Efficacy of Beam Computer Tomography (CBCT) in Diagnosis of Disease Lesions in Paranasal Sinuses

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Abstract: Different techniques of X-ray imaging often confirm the suspected diagnosis, but not infrequently redirect the diagnostic process in other areas. A modern ultrahigh-resolution volumetric tomography, called a cone beam computed tomography (CBCT) also, is one of the most innovative technique and able to visualise these anatomical structures that conventional techniques are not. A differential diagnosis of TMJ dysfunction is particularly difficult due to the quantity of factors that influence the generation of symptoms. Laying on of symptoms that mask the main disease means that frequently, without additional examinations, it is not possible, in an univocal way, to describe the type and extent of this disease. The study assesses the usefulness of volumetric tomography (CBCT) in an accidental detecting in the maxillary lesions sinuses of a temporomandibular joints dysfunction. The analysis was performed on the base of 249 studies of volumetric tomography. The face part of the skull was made by the ~~a~~ camera with a large imaging field (FOV) 17 cm x 23 cm i-CAT Next Generation (ISI). It was found that a significant number of patients (almost half) with TMD have the changes in paranasal sinuses. Based on the observations, the relevance and legitimacy of tested technique helping in stomatognathic system diseases diagnosis was analysed.

1 INTRODUCTION

Different X-ray imaging techniques used in dentistry have different accuracy of image of anatomical details of a diagnosed area (Różyło-Kalinowska, 2011). The diagnostic value of conventional static and functional panoramic imaging (including digital) largely depends on human factors, mainly the skills and consistency of a radiologist who performs the examination. An incorrect positioning of the examined patient, an incorrect angle of incidence during exposure to radiation and instability of above factors can have a negative influence on a detailed, correct analysis. In addition, the conventional radiographic techniques provide a two-dimensional back projection image with overlapping various anatomical details. A technological progress in this area forces physicians to change their approach to diagnostic algorithms.

Radiological examination using cone beam computed tomography (CBTC) allows for the imaging of hard and soft anatomical structures in three projections. CBTC provides an undistorted real-size image allowing for accurate measurements. The accuracy of images reconstructed by volumetric tomography is so superior that all anatomical details in the area under investigation do not require additional testing; a three-dimensional image reconstruction gives a detail insight into the topography of skeletal structures (Różyło-Kalinowska, 2009, Szkutnik, 2001). CBCT is used also successfully in laryngology. Because of the accuracy of this imaging technique it is possible to diagnose and plan treatment for paranasal sinusitis simultaneously. Importantly, the technique is safe for patients since the dose of ionizing radiation is reduced. The average dose of radiation in CBCT is in the range of 20-650 μSv depending on the size of an imaging field and an image resolution (Jager, 2001, Kijak, 2012, Loubele M, 2009, Bargan, 2010, Anjos, 2012) and it is about 20-30-fold lower than in conventional multi-slice CT CBCT is increasingly being used for diagnosis of patients with suspected dysfunction of the tempormandibular joints (TMD), suffering from pain, located in the vicinity of the front of the ear and middle part of the face. Differential diagnosis of TMJ dysfunction is particularly difficult due to the quantity of factors that could infuence the generation of symptoms. The laying on of symptoms that mask the basic disease means that frequently, without

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additional examinations, it is not possible, in a univocal way, to describe the type and extent of the disease.

Very often, the result of specialized laryngological examination is negative and the patient returns to a dentist. With non-specific subjective symptoms, limited only to painful problems, the study of volumetric tomography leads to accidental detection of lesions in the maxillary sinuses. Often the patient is referred to a laryngologist or maxillofacial surgeon. It was provided that these are not individual cases.

The aim of the study was the analysis of imagines obtained by CBCT with a medium and large imaging field in diagnosis of the lesions in paranasal sinuses and commissioned causing dysfunction of temporomandibular joints.

2 MATERIALS AND METHODS

2.1 Materials

The material consisted of 249 studies of volumetric tomography. The face part of the skull was made by ~~a~~ the camera with a large imaging field (FOV) 17 cm x 23 cm i-CAT Next Generation (ISI).

