

An Advanced Device For Determining Pain Sensitivity Of The Oral Mucosa

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Annotation: An improved device for determining the pain sensitivity of the oral mucosa (OM). It includes a rod with a probe, a cylinder, a pressure sensor, a vinyl tube, wires, a battery, a microcontroller and an LCD display for converting and processing the signal from the sensor and displaying information to them. A device for measurement was made in the clinic of orthopedic dentistry. 10 patients with complete absence of teeth were studied. The advantages of the device have been established, such as low material consumption and portability of the device, which makes it possible to use it at any dental chair and the possibility of measuring at any point of the oral mucosa.

Keywords: dentistry, oral mucosa, pain and discrimination sensitivity, medical devices or device.

Relevance of the topic. In clinical dentistry, the functional state of the oral mucosa is determined by the threshold of pain sensitivity or by the degree of its compliance, while these parameters are mutually dependent and complement each other [2, 4, 8, 10]. The most popular and widely studied is the apparatus proposed by E.S. Iroshnikova and A.I. Doynikov to determine the threshold of pain sensitivity of the mucous membrane of the cavity, a special device-esthesiometer. Other researchers also repeatedly improved this device and used it to determine the sensitivity of various parts of the oral cavity (OC) to pressure - pain, as well as tactile sensitivity [3, 6].

Arutyunov S.D. with a co-author [1] dealt with the problem of pain sensitivity of the oral mucosa (OM) with great seriousness and noted that the value of the threshold of mechanical irritation lies in the range of 35-65 g/mm². At the same time, the authors drew attention to the fact that the threshold of pain irritation in the upper jaw is higher than in the lower.

Others [4, 5, 10] studied the functioning of the oral mucosa and tongue in some chronic diseases using an esthesiometer designed by the Central Scientific Research Institute (CSRI) "Elektropribor". The threshold of pain sensitivity of the mucosa was determined in the region of the transitional fold at the level of 2.1 and 2.2 teeth, the values were fixed in the range from 30 to 45 g/mm².

Pain sensitivity of the oral mucosa was studied by R. Svensson et al. who used a high-energy argon laser with a power of 0.05 to 2.5 W with a wavelength of 488 and 515 nm as a sensation stimulator. [11]. The data obtained are expressed in terms of the power of the laser used (watts).

Of particular interest is the study of the sensitivity of the oral mucosa to mechanical stimuli conducted by Chen J. et al. [4, 9, 10]. When studying the biomechanics of the oral mucosa, the authors consider the threshold of pain sensitivity to pressure (pressure-pain threshold - PPT). According to various algometric studies, the PPT value varies from 102 to 405 kPa (from 10.2 to 40.5 g/mm²) and

depends on a number of factors (among them - morphology, thickness of the mucous membrane, location of the area of impact on the mucous, age of patients, rate, type and history of the disease, and others).

Thus, there are no accurate and systematic studies recognized by all researchers, since devices and instruments differ both in design and in measurement accuracy. There are mathematical simulations of the action of a removable prosthesis on the mucous membrane. These data show the need to develop the most practical device that is easy and simple to use in clinical dentistry. Convenient for the doctor with the most accurate measurements at the patient's chair.

The aim of this study is to create a simple and reliable medical device for determining the pain sensitivity of the oral mucosa.

In order to achieve the goal, we defined some tasks for ourselves; including, the device must be portable, accurate, accessible for the work of a dentist. The general objective of the study was also the introduction of the developed apparatus for determining the pain sensitivity of the oral mucosa in the practice of orthopedic dentistry, by introducing a fundamentally new scheme of the utility model into the created portable apparatus with which everyone could conduct clinical research.

In connection with the above, we have set the following **tasks**:

- Development of a schematic diagram of an apparatus for measuring the pain sensitivity of the oral mucosa by improving the known analogue, confirmed by a patent.
- On the basis of the developed utility model, to create a working device for work in the clinic of orthopedic dentistry.
- To introduce the manufactured apparatus into practical dentistry and conduct clinical studies in patients in dentistry.

Materials and methods of research: We have developed a schematic diagram of the improvement of the apparatus for measuring pain sensitivity of the oral mucosa and presented it in the form of drawings with a

description. We also managed to implement this utility model into a portable measuring device that can be used in practical dentistry. They are presented in the form of a photo indicating the control points of the device. In the clinic of dentistry, we managed to use this device, for this we accepted for treatment and measured 10 patients with a complete absence of teeth at the age of 60 and higher. The measurement area was determined both on the upper and on the lower jaw. On the upper jaw in area 11; 12; 16; 26., anterior third of the palate and the region of the suture of the hard palate. On the lower jaw, the measurement was carried out in area 31; 32; 41; 42., as well as in the region of molars 46; 36.

Research results: As an analogue for improvement, we used patent RU 47218 U1, IPC A61C 19/04, published: 27.08.2005, Bulletin No. 24 (Russia).

