

Islam Yousef, Lunhol Olha

Donetsk national medical university

RESEARCH OF PHYSICAL FUNDAMENTALS OF APEXLOCATORS

According to the Law of Ukraine «On Education» (05.09.2017 № 2145-VIII), article 17 «Higher education», the purpose of higher education is the receipt of a high level of scientific and/or creative artistic, professional and general competencies necessary for the activity in a certain specialty or in a certain field of knowledge [4]. Without a deep knowledge of the physical properties of the functioning and operation of medical equipment, it is impossible to achieve a high level of professional competence of future dental doctors. One of the modern stomatological devices, which recently appeared in some offices of our city Kropivnitsky, is an apexlocator (or Electronic apex locator). The purpose of this research is to study the physical fundamentals of the functioning and the peculiarities of the apex locator use in the classes on medical and biological physics.

Apexlocation is an electrometric method for determining the apex for the drop in resistance to electric alternating current by soft tissues at the exit from the root canal. In other words, the method of electronic apexlocation is based on the constancy of the resistance of soft tissues of the oral cavity and tooth tissues.

The principle of operation of the apex locator is that one electrode is made in the form of a metallic mouthpiece, the second electrode is fixed to the endodontic instrument placed in the root canal.

When moving to the top of the root, the device shows the drop in electrical resistance on a special scale. When the electrode penetrates the physiological hole, the resistance to electric current falls sharply. Thus, from the measured resistance, the apexlocator determines the relative distance from the tip of the endodontic instrument to the apex of the root of the tooth.

The resistance of the tooth tissues is much higher than the mucosa of the oral cavity, so fixing the electrodes on the lip and in the tooth canal does not cause the electrical circuit to close until the electrode placed in the channel reaches the physiological constriction (periodontal tissues). In this case, the circuit closes, which is usually accompanied by an audible signal. As the instrument approaches the top of the root, the instrument's light indication becomes intermittent green, and the soundtrack (warning) is intermittent. At the apex of the root canal, the indicator light stops blinking and shows the number «0». In case of possible exit of the instrument behind the apex hole, the red light illuminates and the sound also changes its frequency. The length of the root canal measured in this way is fixed to the instrument using a stopper.

There are different types of classification of apexlocators. We pay special attention to the classification for three types of apexlocators: low-frequency; two-frequency; multifrequency. Low-frequency apex locators react to changes in humidity in the channel (the presence of blood, sodium hypochlorite), which significantly distorts the reliability of the channel length parameters. Two-frequency apex locators are less dependent on humidity in the root canal, multifrequency apex locators reflect real data on the length of the root canal with high accuracy.

Another type of classification is presented by S.I. Boytsanyuk, Yu.A. Rudyak, P.Yu. Ostrovskyy [3]. For clarity, we presented it as Table 1.

Table 1

<i>Gene ration</i>	<i>Discovery</i>	<i>Physical characteristics</i>
1-2	1962, Japanese scientist Sunada. The first device generates electrical waves of the same frequency and fix the resistance of the tissues.	The phenomenon: the electrical resistance of the direct current between the apical periodontal and the mucous membrane of the oral cavity is constant (5kOm), and it is much larger between the mucous membrane and any part of the tooth. Disadvantages: Apparatus with a constant electric current in determining the working length gave errors due to the polarization of the electrodes, the

		presence in the channel of liquids
3	1994, Kobayashi C., Suda H. [1]	Determination of impedance by alternating currents of different frequency. The so-called method of the ratio allowed simultaneously to measure the resistance of the current of two frequencies - 8 kHz and 0.4 kHz and to find the total resistance coefficient, which reflects the position of the file in the channel
4	Method of Prof. Sonada	Measures the canal's impedance using one or more electric frequencies. It is unreliable though in the presence of fluid in the canal which requires additional drying.
5	For example, Endo Analyzer Model, Sybron Dental	Calculation of current resistance of 5 frequencies (0.5, 1, 2, 4, 5 kHz), accurate and fast indicators.



Fig. 1. Apexlocator Dentaport ZX

In the study, we worked with apex locators 3 and 4 generations. Consider the example of the 3-generation apexlocator Dentaport ZX (DP-ZX) (fig. 1). The device is intended for use in an electromagnetic environment in which radiated radio frequency interference is controlled [2]. The device uses radio-frequency energy only for its internal work. A fragment of the studies of the physical quantities characterizing the Dentaport ZX (DP-ZX) Module apexlocator, we presented in Table 2

Table 2 (fragment)

<i>Physical quantity</i>	<i>Value</i>
<i>The main unit for preparation of root canals and light polymerization (with</i>	

<i>built-in battery)</i>	
Rated voltage	DC 9.6 V (with a battery)
Rated current	max 0.2 A
Power consumption	1.92 VA
Rated torque	min 0.039 Nm
<i>Tip, Motor</i>	
Rated input voltage	max DC 9.6 V
Rated current	max 0.2 A
Power consumption	1.92 VA

On the basis of the conducted research it can be concluded that knowledge of the physical foundations of the functioning of dental devices is an important component of the formation of professional competencies of future doctors of dentistry, the improvement of equipment and, consequently, the development of medicine. Perspectives for further research are the study of the physical foundations of other dental devices.

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