Radiological examination is indispensable in current dental practice. Lately, dentists have become not only the beneficiaries of radiographic investigations required for diagnosis, but also their authors, as many dental offices have been authorized to have X-ray machines and carry out radiological activity. This is why dentists who perform dental X-rays have the legal and moral obligation to possess thorough theoretical and practical knowledge about the radiological technique and also about their own and patients’ radiation protection. This study investigates to what extent medical practitioners providing dental radiology services know and apply the technical norms for work and patient protection.

1. INTRODUCTION

The importance of radiation protection measures derives from the harmful effects of radiation, which cause somatic changes and genetic mutations. These can be avoided by correctly performing radiographs and by reducing the number of radiographic examinations and, implicitly, unnecessary radiation exposure.

In developed countries, the number of dental radiological investigations represents 25.25% of all radio-diagnostic examinations performed worldwide [1,2].

In Romania, periodic reporting, to public health centers, the statistical data regarding patient medical radiation exposure levels is mandatory. So far, there are few studies presenting cumulative radiation doses in dental radiodiagnosis. Therefore, this study aims at investigating the observance of standards for radiation protection and for the optimization of patient radiation doses among dental practitioners in Cluj county who attended postgraduate radiation protection courses.

2. MATERIALS AND METHOD

The theoretical knowledge of dentists providing dental radiology services was evaluated based on a questionnaire distributed to 78 dental practitioners.

The questionnaire included 28 questions referring to:
- recommendation of radiological examination (type of indicated X-rays and criterion of the recommendation, technique recommended for periapical X-rays, frequency of radiographic examinations in various disorders),
- radiation protection measures in the dental office (knowledge on the role of radiation protection, radiosensitive anatomical regions, radiation protection measures, type of films and collimator used).

The obtained data were centralized in an Excel 2010 table and were interpreted based on descriptive analysis.

The criterion for the inclusion of dentists in the study was participation in a radiation protection course within the last five years, with or without the provision of dental radiology services.

3. RESULTS

A number of 78 questionnaires were distributed, which were answered by 36 dental practitioners (the response ratio = 46.15%).
Out of all persons who participated in the study, 21 dentists (58.33%) had a dental X-ray machine, 10 dentists (27.7%) had a panoramic X-ray machine, and 14 (38.8%) had no radiological equipment available, but had attended a radiation protection course. A ratio of 72.72% of the respondents had less than 10 years of dental practice experience.

The X-rays most frequently indicated for new patients, on the first examination, were: panoramic X-rays (61.1%), followed by periapical X-rays (50%), bitewing X-rays (8.3%), and full mouth X-rays (5.5%).

Most of the dentists considered radiographic examination necessary first for clinical diagnosis (66.6%), but other criteria were also taken into consideration, such as: the technical performance of the radiology laboratory (11.1%), patient’s financial resources (8.3%), and the difficulties of technical execution (2.7%).

With respect to the anatomical regions requiring protection in dental radiology, the respondents considered the thyroid as the most important one (97.2%), followed by gonads (63.8%) and bone marrow (19.4%). For one respondent, skin was the most important element.

Out of the 36 persons who answered the questionnaire, two persons had no opinion about the use of the lead apron or thyroid collar. The ratio of those who answered affirmatively was 91.6% for the lead apron and 94.4% for the thyroid collar. One person considered the use of the lead apron as unnecessary when performing dental radiographs.

Regarding the performance of X-rays in pregnant women, 5.5% of the dentists considered this as possible in the first trimester of pregnancy, and 27.7% - in the last trimester. On the other hand, 16.6% of them stated that radiographs could be performed without any restriction and 50% believed that they could not be performed at all during pregnancy.

According to this study, the films used in dental radiology services were mostly high-speed films, such as E-speed (30.5%) and F-speed films (19.4%), while slow-speed films, such as D-speed films, were used only in 8.3% of the cases.

The results of our study showed that 58.3% of the respondents used a round collimator and only 2.7% a rectangular one (Table 1).

16.6% of the respondents used a medium cone, most of them - 33.3% - used a short cone, and none used a long cone.

