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A new method which can be used for evaluation of temperature increase during teeth preparation

The development of modern technologies in dentistry enabled using more perfect materials for filling tooth loss and mechanical equipment which is used for cleansing and preparing tooth before its future treatment. Procedures of stomatological equipment constructors were oriented at invention of ultra high-speed equipments, using of which could shorten time of tooth processing and patient's stress and pain. As a result of these procedures stomatological turbines were invented which worked with speed of 18,000–2,000 rpm. Their use shortens the time of tooth preparation, but also causes a significant increase of tooth temperature in the cutting zone. The process of energy transformation in system-tool cutting tooth can be showed in different ways, but thermal energy is always the most important factor. This causes temperature increase in tooth processing zone which can cause damage of tooth pulp (1-6). Literature data showed that temperature increase over 328K caused pulp death in 100% of patients (6), however permissible temperature of tooth processing above which pulp could be damaged is 314–315K. A factor which has prevalent influence on tooth temperature growth is the rotary speed of cutting equipment. Commonly used dental turbines generate temperature higher by 20 degrees per 30 seconds. Additionally using much more stronger pressure during processing, which is regulated by the dentist himself also caused the temperature growth. In order to decrease this unfavourable parameter for patient's health, different techniques of cutting are used, especially applying cooling to the cutting zone. But these procedures are not able to eliminate unfavourable influence of temperature growth on tooth tissues. Another factor which determines energy growth in teeth during processing is the kind of cutting tools and how blunt they are. It might be assumed that the angle of cutting was correctly administered which is related to low temperature emitting. But when tools become more blunt, the conditions of cutting will be worse and the temperature will grow. This problem, which is not well known, has a very important meaning during proper stomatology treatment. Few works on this subject (2, 6) do not answer the question: how to reduce temperature growth during tooth processing and how to study temperature growth using different techniques and cutting tools.

In this study the authors tried to introduce methods of analyzing temperature growth of a tooth during its processing. Because of the simplicity of equipment maintenance and because of using modern control-measuring mechanism which enables continuous monitoring and saving of analyzed parameters in computer memory, knowledge about processes which are responsible for temperature growth in the friction zone: tooth – cutting tool, could be easier to obtain.

MATERIAL AND METHODS

The principle of examining temperature growth of teeth according to the method proposed by the authors consists in evaluating precise temperature growth of tooth pulp by means of thermocouple with encumbrance of cutting tool and proportion of processing time to its pause.

As the analysis result arithmetical mean of results of at least three tests was accepted. And results which have been a ground to calculate mean temperature, might not include values which need to be refused based on statistic Dixon's test. The amount of tests in basic researches was established based on preliminary examinations and individual assumptions adopted for mathematical results evaluation. Initial examination temperature was equal to surroundings temperature.

Samples for examinations were taken from patients who were treated by periodontologists. In order to maintain the mapping of conditions during teeth processing in patient's oral cavity, the tooth, which was previously mechanically cleaned, has been examined immediately after extraction. The cleaned tooth has been stored in normal saline solution until the moment of examinations.

The view of research box was shown in Figure 1, the way of tooth fixing in holder – in Figure 2, and the schema of device and the way of fixing thermocouple were shown in Figure 3 and 4.

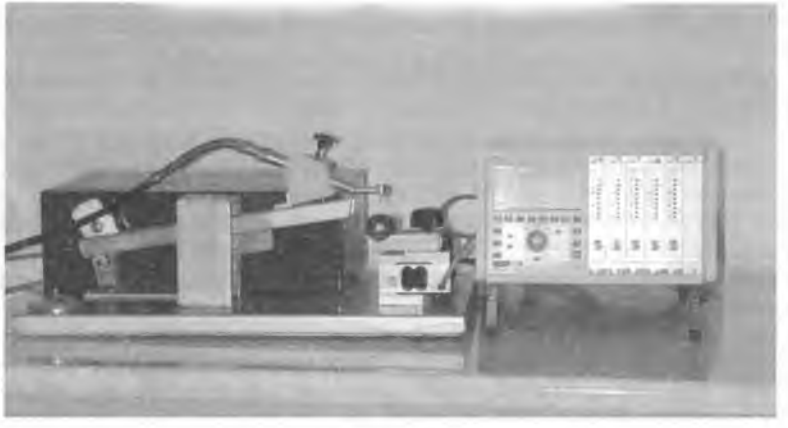

Fig. 1. The increase of teeth temperature examination box in processing

The preliminary researches were performed before beginning the main researches. The thermocouple should be calibrated both before the main researches and the preliminary researches. The thermocouple was smoothly inserted in the place of the removed pulp through foramen at the top of the tooth in order to fix the device's measuring end over the tooth cavity fornix.

Fig. 2. The fixing manner of tooth on holder during the examination

Proper verifying researches were performed with constant force 1N and determined tooth time processing in relation to its pause, which equalled 1/3.

