray radiography in veterinary medicine

N.N. Potrakhov¹, Y.N. Potrakhov¹

¹Saint Petersburg Electrotechnical University "LETI", Russian Federation

Contact: yn@eltech-med.com

Introduction

The provision of veterinary dental care is becoming an increasingly urgent task, for example, in dog breeding. So, for a thoroughbred exhibition animal, the loss of even one tooth can lead to the termination of a career.

In medicine in the vast majority of cases, diagnosis of the maxillofacial department is carried out with the help of specialized X-ray devices: traditional dental units, orthopantomographs and cone-ray tomographs [1]. Traditional dental devices (radioviographs) are designed to produce images of individual teeth or jaw areas, orthopantomographs for two-dimensional, and cone-ray tomographs for three-dimensional images of the full dentition of both jaws, including adjacent anatomical structures.

For a number of reasons - differences in the anatomy and physiology of the maxillofacial department of man and dog, as well as the language barrier, these devices cannot be directly used in veterinary dentistry. The flexibility and mobility of the fingers, paws, neck, and back of the dog are fundamentally lower than that of the corresponding human organs. The dog cannot fix the detector of the X-ray image with a finger or sit motionlessly in the chair of the cone-ray tomograph for a long time. The dog also cannot understand and fulfill the specific requirements of the X-ray assistant during the X-ray shooting.

Obviously, to solve the problems of diagnosis of veterinary dentistry in full, it is necessary to develop the appropriate technology.

Materials and Methods

At the present time for diagnostics in veterinary stomatology is used:

- sighting (traditional) dental units for taking pictures of individual teeth or jaw areas on an X-ray detector measuring 30×40 mm, which is placed in the oral cavity of the animal (Fig. 1)



Figure 1. Examples of obtained images using standard sighting dental devices.

- stationary X-ray apparatus for obtaining images of the entire head of the animal on an X-ray detector of 240×300 mm or more (Fig. 2, 3).



Figure 2. Scheme of shooting using powerful stationary X-ray apparatus.



Figure 3. Example of obtained images using powerful stationary X-ray apparatus.

The main disadvantages in the first case.

The size of the image detector does not allow:

- get a complete picture of even one tooth of a large dog;
- placement the image detector in the oral cavity of a small dog.

The probability of damage to the image detector by a dog of any size is great.

The main disadvantages in the second case:

- on the picture of the dog's head, images of all the teeth, bones of the skull and soft tissues are superimposed on

each other. This greatly complicates the description of the picture and the diagnosis

- the additional dosage for the animal and personnel.

At the beginning of the 21st century in Russia was offered a technique of Microfocus X-ray radiography. Unlike the currently known methods, this method allows to obtain:

- sighting images of individual teeth or jaw areas;
- panoramic images of the full dentition of both jaws, including adjacent anatomical structures [2].

To implement the technique, an X-ray tube with a hollow outside anode and a massive target 0.01BD57-90 (Fig. 4) was developed [3]. The length of the anode pipe is 120 mm, diameter 12 mm, and material - aluminum. The tube generates a panoramic X-ray beam with a solution angle of $135 \times 360^\circ$. The direction of the radiation output is opposite to the direction of motion of the electrons in the accelerating gap of the cathode-anode (tube target). On its basis, the sighting-panoramic dental X-ray apparatus PARDUS-02 was also developed [4].

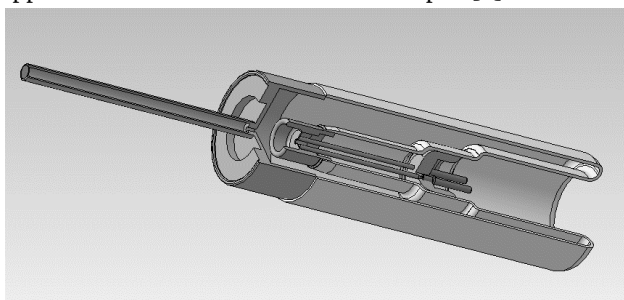


Figure 4. 3D drawing of the X-ray tube with a hollow outside anode and a massive target 0.01BD57-90.

Results

Studies conducted based on the city veterinary clinic №1 of St. Petersburg showed that the sighting device of the PARDUS family in portable design can be successfully used in veterinary dentistry for the direct dental studies. In the course of the tests, specialists highly appreciated the quality of the obtained X-ray images (Fig. 5), as well as the prospects for the development of a sight-panoramic technique for performing X-ray studies in veterinary medicine.



Figure 5. Dental pictures, obtained with portable X-ray device of the family "PARDUS".

A fundamental difference between the technique of panoramic X-ray radiography in veterinary medicine, in contrast to the standard methods, is the location of the anode of the X-ray tube directly inside the oral cavity of the animal. The X-ray generated by the tube passes through the teeth, jawbones, soft tissues and get to the X-ray detector, which is located outside the head of the dog opposite the diagnosed area (Fig. 6). In the course of further planned studies, the methods of installation will be tested, the shooting regimes will be improved, the dose of irradiation of the animal and the X-ray assistant will be estimated.

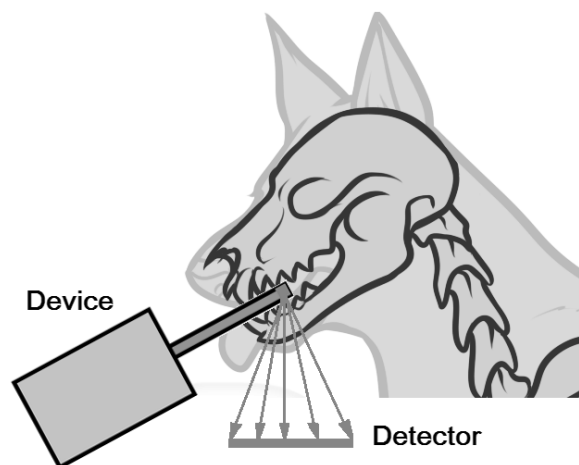


Figure 6. Scheme of the intraoral panoramic X-ray survey in veterinary medicine.

The main advantages of the method of the intraoral survey in veterinary medicine:

- small diameter and long length of the anode pipe allow placing the target of the X-ray tube anywhere in the oral cavity of an animal of any size;
- the reverse panoramic direction of X-ray radiation excludes the imposition of teeth belonging to different branches of the jaws;
- high informativeness of the images is provided by a small focal spot at an extremely low current tube (0.1 mA) and, accordingly, very low the exposure dose;
- the source of X-ray radiation is located inside the mouth, so the intensity of unused radiation is fundamentally lower due to absorption of the tissues of the head;
- ensured safe conditions for the X-ray assistant when shooting "from the hand" without the use of a traditional tripod;
- shooting "from the hand" greatly facilitates the laying of the animal and improves the efficiency of the diagnosis, primarily in non-specialized and non-stationary conditions.

Conclusions

As a result of a complex of design, technological and clinical research, a new technology for performing X-ray diagnostics in veterinary dentistry was proposed. The technology includes the method of the sight-panoramic survey

of the maxillofacial department of the animal and a set of digital technical means for its implementation. Conducted tests have shown expediency of carrying out of the further practical development in the field an X-ray survey of the maxillofacial department of the animals.

References

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