In the present study, more than half of the respondents (63.8%) reported the utilization of the paralleling technique (with a film-holding device) to perform retroalveolar X-rays, fewer respondents (41.6%) used the bisecting angle technique, and 5.5% did not answer this question.
Table 1. Answers (as percentages) to the main questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer variants</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>What type of X-rays do you most frequently indicate for new patients, on their first examination?</td>
<td>a. bitewing X-rays</td>
<td>8.3%</td>
</tr>
<tr>
<td></td>
<td>b. periapical X-rays targeted depending on pathology</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>c. full-mouth X-rays</td>
<td>5.5%</td>
</tr>
<tr>
<td></td>
<td>d. panoramic X-rays</td>
<td>61.1%</td>
</tr>
<tr>
<td>What anatomical regions require protection in dental radiology?</td>
<td>a. bone marrow</td>
<td>19.4%</td>
</tr>
<tr>
<td></td>
<td>b. thyroid</td>
<td>97.2%</td>
</tr>
<tr>
<td></td>
<td>c. skin</td>
<td>1 person</td>
</tr>
<tr>
<td></td>
<td>d. gonads</td>
<td>63.8%</td>
</tr>
<tr>
<td>Do you use (recommend the use of) the lead apron during radiological examination?</td>
<td>a. yes</td>
<td>91.6%</td>
</tr>
<tr>
<td></td>
<td>b. only in young patients</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>c. I do not consider it necessary</td>
<td>2.7%</td>
</tr>
<tr>
<td>Do you use (recommend the use of) the thyroid collar during radiological examination?</td>
<td>a. yes</td>
<td>94.4%</td>
</tr>
<tr>
<td></td>
<td>b. only in young patients</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>c. I do not consider it necessary</td>
<td>0%</td>
</tr>
<tr>
<td>Can retroalveolar X-rays be performed in pregnant women in emergency situations?</td>
<td>a. Yes, in the first trimester of pregnancy</td>
<td>5.5%</td>
</tr>
<tr>
<td></td>
<td>b. Yes, in the last trimester of pregnancy</td>
<td>27.7%</td>
</tr>
<tr>
<td></td>
<td>c. Yes, without any restriction</td>
<td>16.6%</td>
</tr>
<tr>
<td></td>
<td>d. Not at all throughout pregnancy</td>
<td>50%</td>
</tr>
<tr>
<td>What type of collimator do you use?</td>
<td>a. a round one</td>
<td>58.3%</td>
</tr>
<tr>
<td></td>
<td>b. a rectangular one</td>
<td>2.7%</td>
</tr>
<tr>
<td>What cone length do you use?</td>
<td>a. 20 cm</td>
<td>33.3%</td>
</tr>
<tr>
<td></td>
<td>b. 30 cm</td>
<td>16.6%</td>
</tr>
<tr>
<td></td>
<td>c. 40 cm</td>
<td>0%</td>
</tr>
<tr>
<td>What dental film speed do you use for periapical X-rays?</td>
<td>a. D</td>
<td>8.3%</td>
</tr>
<tr>
<td></td>
<td>b. E</td>
<td>30.5%</td>
</tr>
<tr>
<td></td>
<td>e. F</td>
<td>19.4%</td>
</tr>
<tr>
<td>What technique do you use (recommend) for periapical X-rays?</td>
<td>a. the paralleling technique (with a film-holding device)</td>
<td>63.8%</td>
</tr>
<tr>
<td></td>
<td>b. the bisecting angle technique (the patient holds the film with his finger)</td>
<td>41.6%</td>
</tr>
<tr>
<td></td>
<td>- no answer</td>
<td>5.5%</td>
</tr>
</tbody>
</table>
4. DISCUSSION

The concept of patient radiation protection in dental medicine is based on three physical principles: the use of shields (usually of lead) for areas not to be exposed to radiation (particularly for radiosensitive organs), increased distance between the source of radiation and the target area, as well as reduction of the exposure time [1-3]. However, the most important radioprotection criterion includes justified X-ray indication and reduction of unnecessary recommendations.

The advantages of digital radiology compared to conventional film-based radiology include the image acquisition speed, reduction of radiation exposure for both patients and medical staff, as well as elimination of film processing with chemical substances [4,5].

