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The use of radiology and CBCT in dentistry

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Abstract : ***Objectives:*** *The purpose of the study was to determine the preferences in imagistic techniques and to evaluate the frequency for CBCT among dentists. CBCT represents a major change in dental radiology giving three dimensional images with 10 times less radiation dose than conventional CT scanners do.* ***Materials and methods:*** *An anonymous survey consisting of 13 questions was distributed among 110 dentists with different dental specialties and from various cities of Romania.* ***Results:*** *The imagistic methods preferred by the respondents were panoramic radiography (93,6%) and periapical radiography (95,5%). A total of 60,9% of respondents use also CBCT. Among the respondents, 21,8% never recommended CBCT because the interpretation of CBCT images is difficult (36,7%) or the patients refuse the investigation (36,7%). Some of them are satisfied with the information obtained by a two dimensional image (26,7%) or they don't think it's useful (10%).* ***Conclusions:*** *Digital radiology gives real information about the complexity of the clinical case and sometimes emphasizes the need for further investigations, like CBCT, an efficient technique in determining the diagnostic and treatment plan.*

Keywords : *Survey, CBCT, radiography.*

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I. INTRODUCTION

Radiographic imaging is an essential part of clinical dentistry that provides information needed for diagnosis, treatment planning and following-up the treatment and lesions. It give insight into the dental structure of teeth and alveolar bone to reveal caries, periodontal and periapical diseases and other osseous conditions. Two dimensional periapical and panoramic radiographs are routinely used in dental practice [1].

Intraoral and extraoral radiographs suffer some limitations because they provide a two-dimensional image of a three-dimensional object and that limits the diagnostic performance [2]. The two-dimensional image can lead to errors in interpretation because of the regional anatomy, the geometric distorsion of the anatomical structures and the superimposition of both the teeth and dentoalveolar structures [1,3].

In 1980s, computed tomography was available for 3-dimensional dental imaging, but due to the high cost, limited access and radiation exposure, it was rarely used. CT was indicated mainly for the management of craniofacial anomalies, complex surgeries, and other unique dental situations. In 1988, cone beam computerized tomography (CBCT) was introduced to dentistry. CBCT produces clear images with higher resolution at a reduced radiation and lower cost when compared to medical CT [4-6].

The CBCT has a cone-shaped X-ray beam centred on a 2-D detector that performs one rotation around the object and makes a series of 2-D images. These images are reformed in 3-D using a modification of the original cone-beam algorithm developed by Feldkamp et al. in 1984 [7]. Although, it has been given several names including dental volumetric tomography (DVT), cone beam volumetric tomography (CBVT), dental computed tomography (DCT) and cone beam imaging (CBI), the frequently used name is cone-beam computed tomography (CBCT) [8].

Cone Beam Computed Tomography (CBCT) is a radiographic imaging method specifically designed for three dimensional imaging of the oral and maxillofacial structures. Most of the limitations associated with conventional radiography are overcome with cone beam computed tomography (CBCT). [6]. Radiation exposure dose from CBCT is 68 µSv compared with 600 µSv of conventional CT [9]. It is becoming widely available and has applications in implantology, orthodontics, endodontics, periodontics and also, oral surgery.

Therefore, the purpose of the present study was to gather information about the radiographic preferences and the use of CBCT of Romanian dental practitioners.

II. MATERIALS AND METHODS

A survey was used to collect data for the study. It was performed on 110 dentists with different specialties from Romania. The survey consisted of 13 questions regarding demographics, experience, specialty, frequently used radiographic methods and frequency in using CBCT. The questionnaire also enquired about the advantages and disadvantages of CBCT.

Respondents of either gender, with age between 24–49 years, were included in the study.

The completed questionnaires were collected, results obtained and tabulated. The results of the questionnaire were digitized as an Excel file (Office 2007 version), which made further descriptive statistical analysis of the data possible with a statistics software program.

III. RESULTS

Most respondents are general dental practitioners (69.1%), followed by endodontists (10%), prostodontist (9.1%), periodontologists (7.3%), oral surgeons (5.4%) and orthodontists (4.5%).