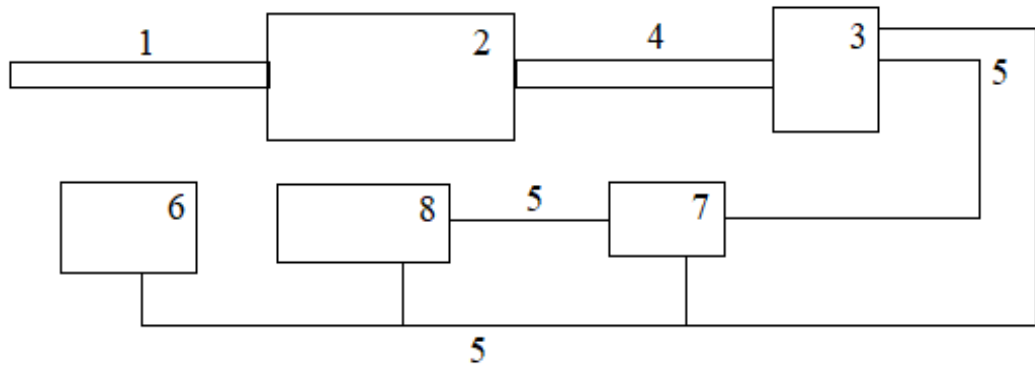
This patent is the closest in technical essence. A device for determining pain sensitivity of the oral mucosa, which includes a rod with a removable tip, inside which a cylinder with a piston is installed. The cylinder is connected to a pressure sensor by means of a flexible tube. There is also a button for registering pain. Information from the sensor is sent to a personal computer.

The disadvantage of this device is the material consumption and high cost, due to the need for a personal computer.

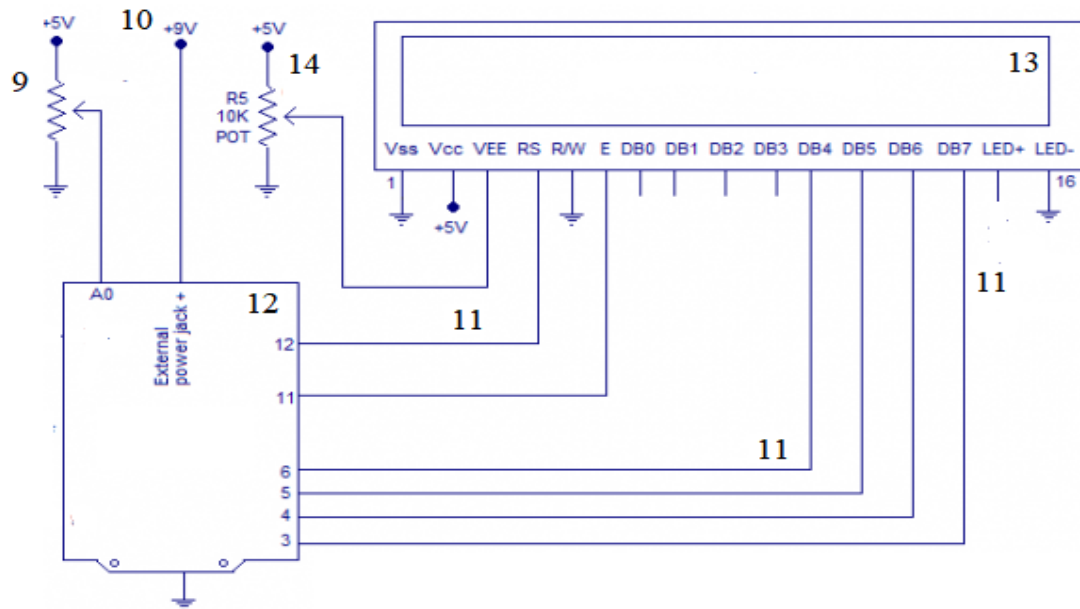
The advantage of the proposed device is to reduce the cost of the device and speed up the process of determining the pain sensitivity of the oral mucosa.

In order to achieve the technical result of a device for determining the pain sensitivity of the oral mucosa, we have proposed a medical device that includes a rod with a probe, a cylinder, a pressure sensor, a vinyl tube, wires, a battery; instead of a personal computer, a microcontroller and an LCD display for conversion are installed on our utility model. and signal processing from the sensor and information display. The data are presented in the drawings as scheme No. 1, scheme No. 2.

The utility model is illustrated by the following drawings.



Scheme No. 1. General scheme of the device, where: 1 - rod with a probe; 2 - cylinder; 3 - pressure sensor; 4 - vinyl tube; 5 - wires; 6 - battery; 7 - microcontroller; 8 - LCD display.



Scheme No. 2. The electrical circuit of the device, where: 9 - pressure sensor; 10 - battery; 11 - wires; 12 - microcontroller; 13 - LCD display; 14 - trimmer resistor.

