

Thermal Imaging Diagnostics of Blistering Disease of Cheeks and Lips, Which are Caused by the Brackets, and Decorative Sticker on the Dentition with Braces for Prevention of This Iatrogenic Illness

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Abstract

It is shown that traditional brackets cause local irritation of the lips and cheeks of patients due to friction. This irritation can cause inflammation of reversible and irreversible until the sores. Found that infrared thermography provides timely detection of early symptoms of the local inflammation of the soft tissues and prevent the development of blisters and sores, i.e. the development of iatrogenic illness that we call blistering or calluses disease from brackets. To prevent iatrogenic disease, we developed an original method of splinting brackets and original device that eliminates the friction of the brackets on the surface of the lips and cheeks. The essence of the method of splinting brackets is lies in the fact that the teeth with brackets need to completely cover the wax up to the formation of her wax roller. Then, the resulting wax roller should be immediately securely cover with food wrap. New device was called decorative sticker on splinting brackets. This device is a beautiful analog of a food wrap, because on the surface of the tape placed series of color photographs - panoramic 3D images of the visible front surface of the upper or lower dentition of a healthy person is whole in full size.

Introduction

Currently, engineers and designers are making more effort to improve the design of the brackets, than dentists. This is manifested by intense progress in improving the design of the braces, but not is sufficiently intense improvement of technology of their application and the wearing. Therefore, the design of modern brackets and modern technology is their use in dentistry still have significant flaws. In particular, braces, and many dental designs and even tablets, can cause local damage of the soft tissues in the mouth [1,2]. Moreover brackets are leaders in producing oral blisters and sores. The damaging effect of brackets on the oral cavity soft tissues increases after their accidental breakage. The most likely accidental breakage of brackets happens when chewing hard foods such as bones, river pebbles, stone and hard pills [1].

Causes of oral blisters and ulcers after the imposition of brackets and protection of cheeks and lips from these damages are not sufficiently studied. We first assumed that prior to the formation of blisters and ulcers in their place there is local inflammation. In turn, local hyperthermia can be detected with a thermal imager. In this connection, we have conducted the necessary research.

In 2016, we proposed for the first time infrared diagnostics of the calluses disease from brackets [2] and in 2017 at the opening ceremony of the 20th Global Summit Dental (March 20-22, 2017 Rome, Italy) we first publicly proposed a new device that we invented to prevent blistering diseases caused by brackets [3].

Materials and Methods

During healthy adult volunteers (Group 1, n=10) with body mass of 55-72 kg and adult patients with brackets (Group 2, n=30) with body mass of 48-63 kg were observed during 2009-2016. We obtained thermal images of the subjects' facial skin and mucous membranes of the lips, cheeks, gums and tongue immediately after installing the braces and then every day during one week. We used to improve the aesthetic result metal self-ligating brackets of passive type with high-tech wire arcs Damon Clear, Damon Q, Damon 3, Damon 3 MX, Mini Diamond и sapphire braces Inspire Ice (ORMCO, USA).

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All tested patients were standing upright. Infrared monitoring was performed with Thermo Tracer TH9100XX (NEC, USA) thermal imager. Thermal imager was installed at a distance of 1 meter from the surface of the shield. Ambient temperature in the examination room was 24-25°C, the temperature field of the thermal camera was set in the range of 25 to 36°C [4]. The data obtained were processed using the Thermography Explorer and Image Processor software. The photographs were archived in the form of thermo maps atlas. Before the beginning of the research, its protocol was approved by the Ethics Committee of ReSto dental clinic (Izhevsk), based on the principles set in the Declaration of Helsinki of the World Health Organization. All patients involved signed an informed consent for participation in the study.

