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Radiographic techniques for medical–dental research with minipigs

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Abstract

Techniques were developed to obtain standardised intra- and extra-oral radiographs in minipigs for use in medical–dental research. Twelve male minipigs (BR-1 Minipigs) were chosen at random. Two animals each at 3, 5, 7, 9, 12 and 15 months of age were anaesthetised and subjected to radiographic examinations to assess six techniques. Three intra-oral and three extra-oral techniques, standardised for humans, were used with variations of the angle of incidence of the X-ray beams, focus-film distance and exposure time. Two film positioners were developed for the intra-oral techniques. Two examiners then chose the radiographs with the least image distortion, greatest clarity and least superimposition of images. For each technique, the suitable angle of incidence of the X-ray beams, the focus-film distance and exposure time that produced the highest quality radiographs were standardised.

Keywords: Minipig; Swine; Medical–dental research; Radiographic techniques

1. Introduction

In studies that are based on the interpretation of radiographic images, the technique and radiographic processing procedures need to be standardised as many factors can interfere with the formation of the image. Some are related to the apparatus, others to the technique itself or to the method of radiographic processing (Freitas et al., 1984; Mattaldi, 1975; Wuehrmann and Manson-Hing, 1985). The need to develop devices for radiographic standardisation has been confirmed by various authors. Walton (1973) pointed out that the film must be placed correctly and that the incidence of the X-ray beams is particularly important. Jensen and Turek (1978) stated the importance of supporting radiographic films for taking standardised radiographs. Bender (1982) affirmed that the angle of the X-ray beam is responsible for the size and form of a lesion image, or even for its disappearance.

Radiographic interpretation of images taken of animals may be more difficult than with humans if they are not taken correctly (Cordeiro et al., 1995; Eisner, 1990, 1998; Zontine, 1974). This is because the anatomy of animal jaws makes placing and stabilising the films more difficult so that random angles of X-ray beams, which are not always ideal, are often used (Cordeiro et al., 1995; PittFord, 1984). Therefore, protocols must be established for the techniques used.

Eisner (1990) confirmed the need for precise radiographic techniques in assessing teeth, periodontal structures and anatomical repairs, especially for diagnosing neoplasia, infectious lesions and traumas in the maxilla, mandible and calvaria. He also suggested that radiography should be used frequently in veterinary practice to inform dental procedures. He compared the use of images obtained with conventional techniques to digital radio-

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graphs and concluded that, irrespective of the technique, priority should be given to the quality of the images to make an accurate diagnosis.

Conducting scientific research with radiographic images in animal studies can therefore be difficult. To standardise and facilitate research carried out with radiographs in dogs, Cordeiro et al. (1995) developed a device that enabled the ideal and constant positioning of teeth, film and X-rays, which has improved comparisons of pre- and post-operative radiographic images. The goal of the present study was to develop techniques to obtain standardised intra- and extra-oral radiographs in minipigs for use in medical–dental research.

2. Materials and methods

The research was approved by the Ethics Commission on Teaching and Research in Animals (Comissão de Ética no Ensino e Pesquisa em Animais – CEEPA) of the Bauru Dental School, University of São Paulo, Brazil.

Twelve male minipigs that belonged to the BR-1 Minipig colony were chosen at random. Two animals each at 3, 5, 7, 9, 12 and 15 months of age were anaesthetised and subjected to radiographic examinations to assess six techniques for standardised radiographic studies.

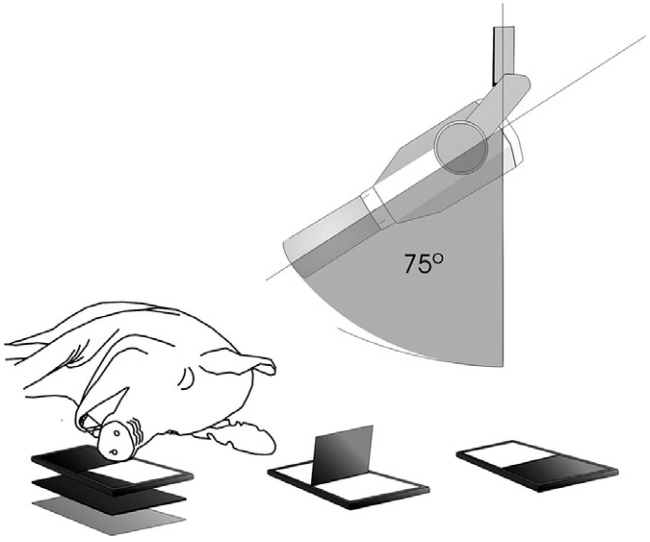

Fig. 1. Animal in lateral recumbency with chassis under its head. Detail shows the X-ray apparatus at an angle of 75° to evaluate the caudal and rostral teeth in the maxilla.

The six techniques described were developed with the dental X-ray apparatus Dabi Atlante (Dabi 70×), calibrated to 70 kV and 8 mA. Three types of film were used: periapical (Kodak: EP-01, Ektaspeed, size 2 boxes with 150 films), occlusal (Kodak: EO-41, size 4 boxes with 25 films) and extra-oral (Kodak: T-MAT-Diagnostic Film, size 18 × 24 cm).

The examinations were conducted with the animals under deep sedation. We injected a combination of azaperone (1 mg/kg) and ketamine (5 mg/kg) IM, which was effective for approximately 60 min.

The techniques standardised for humans were followed (Álvares and Tavano, 1998; Goaz and White, 1987; Pasler, 1999), with variations of the angle of incidence of the X-ray beam, focus-film distance and exposure time. Some further alterations were considered necessary because of the animal's anatomy (Bustad and McClellan, 1965; McKean et al., 1971; Sisson and Grossman, 1973; Swindle, 1988; Swindle et al., 1988; Tumbleson, 1986; Weaver et al., 1962, 1966, 1969), the types of film and the X-ray apparatus used.

For all techniques, the animals were placed in the oblique position. The exposure times ranged from 0.1 to 1.2 s, and for animals 5 months of age and younger, the time was reduced by 0.2 s for all techniques except that for the anterior region of the maxilla, in which there was no variation of time. The tests for initial assessment of each technique were carried out on six animals at ages 3, 5, 7, 9, 12 and 15 months.

To conduct the extra-oral techniques (Fig. 1), we tested various angles, exposure times and focus-film distances (Table 1) according to the previously described criteria. For the intra-oral investigation, two positioners were developed with different extensions that provided a controlled variation in the angle of incidence and focal distance with previously selected values (Table 2). These were as follows:

(1) Adaptation of the Han-Shin type positioner for the periapical technique: the bite block was removed and replaced by a rigid block made of a 2-mm thick acrylic resin (Figs. 2 and 5).

Table 1
Variations tested for extra-oral dentistry radiographic techniques in minipigs (Minipigs BR-1)

Extra-oral variations tested	Film		Incidence of X-ray beam	Focus-film (cm)	Exposure time (s)
	Type	Position			
Assessment of caudal and rostral teeth in maxilla	Kodak X-Omat (XK-1), size 18 × 24 cm]	Film on chassis (18 × 24 cm, under animal's head in standard position)	60°, 75° and 80°	45, 50 and 55	Rostral region: 0.1 and 0.2 Caudal region: 0.4, 0.6 and 0.8
Assessment of caudal teeth in mandible (oblique side)	Kodak X-Omat (XK-1), size 18 × 24 cm	Film on chassis (18 × 24 cm), under animal's head in standard position	45° and 50°	45, 50 and 60	0.5, 0.7 and 1.0