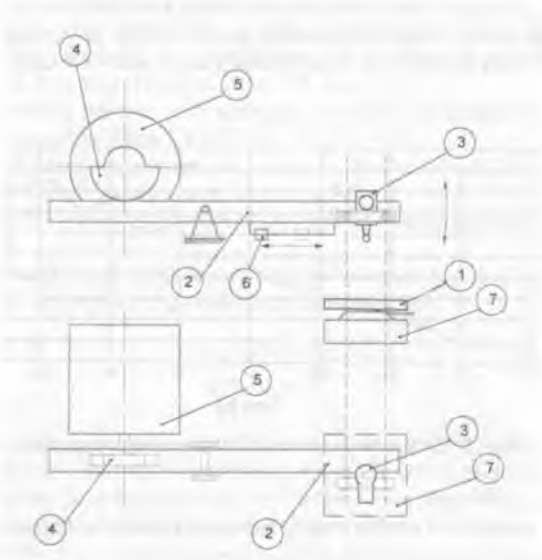

Fig. 3. Schema of increase of teeth temperature examination box in processing

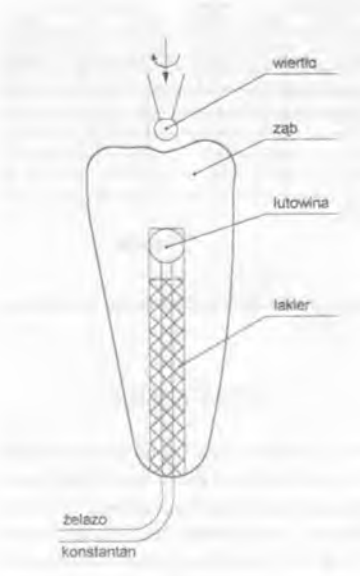

Fig. 4. The way of fixing thermocouple on the examined tooth

RESULTS

The result of increase of temperature tooth cavity researches are shown in Figure 5 and 6. Figure 5 shows the increase of temperature in examining tooth pulp related to the proportion of processing time to its pause. Noted temperature growth during processing time and its decline during the pause indicated perfect precision of used gauges and well-composed examination parameters.

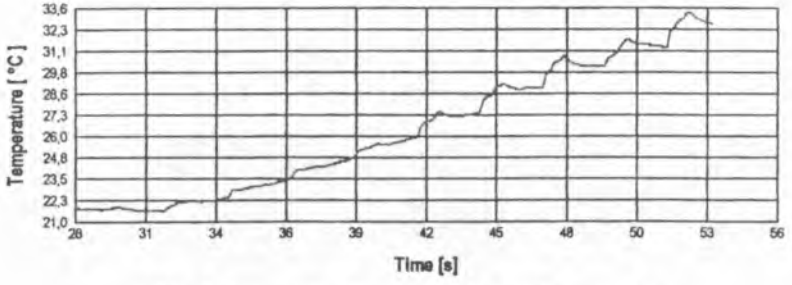

Fig. 5. Temperature increase during tooth processing

The value of pressure force of drill during the tests is shown in Figure 6. The whole examining cycle is described with constant value of force pressure during tooth processing and lack of the drill pressure during the implied pause.

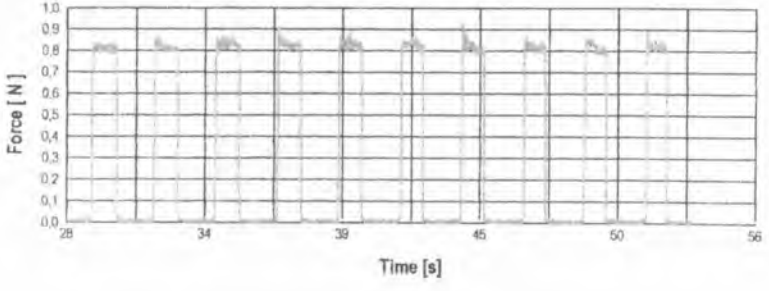

Fig. 6. The value of the drill pressure force during tooth processing

CONCLUSIONS

To define usefulness of the new method in growth temperature examination of the teeth milled by high-speed stomatological turbine there have been performed verification tests, whose results indicate that the presented research method allows to precisely define temperature increase in tooth pulp during its preparation. The obtained preliminary research scores found affirm that the precision of equipment as well as its researching possibilities could contribute to better recognizing of the phenomena, which appears during teeth preparation by high-speed stomatological turbine.

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SUMMARY

In this work new research equipment was introduced which enabled precise evaluation of pulp increase temperature during grinding for prosthetic crowns or cavity preparation. Construction of equipment which included control-measuring mechanism was described. This system enabled precise measurement of all monitored parameters and their storing in computer memory.

Nowa metoda służąca do określania przyrostu temperatury podczas opracowywania zębów

W artykule przedstawiono nową metodę badawczą, umożliwiającą precyzyjne określenie przyrostu temperatury miazgi zęba podczas jego obróbki w trakcie szlifowania pod korony protetyczne jak również w trakcie leczenia zachowawczego. Opisano budowę urządzenia ze szczególnym uwzględnieniem nowoczesnego układu kontrolno-pomiarowego, zapewniającego precyzyjny pomiar wszystkich monitorowanych parametrów oraz ich archiwizację w pamięci komputera.