Results

We was studied the dynamics of the local temperature of the inner surface of the cheeks and lips in patients after the installation of traditional brackets on upper and lower dentitions. The results of our studies confirmed the high risk of braces for the mucous membranes of the oral cavity. Multiple local irritations, inflammations and necrotic damages to the inner surface of cheeks and lips were observed in 7 from 30 patients after installation of brackets. It is shown that local inflammations occur in the beginning, then they disappear or get worse, transforming into watery blisters, and later in sores and ulcers that scar after 2-3 weeks. It has been found that if a patient does not observe local irritations, cheeks and lips injuries in one week after the brackets installation, these injuries will not appear later. It is also found that after successful regeneration of damaged tissues, recurrent injuries of lips and cheeks are also not likely to occur.

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It is shown that local injuries of the lips and cheeks are caused not by the brackets itself, but by the friction between their hard and hilly parts with the inner surface of the mouth. Therefore, we described this disease as blistering disease of cheeks and lips.

It is found that the appearance of local hyperthermia zone on the cheek and/or lip inner surface may be considered as a diagnostic symptom for the development of local inflammation. It is established that early diagnostics of blistering disease is impossible without thermal imaging.

To protect lips and cheeks from the local irritation of brackets, we have developed a method of splinting brackets [5]. The essence of the method lies in the fact that the teeth with brackets need to completely cover the wax up to the formation of her wax roller. Then, the resulting wax roller should be immediately securely cover with food wrap. And that's all.

The high efficiency of the inventive method and diagnostic value of thermal imaging are illustrated in the following photographs and thermograms of the bottom row of teeth and drooping lower lips (Figure 1).

