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QUALITY ASSESSMENT OF ENDODONTIC TREATMENT IN PATIENTS, PASSED TOMOGRAPHY
EXAMINATION IN BELGOROD

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Abstract

The purpose of root canals treatment is the maintenance (re-creation) of aseptic in the system of dentinal tubules, preventing the infection contamination of periapical tissues. Before the creation of cone-beam computed tomography, pre-operative estimation of the roots and periapical area, planned for operational impacts, had some difficulties, caused by projection distortions. Computed tomography allows with high accuracy to determine the working length of the root canal, the location of apical constriction and the distance from the apical constriction to radiographic apex. The paper presents a comparative assessment of the endodontic treatment quality of 1000 root canals of persons, passed tomography examination in the city of Belgorod in 2016. The receiving data were compared with the data, presented by Central Research Institute of Dentistry and Maxillofacial Surgery of Ministry of Health and Social Development of the Russian Federation in 2012.

Keywords: endodontic treatment, tomography examination.

Introduction

The beginning of cone-beam computed tomography (CBCT) application in dentistry commonly believed in 2000 [1]. Currently, the references to the cone-beam computed tomography are fairly common in the dental literature. In most cases, in the process of endodontic treatment, the use of cone-beam computed tomography is in preference to other methods, because this type of diagnostic is characterized by the minimum exposure of patient and high resolution capability [2, 3]. There are the following situations, in which the use of cone-beam computed tomography has the paramount importance: the assessment of the root canals topography, the presence of inosculation; the curve of root canals and the risk of broken tools in their lumens; the diagnosis and treatment of dislocations and fractures of the teeth; planning of endodontic treatment tactics with the determining of apical holes localization, their correlation with

maxillary sinus, and inferior dental canal; the assessment of quality of endodontic treatment, including uniformity of root canal filling, overfilling, the presence of perforations; the dynamics of the configuration changes of periodontal fissure, periapical changes [4-9]. Five years ago, the Central Research Institute of Dentistry and Maxillofacial Surgery of Ministry of Health and Social Development of the Russian Federation (CRIDMS), based on the study of archive data of cone beam computed tomography, assessed the issues of endodontic treatment as a result of the imaging study of 1000 root canals (RC), 521 teeth of patients from different age groups [10]. The quality of endodontic treatment and the features of anatomical structure were assessed, according to 26 criteria, 6 of which characterized the peculiarities of instrumental treatment and obturation of root canals: the depth of obturation, the homogeneity of filling material (FM), the treatment of tooth canal orifice, excessive excretion of filling material, the root canal perforation. Since the Central Research Institute of Dentistry and Maxillofacial Surgery is one of the leading Russian diagnostic and treatment facilities, we compared the data on 6 criteria, characterizing the features of instrumental treatment and obturation of root canals, obtained by CRIDMS in 2011, with the data, obtained in the process of tomograms assessment of patients, passed endodontic treatment in Belgorod agglomeration, during 2014-2016.

The aim of this study is a comparative assessment of the incidence degree of endodontic treatment mistakes.

Materials and Methods

It was investigated 102 tomograms of patients, applied to diagnostic and treatment department of Dentistry Faculty of Medical Institute of Belgorod State National Research University (BSU). 1000 root canals and 497 teeth were studied. The vast number of imaging was made using the dental X-ray apparatus PaX-Reve3D from company Vatech Co. Ltd, with the anode voltage of 88 kVp and the tube current of 5.0 mA. Biological prototypes were analyzed using Ez3D2009 Professional software with slice thickness from 1.0 to 2.0 mm.

Main Part

The results of the study of Central Research Institute of Dentistry and Maxillofacial Surgery showed that only a third of root canals (28.3%) had qualitative filling and instrumental treatment. According to the data of Belgorod State University, we found 39.6% of cases with qualitatively sealed root canals.