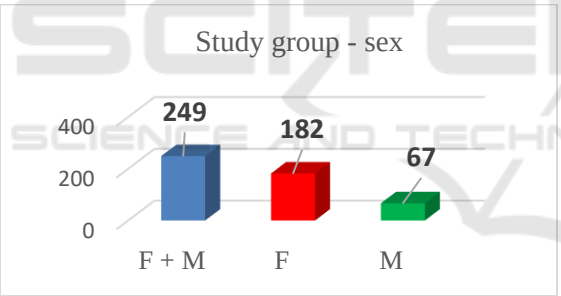

Figure 1: Size and gender of the study group.

A total of 249 subjects (182 F and 67 M) aged 13 to 88 years were enrolled, who reported to the Department of *Prosthetic Dentistry Pomeranian Medical University* due to TMD-related ailments.

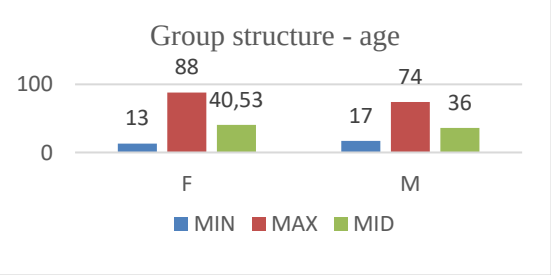

Figure 2: Age of tested people.

2.2 Methods

An important feature of the device is a short scanning time from 5 seconds at low volumes up to 27 seconds at the largest imaging field that can be adjusted by varying the test resolution in the range of 0.125 to 0.4. Patient' sitting position with correctly setting head minimizes the presence of motion artefacts. Using Quantum IQ software, soft-tissue imagines were obtained that were much better than other types of imagines (Photo 1). The exposure parameters were 110 kV and 5 mAs. The exposure time was 14 seconds and 0.3 voxel resolution was used the most commonly.

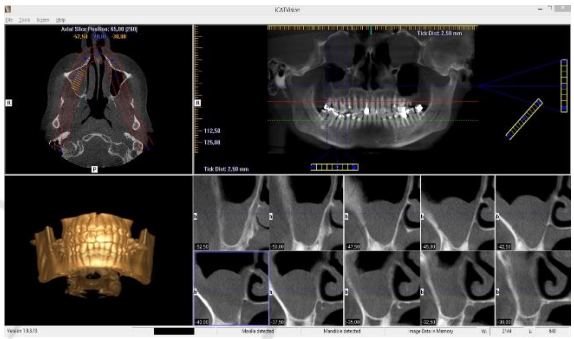

Photo 1: CBCT - large imaging field.

3 RESULTS

Volumetric tomography allows the diagnosis of even the smallest pathological lesions located in the maxillary sinuses (Photo 2) beginning from the most commonly diagnosed inflammatory conditions (edema) of the sinus lining (Photo 3), through various types and extent of hyperplasia (Photo 4) until the total air loss of one of the bays – Photo 5.

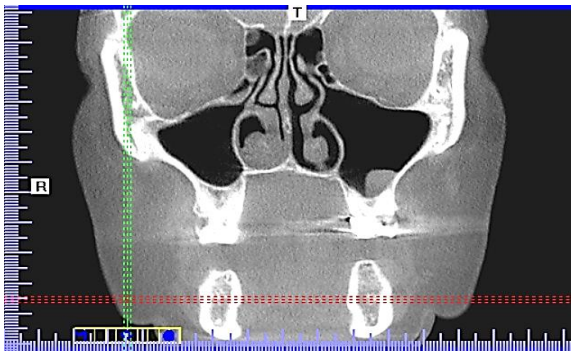

Photo 2: Limited pathological change in the bottom of the left maxillary sinus.

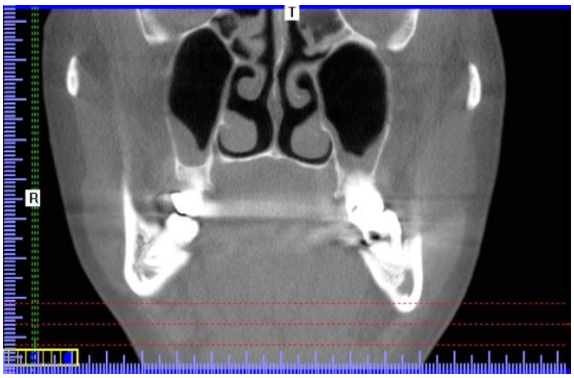

Photo 3: Oedematous mucosa of alveolar recess of the two maxillary sinuses.