The radiographs most commonly prescribed by the respondents were the periapical radiography (95.5%) followed by OPG (93.6%). Other imagistic methods used by respondents were CBCT (60.9%) and bitewing radiography (39.1%) (Fig.1).

Dental practitioners were asked to indicate how frequently they recommended CBCT in their daily practice with option often, sometimes and occasionally. Of all respondents 31% recommended CBCT often, 43.7% sometimes and 25.3% occasionally during the diagnostic procedure.

A total of 21.8% of respondents said that they had not used or advised CBCT for diagnostic purpose in their cases because the interpretation of CBCT images is difficult (36,7%) or the patients refuse the investigation (36,7%). Some of them are satisfied with the information obtained by a two dimensional image (26,7%) or they don't think it's useful (10%). 72.3% of the participants said that they used CBCT for implant cases, 54.3% for evaluation of impacted teeth, 78.8% for endodontic purpose and 16% for orthodontic assessment (Fig.2) . 97.2% felt the 3D visualization of the craniofacial skeleton as the main advantage, followed by lower radiation dose compared to medical CT (50.5%). On the other hand, the respondents said that the main disadvantage of CBCT was the high cost (97.1%), followed by difficult interpretation (25%).

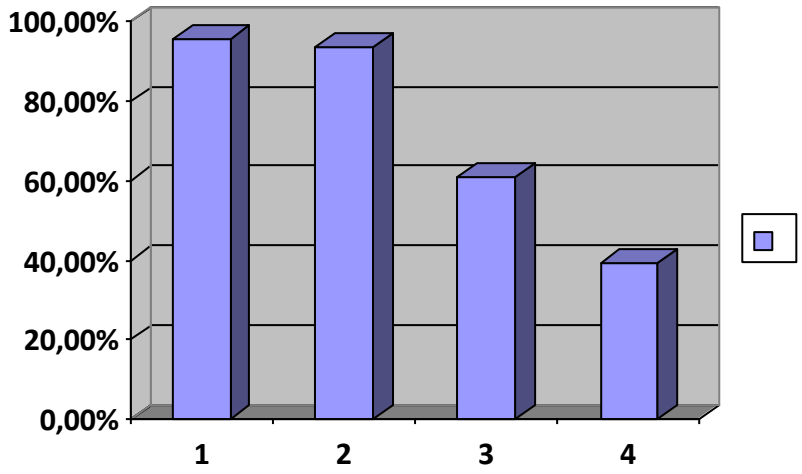

Figure 1. *The distribution of the various imaging modalities prescribed by the respondents. 1. periapical radiography; 2. OPG; 3. CBCT; 4. bitewing radiography.*

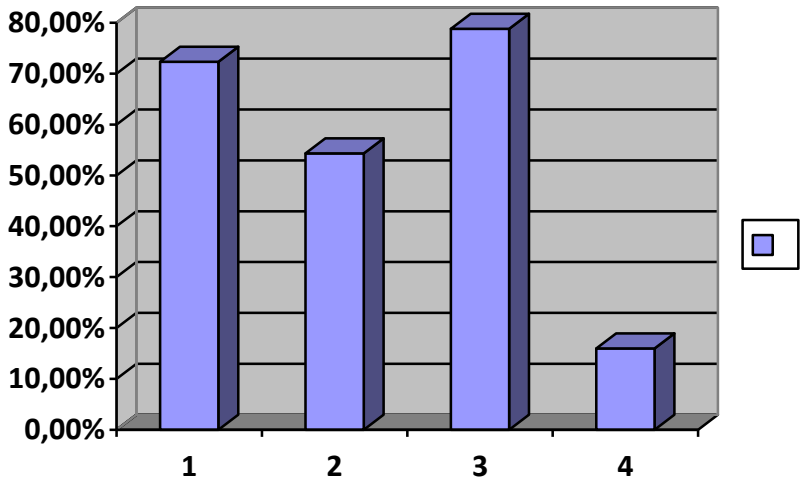

Figure 2. Distribution of the reasons for prescribing CBCT. 1. implant cases; 2. evaluation of impacted teeth; 3. endodontic purpose; 4. orthodontic assessment.