Taking into account the number of root canals in the tooth, the evidences of qualitative root canals obturation, were detected by CRIDMS in 47.1% of canals of single-canal teeth, in 21.8% of double-canal teeth, in 20.2% of three-canal teeth, in 16.7% of four-canal teeth. In the second case, the evidences of qualitative root canals obturation, were

found in 66.8% of canals of single-canal teeth, in 29.2% of double-canal teeth, in 22.2% of three-canal teeth, in 18.3% of four-canal teeth. As follows from the obtained data, the highest increment in the period from 2011 to 2016 of correctly completed endodontic manipulations is found in single- and double-canal teeth (41.0% and 33.9%, respectively); this fact can be logically explained by the anatomical uniqueness of the situation and the ease of access. Thus, statistical studies, conducted in 2016, showed that the presence of two canals in the tooth twice reduced the correctness of endodontic procedures, and the presence of three or four canals reduced the quality of this procedure three-fold (Table 1).

Table 1. The increment of qualitative sealed root canals over a five-year period, from 2011 to 2016 (%)

The anatomical characteristics of the tooth	2011	2016	Increment
Single-canal	47.1	66.8	41,8
Double-canal	21.8	29.2	33.9
Three-canal	20.2	22.2	9.9
Four-canal	16.7	18.3	9.5

The incidence degree of endodontic treatment mistakes, was the following: insufficient depth of root canals obturation in 2011 - 46.6%, in 2016 - 42.2%; the inhomogeneity of root canals filling by FM in 2011 - 54.8%, in 2016 - 29.6%, insufficient instrumental treatment of teeth canals orifices in 2011 - 49.6%, in 2016 - 12.4%; insufficient instrumental treatment of root canals in 2011 - 62.9%, in 2016 - 53.8; excessive removal of filling material from root canals in 2011 - 9.8%, in 2016 - 9.2%, the presence of the perforation in the tooth root in 2011 - 1.8%, in 2016 - 1.9%. With a decline by 14.4%, the most common mistake in 2011 and 2016 (62.9% and 53.8%, respectively) was inadequate instrumental treatment of root canals, having resulted in insufficient depth of instrumental treatment and widening of root canal area, the absence or small conicity of shadows contours of obturated root canals, that prevented qualitative chemical and mechanical disinfection and obturation of root canals (table 2).

Table 2. The dynamics of mistakes incidence degree, characterizing the quality of endodontic treatment (%).

Category of mistake	2011	2016	Dynamics
insufficient depth of root canals obturation	46.6	42.2	↓ 9.4
inhomogeneity of root canals filling by FM	54.8	29.6	↓ 45.9
insufficient instrumental treatment of teeth canals orifices	49.6	12.4	↓ 75.0

insufficient instrumental treatment of root canals	62.9	53.8	↓ 14.4
excessive removal of filling material from root canals	9.8	9.3	↓ 5.1
the perforation in the tooth root	1.8	1.9	↑5.6

In the group with insufficient depth of root canals obturation, the absence of filling material shadow in the root canal lumen was observed in 18.3% of cases in 2011; in 2016 we found 6.2% of such canals. The lumen of root canals was obturated by 3/4 of its lengths in 12.3% of cases in 2011, and in 17.8% of cases in 2016. The group of teeth with satisfactory depth of root canals fillings, up to the physiological diminution (PD) was 29.1% in 2011, and 37.9% in 2016. The shadow of the endodontic filling material reached the anatomical apex of the tooth root (AA) in 24.3% of cases in 2011, and in 30.7% of cases in 2016 (Table 3). The results of the study allowed to reveal the direct correlation between the depth of root canals filling and the adequacy of instrumental treatment of teeth canals orifices. In case of insufficient instrumental treatment of teeth canals orifices, the anisotropy of filling material obturation was observed in 2011 and in 2016, in 96.2% and 94.8% of cases, respectively. In case of insufficient instrumental treatment of root canals, the anisotropy of filling material obturation was found in 87.4% of cases in 2011, and in 89.1% of cases in 2016.