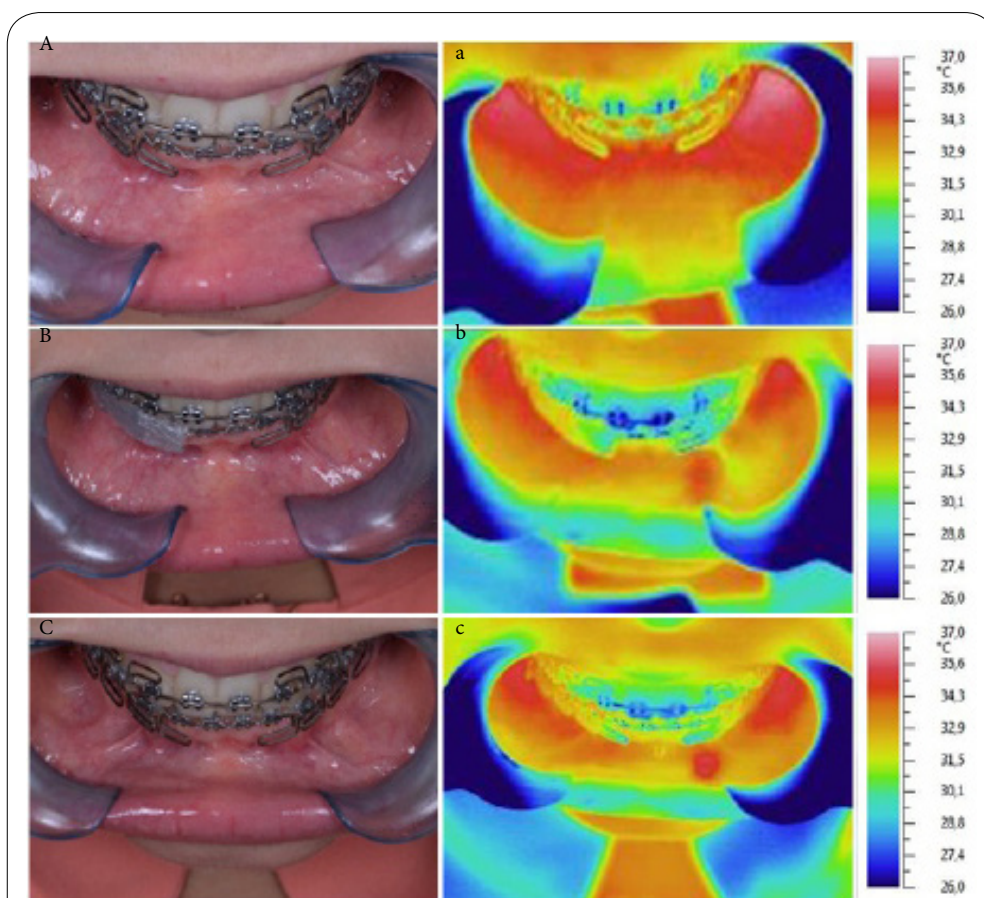


Figure 1: Photography in the visible range of radiation spectrum (A, B, C) and in the infrared range of the radiation spectrum of tissues (a, b, c) (Girl G. 22 years).
 A and a – immediately after the installation of brackets on the lower dentition (prior to splinting braces with wax);
 B and b – 3 days after the installation of brackets and splinting of the right half of the brackets with wax;
 C and c - 5 days after the installation of brackets and splinting of the right half of the brackets (pre-this day the wax was removed completely).

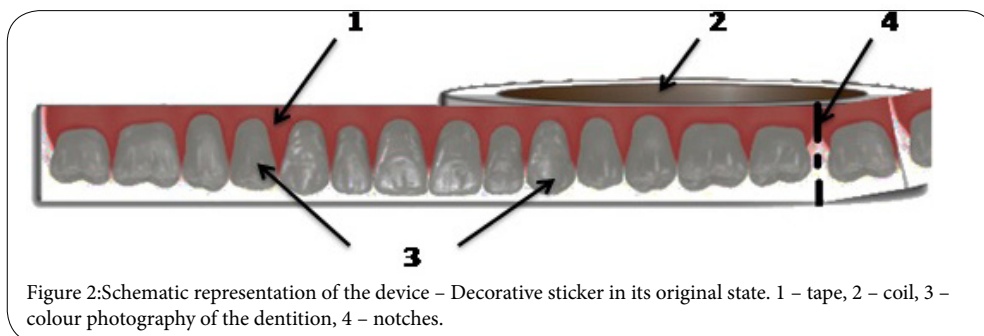


Figure 2: Schematic representation of the device – Decorative sticker in its original state. 1 – tape, 2 – coil, 3 – colour photography of the dentition, 4 – notches.

The specified series of images illustrates the dynamics of surface condition of mucosa and the local temperature of the lower lip in the field of open and closed parts of the brackets. It is seen that the left part of the brackets were left without shelter wax (was open), and it irritated lips. The thermogram clearly shows the area with local hyperthermia, which is located in the left part of lips and is opposite one of the metallic elements of the brackets. The right half of the brackets was closed with wax and it did not cause local irritation of the lips. The thermogram shows that the right part of the lower lip has no areas of local hyperthermia.

We then decided to close the brackets by food wrap. Studies have shown that splinting brackets by wax and sticking them on the food wrap completely prevents the development of blisters on the lips and cheeks. To this end, we invented a decorative sticker [RU Application No. 2016147639 (076523), stated 05.12.2016].

Sticker is designed in the form of a tape wound on the spool. On the surface of the tape placed series color photographs - panoramic 3D images of the visible front surface of the upper or lower dentition of a healthy person is whole in full size (Figure 2).

It is proved that the use of a thermal imaging camera improves the quality of dental treatment during the installation of brackets, because it provides early detection of the blistering disease of cheeks and lips. In addition, thermal imaging camera allows us to shoot a film on the dynamics of the local temperature and the colour of facial skin and mucous membranes of the mouth, which, in its turn, can be archived using the flash memory, and can then be used by dentists as an additional document proving the quality of dental treatment provided to the patient.

Early diagnosis of the beginning of blistering disease in cheeks and lips and splinting brackets by wax and covering the surface by food wrap is prevented local irritation to the lips and cheeks and the development of iatrogenic disease. Thermal imaging diagnostics of blistering disease of cheeks and lips, which are caused by the brackets, and decorative sticker on the dentition with braces for prevention of this iatrogenic illness.

Competing Interests

The authors declare that they have no competing interests.

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