IV. DISCUSSIONS

The survey questionnaire is frequently used in evaluating healthcare systems. They can provide important, cost-effective information on dentists' knowledge, attitudes and practices [10-12].

Radiographic imaging is an important part of the dental practice and provides information about the present or absence odontogenic and nonodontogenic pathoses, helps with the differential diagnosis and treatment planning. It is impossible to imagine dentistry without radiology. A proper diagnosis and treatment is established only by using a combination of clinical and radiologic examination. The results of this study show the choices made by Romanian dentists.

The fundamental principle in diagnostic radiology is ALARA ("as low as reasonably achievable"). It is important to keep the exposures as low as possible. That can be achieved by a good case selection, a properly trained personnel to make radiographic exposure, optimal technique factors, fastest x-ray detector. It is important to weigh potential patient benefits against the risks associated with the level of radiation dose. Cases must be assessed and when the 2D radiographic images are not enough, CBCT should be used. Also, unnecessary repeated examinations should be avoided [13].

Studies have shown that a 43% reduction in the number of radiographs can be achieved without reducing the quality care by following an efficient selection criteria on clinical evaluations for asymptomatic patients, combined with selected periapical radiographs for symptomatic patients [14,15].

The panoramic radiography offers a general overview of the dentition and the jaws, but produces distortions in the horizontal plane and magnification in the vertical plane. Another disadvantage is that important anatomical structures are not well viewed on the panoramic radiography. Airway shadows, Ghost images and soft tissue shadows can have an effect on the treatment planning [16,17]. However, in a study made on 256 patients regarding the comparison of panoramic radiography and CBCT to predict postoperative outcome after wisdom tooth removal, the conclusion was that CBCT isn't better than panoramic radiography in determining postoperative complications for moderate-risk cases of impacted third mandibular molars, but can accurately confirm the number of roots and root morphology of the third molar [18].

In this study, 72,3% of the participants used CBCT for determining the implant site. A study regarding the radiographic imaging method selected when dentists have to assess the implant site, showed that 95% of them take OPG as a pre-surgical assessment radiograph [19]. Sakakura et. al reported that 68,3% of dentist prescribed only OPG for dental implant assessments and only 7.2% of the dentists prescribed conventional tomography as a single examination and 10.1% prescribed CT in combination other types of radiographic examination bringing the total up to 17.3% [20]. These studies were made in 2001 and 2003 and since then there has been an increasing trend to adopt CBCT.

In a study conducted in 2011, implant planning and diagnosing of cyst-tumours were the most common reasons for prescribing CBCT. These results are supported by the findings of Arnheiter et al. regarding the trends in maxillofacial cone-beam computed tomography usage [21,22].

Hassan et al. discovered that the sensitivity obtained with CBCT is higher than with periapical radiographs (80% versus 37%) for detecting vertical root fractures and the specificity was only slightly lower

(92% versus 95%). The results showed that the specificity of CBCT was reduced by the presence of root canal filling. It was also established that the overall accuracy and the sensitivity of periapical radiographs were reduced by the presence of root canal fillings. The accuracy of CBCT was 86% compared to 66% for periapical radiographs[23].

CBCT can help practicians from the diagnosis to treatment outcome evaluation.

V. CONCLUSION

Recent advances in radiology have improved dental diagnostics and treatment planning. It is important to select the appropriate imagistic method and with the correct interpretation, detect pathologies in very early stages, which ultimately reduce morbidity and mortality and improve the quality of life of the patients. The use of CBCT in dentistry is rapidly increasing. As ionizing radiation is used, it is essential that exposures are kept as low as reasonably achievable (principle ALARA). In each case, there must be an individual assessment to determine the correct management and to avoid unnecessary investigations.

Contribution Note: All authors made equal contributions to the study and the publication.

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