Table 3. The dynamics of the obturation depth of root canals over a period from 2011 to 2016 (%)

Obturation depth of root canals	2011	2016	Dynamics
The absence of filling material shadow in the root canal lumen	18.3	6.2	↓66.1
The shadow from filling material reaches ¾ of the length of root canal lumen	12.3	11.8	↓4.1
Other variants of obturation depth of root canals	16.0	13.4	↓16.3
The shadow from filling material reaches physiological diminution	29.1	37.9	↑30.2
The shadow from filling material reaches anatomical apex of the tooth root	24.3	30.7	↑26.3

The study of the incidence degree of inhomogeneous density of filling material in root canals showed, that the obturation up to physiological diminution, was accompanied by uneven filling of canal space with filling material in 39.86% of cases in 2011, and in 38.55% of cases in 2016. The obturation up to anatomical apex of the tooth root combined with a similar inaccuracy in 19.8% of cases in 2011, and in 19.2% of cases in 2016. Similar results were obtained during the study of incidence degree of insufficient instrumental treatment of teeth canals orifices of endodontic treated teeth. In case of root canals obturation up to physiological diminution, this mistake was defined in 27.8% of cases in 2011, and in 28.5% of cases in 2016; in case of obturation up to anatomical apex of the tooth root, this mistake was found in 13.6% of cases in 2011, and in 13.9% of cases in 2016. The evidences of insufficient instrumental treatment of root canals, in case of obturation up to physiological diminution were defined in 41.2% of cases in 2011, and in 40.8% of cases in 2016; in case of obturation up to anatomical apex of the tooth the evidences of insufficient instrumental treatment were found in 18.1% of cases in 2011, and the same value was in 2016.

In case of root canals obturation up to physiological diminution, the excessive removal of filling material from root canals was observed in 2011 in 2.75% of cases, and in 2016, in 2.92% of cases; and in case of obturation up to anatomical apex of the tooth, the excessive removal was found in 34.98% and 34.01% of cases, in 2011 and 2016, respectively. Perforations of root canals in the bifurcation area were diagnosed in 5.69% of cases in 2011, and in 6.13% of cases in 2016.

Discussion

The use of cone-beam computed tomography allows us to study the imaging of *Status localis* of dental patients with endodontic diseases and received endodontic treatment with the maximum accuracy. This capability is provided by the technological characteristics of tomographic scanners, providing visualizations without projective distortion, that increases the objectivity of the studied assessment criteria. The design of performed in 2011 by employees of Central Research Institute of Dentistry and Maxillofacial Surgery, assessment of endodontic treatment quality, has been accepted by us as a basis, and we, in our work, calculating the dynamics of the quality criteria changes, have been comparing data, obtained in 2016 with the data, published by CRIDMS. Comparative assessment of archival material identified improving the quality of endodontic treatment, conducted in Belgorod agglomeration from 2014 to 2016. It should be noted, that the results of endodontic treatment could not be considered as satisfactory, because the mistakes of instrumental treatment and filling of root canals were revealed radiologically in more than a half of cases of the treated teeth. In the dental literature, considerable attention is given to various aspects of the quality of endodontic

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treatment; in some similar studies, conducted by colleagues, satisfactory quality of treated canals is higher and reaches 78.2% -91.5% [11]. Nevertheless, the problem of the quality of endodontic treatment is still quite relevant. Citing data from the studies, conducted in different countries [12], it should be noted, that unsatisfactory endodontic treatment is visible in conjunction with periodontal pathology in about 30-50% of endodontically treated roots.

Conclusions

Against the common background of reducing the mistakes, in the process of endodontic treatment of teeth, the most often we found insufficient instrumental treatment of root canals, including insufficient depth of root canals treatment and creation of small conicity of root canals lumens, that prevents their qualitative obturation, as in 2011 (62.9%) as in 2016 (53.8%).

The criterion of “insufficient instrumental treatment of teeth canals orifices” had the largest decrease, from 49.6% to 75% of cases in 2011, and to 12.4% of cases in 2016.

We must assume, that the desire of dentists to form the teeth canals orifices properly, is the cause of non-significant increase of perforations in the bifurcation area of the roots, from 5.69% in 2011 to 6.13% in 2016.

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