Photo 4: The disease process includes the entire light of the right maxillary sinus.

Photo 5: The disease process includes the entire light of the right maxillary sinus.

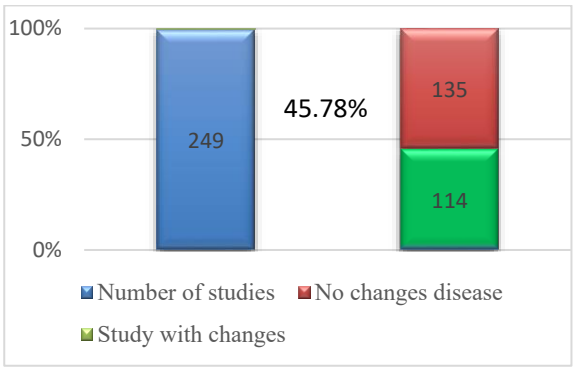

Figure 3: The incidence of lesions disease of maxillary sinuses detected by CBCT.

The studies have shown that the incidence of lesions is relatively high at almost 50%.

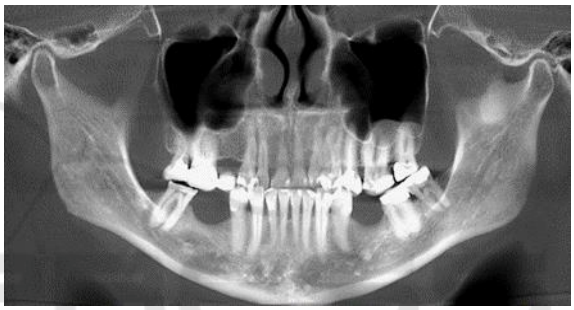

Photo 6: The root appex of the teeth 25, 26, 27 in the maxillary sinus.

From the point of view of the therapeutic possibilities available to the dentist, we are interested in teeth related changes that are located in the alveolar recess of the maxillary sinuses: roots in the sinuses (Photo 6),pushed through the endodontic treatment of the material (Photo 7), and unerupted tooth located in the immediate vicinity of the bay.

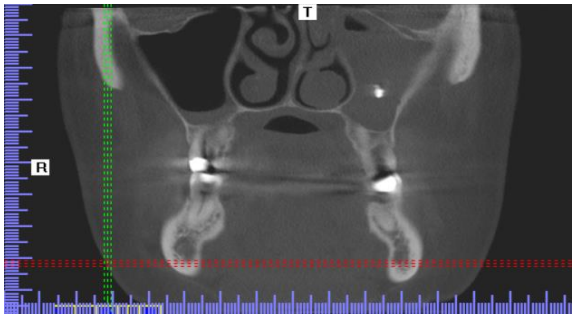

Photo 7: The material stuffed as a result of endodontic treatment in the bottom of the left sinus.

CBCT and the capabilities of computer programs that support this imaging method greatly extend the

potential for the effective topological evaluation of pathological lesions "accidentally" detected. Even when they are diagnosed in a traditional pantomographic examination, a lesion derived from the alveolar recess as observed in a volumetric study, the diagnosis has to be change.

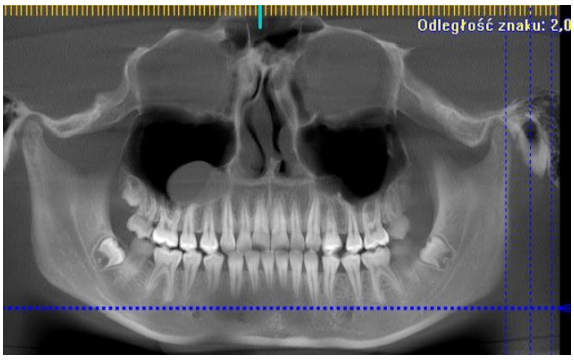

Photo 8: Disease lesion in the right maxillary sinus cavity - image in volumetric tomography.

Photo 8 shows a classic pantomographic imaging performed by CBTC, which was helpful in the diagnosis of a polyp lesion that originates from the alveolar sinus of the right maxillary sinus. Further evaluation of the same image diametrically changed our view of this pathology (Photo 9). The disease is not associated with the teeth because it is clearly visible in the axial projection that it originates from the antero-medial walls of the sinus.