According to literature data, the increased use of digital systems compared to conventional radiology has resulted in a considerable reduction of the radiation doses (a 37% decrease in 2007) and has eliminated errors associated with manual film processing. In the future, further reduction of the radiation doses can be predicted by a gradual replacement of X-ray machines that still use manual processing with digital systems [6-8]. Replacement of D-speed films with E-speed films may reduce the radiation dose up to 50%. Utilization of F-speed films leads to a 20% decrease of the radiation dose compared to E-speed films. Studies on image quality have demonstrated that it does not affect the use of high speed films. However, dentists do not always choose the fastest receptor. Research carried out in various countries (Belgium, Turkey, Spain, Denmark, Finland) has shown a wider use of E-speed films. According to the authors of these studies, this is probably due to the lack of knowledge on the effect of collimation and to the differences between the two types of collimators, an explanation deriving from the fact that almost half of the respondents did not wish or did not know how to answer this question. Using a rectangular collimator restricts the X-ray beam to the receptor area and can prevent unnecessary patient exposure. Replacement of a round collimator with a rectangular one results in an almost 60% reduction of the radiation dose [4,6,8,16].

To reduce patient exposure, the use of a long cone is recommended for increasing the distance between the radiation source and the target area. With the long cone, the X-ray beam will be less divergent and the amount of radiation and, implicitly, patient exposure will be diminished [4,16,17].

The non-use of a long cone by our respondents is a paradoxical situation, in complete
contradiction with the recommendations of specialists.

Some authors mention a higher number of leukemia cases in children whose mothers were exposed to radiological examinations during pregnancy, such as radiographic pelvimetry, by which the entire body of the fetus was exposed to high radiation doses. At the same time, an increased frequency of thyroid cancer is recorded in patients exposed to thymic irradiation during childhood, as well as a risk for intracranial meningioma following several dental X-rays [18,19].

Pregnant women should be particularly protected, with the complete avoidance or minimization of fetal radiation [20].

The relationship between dental radiation exposure during pregnancy and a low birth weight, even in the absence of fetal exposure, has been reported in the literature, but there is no mention of the organ whose radiation exposure is particularly responsible for this [21]. Experimental and epidemiological studies indicate that exposure of the thyroid gland might be responsible for this situation.

In our study, the responses regarding the performance of retroalveolar X-rays in pregnant women in emergency situations evidence the confusion of dentists with respect to this aspect. The incorrect opinions expressed could be due to the incomplete questions intentionally formulated in this way (in order to better check the knowledge of respondents), but also to the deficient knowledge in this area.

This shows the need for specialists performing dental X-rays to review their general knowledge of radiology, for adopting an adequate attitude on radiation protection.

The genetic effects of radiation consist of mutations whose number is directly proportional to the gonadal dose, regardless of the intensity of or the time period between exposures. Consequently, the lead apron should not be ignored as a radiation protection instrument.

Any radiological examination should ensure maximal patient radiation protection, to decrease radiation and its effects. Protection measures are important at any age, particularly in the case of young persons, under 30 years of age [18,22,23].

In most dental radiographic examinations, the thyroid gland is usually within the area exposed to radiation. There is an increased risk of thyroid cancer in the follicular epithelium after radiation exposure, women and children being predominantly predisposed. Because orthodontic treatment is more frequently requested in childhood, and cephalometric radiography is one of the most widely used radiological investigations before orthodontic treatment, it is vital to protect the thyroid gland during cephalometric exposure. The thyroid collar is the easiest and most effective modality to protect the thyroid from radiation [24,25].

The doses absorbed by the thyroid gland during a lateral cephalogram vary, according to different authors, between 5 and 57 μGy for one exposure. It was demonstrated that the use of a thyroid collar allowed a reduction ranging between 50% and 80% of the radiation dose absorbed by the thyroid after a cephalogram [5,24].

A comparison of the answers to the question regarding the radiological X-rays technique with those referring to the length of the cone used shows an obvious contradiction, leading to the conclusion that the respondents have no knowledge on the equipment, the projection technique, or both.

Possible answers to the questions did not include the option “I don’t know”. Therefore, the absence of an answer could be assimilated to the absence of knowledge on the respective issue. It should be noted that the absence of an answer was mostly related to questions referring to the type of collimator, cone length, and speed of the film used.

5. CONCLUSIONS

Dentistry uses radiology in current practice more than other medical specialties.

Indication for radiological examinations should be based on strict necessity and correct choice, in order to avoid unnecessary radiation exposure. These examinations must not be repeated at short time intervals. This is why all medical practitioners have to know the advantages, risks and limitations of the
radiological examination they perform or request, for a correct evaluation of the risk-benefit ratio.

It can be concluded that neither the knowledge nor the behavior of dentists regarding safety standards in oral radiology is satisfactory.

By evidencing the current level of theoretical knowledge and the attitude towards radiation protection in oral medicine, the study suggests that more attention should be paid to this aspect, for reducing the exposure of patients to ionizing radiations.

References