According to the general scheme of the device, it includes a rod with a probe -1, installed inside the cylinder - 2, then the cylinder is connected to the sensor - 3, through the tube - 4, Wire - 5, connects the sensor to the battery - 6 and the microcontroller - 7, which connected to the LCD display. Further, in accordance with the electrical circuit of the device, the pressure sensor - 9, is connected to the battery - 10, through the wire - 11, the signal from the pressure sensor - 9, is fed to the microcontroller - 12, which is connected to the

LCD display - 13. The trimmer resistor is connected to the LCD - display - 13.

The device works as follows; a rod with a probe set at an angle acts on the oral mucosa and the pressure in the cylinder changes, which changes the electrical parameters of the pressure sensor. Thanks to the software package and microcontroller used, the signal from the pressure sensor is read and converted into a digital signal. Further, the value of the current pressure is displayed on the LCD display. The

trim resistor is used to adjust the brightness of the LCD display.

Advantages - low material consumption, which leads to a decrease in the cost of the device due to the use of a microcontroller capable of processing a signal from a pressure sensor without using a personal computer with a higher information processing speed, portability of the device, which makes it



Fig. No. 1. General view of the device

This machine works as follows. The device turns on, the number "0" is displayed on the display, then, after antiseptic treatment, the probe of the device is applied to the measured point and the doctor exerts some effort, when a painful sensation appears, the patient gives a voice message. At this moment, the doctor on the display takes the reading of the device. These readings are calibrated to grams. The readings are recorded on the display. Dentists note the practicality of working on this device. Easily sterilized. Convenient to use, you can measure the OM at any point. Indications are stable. The record will be saved and within a certain time, you can remove the device indicators. The device showed the best data when measuring in the area of the torus and in the presence of sharp edges of the alveolar processes, in order to further isolate them in a removable prosthesis.

We have conducted a clinical trial of this device in the "Intercity" clinic of the Republic of Kazakhstan, with the consent of patients who previously had removable dentures made in the absence of teeth. 10 patients with complete loss of teeth were studied with the help of an improved apparatus

possible to use it at any dental chair and take measurements at any point oral mucosa.

On the basis of the Kazakhstan National Technical University named after K.N. Satpaev, under the guidance of Doctor of Science, honoris Causa Ozhikenov K.A., designed an apparatus for determining the pain sensitivity of the ORM for clinical dentistry, which consists (in Figures No. 1 and No. 2) of a display with controls, a pen, a measuring probe.



Fig. No. 2. Device during examination

developed by us for determining the pain sensitivity of oral mucosa.

The results of our study showed that the threshold of pain sensitivity in the area of the anterior teeth of the upper jaw showed from 20.0 g/mm². The maximum value was 40 g/mm² in two patients. In the area of chewing teeth, the reading of the device ranged from 40 g/mm² to 60 g/mm², in the area of the anterior third of the palate from 60 g/mm² to 80 g/mm², in the area of the suture of the hard palate, the indicators were from 20 g/mm² to 60 g/mm². In the lower jaw, the threshold of pain sensitivity in the area of the anterior teeth was from 10 g/mm² to 20 g/mm², and in the region of the chewing teeth, the device showed from 30 g/mm² to 50 g/mm².

The results of our study showed that pain sensitivity is most pronounced in the anterior region compared to the region of the chewing teeth, almost twice. Both in the area of the upper and lower jaw. When comparing these indicators of the device in the frontal area on the upper and lower jaws, we did not observe a significant difference in the indicators of the device. Although in two patients the maximum readings of the device were 40 g/mm², when

measured in the region of the anterior teeth of the upper jaw.

When comparing the indicators of the device in the area of the chewing teeth of the upper and lower jaws, the largest indicators were found in the upper jaw compared with the data of the lower jaw by 10 units. These figures refer to both the minimum and maximum values in this comparison. The region of the anterior third palate has the least pain sensitivity, where the maximum values reach 80.0 g/mm², somewhat less in the region of the third palate suture, where the maximum data were 60.0 g/mm².

The data of our device are consistent with the literature data and there are certain discrepancies. So according to [1], the threshold of pain irritation lies in the range of 35-65 g/mm², fully consistent with our indicators. The threshold of pain irritation in the upper jaw is higher than in the lower jaw [1], and in our case the threshold of irritation in the upper jaw is lower than in the lower jaw.

According to Iordanishvili A.K. and co-authors [5], indicators of pain sensitivity in area 21; 22; teeth fully correspond to the data of our device, that is, indicators from 20 g/mm² to 40 g/mm².

Thus, we have developed an improved apparatus for determining the pain sensitivity of the oral mucosa, designed in the form of an apparatus and used in clinical dental practice. For practitioners, a device has been proposed that allows, in a clinic, to determine the pain sensitivity of oral mucosa for dental purposes. Recommended for use.

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