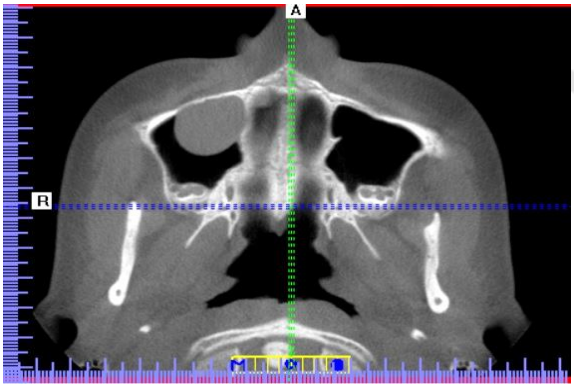

Photo 9: The same lesion (Figure 8) - CBCT image in axial projection.

The precise identification of the source of a disease process directs the further course of diagnostic and therapeutic procedures. Random detected pathological changes are not necessarily a direct cause of ailments. It may reflect an asymptomatic condition that is accompanied by a main disease. This should not, however, slow down the doctor from further diagnosis, which is becoming more targeted and easier. The disease lesions detected in both bays in the study population recorded in more than one-fifth of cases.

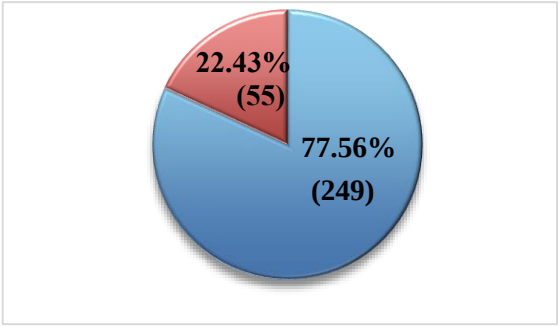

Figure 4: Disease lesions in both sinuses.

The CBCT images obtained, evaluated in a multifaceted image reconstruction, allow for the precise definition of a disease process extention. Frequently, a study of volumetric tomography, with a large field of imaging, is a diagnostic procedure that is sufficiently adequate to an implement proper treatment in the therapeutic process.

4 DISCUSSION

Detection of various pathological processes occurring in the sinus of the paranasal sinuses with the diagnosis of dysfunction of the chewing organ is not uncommon (Phothikhun, 2012). The accuracy of CBCT studies is so significant that it is impossible to compare such tests with traditional and routine radiology procedures used in dentistry (Różyło- Kalinowska, 2009, 2011). The ability to choose the size of the imaging (cone), gives the possibility of the radiological protection by lowering the dose of ionizing radiation. In the case of functional abnormalities of the chewing organs, the multitude of anatomical and physiological details cause a multi-faceted pain. Symptoms often correlate with the clinical picture of the stomatognathic system functional evaluation (Anjos, 2012). Often, a dentist dealing with the problem faces a dilemma: adhere to radiological protection rules and commission CBCT examinations limited to the temporal and temporal joints, or extend the examination to adjoining areas. The choice is difficult especially in the absence of pathognomonic symptoms. Radiological protection should be superior. Adherence to the principles developed by the European Academy of DentoMaxilloFacial Radiology (EADMFR) should not, however, limit diagnostic possibilities

(Scarfe, 2008)). In case of maxillofacial dysfunction there are unfortunately no uniform procedures. The difference in dose of ionizing radiation between pantomographic imaging supplemented with conventional sinus radiographs and CBCT with medium to large imaging with modern imaging is not as significant (Loubbele, 2008). The benefit of the evaluation of paranasal sinuses in volumetric thomography is undoubtedly greater (Rege, 2012), so it should account for the balance of gains and losses.

5 CONCLUSIONS

Volumetric Tomography is a valuable x-ray imaging technique useful in the differential diagnosis of TM dysfunction. The laying on of symptoms that mask the main disease means that frequently, without additional examinations, it is not possible, in a univocal way, to describe the type and extent of a disease. The diagnosis of functional disorders of the muscular of the chewing systems should take into account the disease lesions in the maxillary sinus. Detection of various pathological processes occurring in the sinuses paranasal, during of the diagnosis of dysfunction of the chewing organ is not uncommon.

Limiting the imaging field in a volumetric tomography study significantly reduces the diagnostic potential of the study. The advantage of the possibility of additional evaluation of the collateral sinuses and the diagnosis of the underlying disease process is undoubtedly greater.

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