Infrared thermography in the diagnostics of hidden infections – case reports

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Abstract. Two interesting case reports are presented that prove the many advantages of infrared thermography as a new diagnostic tool that can be successfully used in detecting hidden pathological processes. The first case report is about a 40-year-old female patient with alopecia areata – head lesion. The dermatological treatment gave no results, so the patient was sent for focal diagnostics. The infrared thermography showed two sites with hidden infection. The first one was of dental origin – periapical granuloma on the first mandibular left molar; the second site was in the genital area – endometriosis. A root canal retreatment of the molar and a gynecological operation were performed. After elimination of the focal infection, the hairless lesion recovered fully. The second case report is of a 34-year-old healthy male with alopecia areata of the beard and no other complaints. Infrared thermography detected active sinusitis of the ethmoidal left sinus. A microbiology test confirmed the presence of Staphylococcus Aureus and after an antibiotic course the beard recovered fully. These cases clearly illustrate the advantages of infrared thermography as a novel promising, non-invasive and objective diagnostic tool for clarification of difficult-to-diagnose cases.

1. Introduction

Focal infection is a hidden inflammation which is not strong enough to cause any particular complaints, because the immune system of the organism restricts it with a defensive wall of cells [1, 2, 3, 4]. However, in certain situations, such as stress and a viral attack, the immune system reacts to the new danger and this defensive wall is no longer persistent, so that the focal infection can affect through the connective tissue distant organs, such as skin, heart, kidneys, joints, eyes [5, 9, 10]. Sources of focal infection in the head can be asymptomatic diseases of teeth and periodontium, sinuses, tonsils, thyroid gland, lymph nodes, TMJ, allergies. They can cause common diseases of the organism which cannot be affected by conventional therapy [11, 12]. The infrared thermography is a modern method for contactless thermal diagnostics that registers for a very short time the temperature at any point of the body as a "heat picture". The infrared camera is a highly sensitive, high-tech equipment which detects the infrared radiation spectrum of the studied subject [6, 7, 8]. The thermal picture analysis is conducted by software, which guarantees the precision of the focal diagnostics.

We report two interesting cases that prove the many advantages of infrared thermography as a new diagnostic tool that can be successfully used in detection of hidden pathological processes with vague, unclear symptoms. The infrared camera used was Flir T335 (figure 1) – a professional infrared camera with a 0.05 °C thermal sensitivity and high resolution – 320×240 pixels, with 2× continuous digital
zoom and a 120° rotating lens that offers a wide range of viewing angles. The software used for the thermal analysis was Flir Reporter Pro.

2. Case report 1 – Alopecia areata
The first case report concerns a 40-year-old female patient with alopecia areata at the right fronto-temporal region – a 5-cm lesion and no other complaints (figure 2 and figure 3). The dermatological treatment gave no results, so the patient was referred to dentist for focal diagnostics.

The infrared thermography was performed in a room at 22°C room temperature with the images taken from a distance of 1.5 m. Both digital and infrared images were taken simultaneously by the infrared camera. The two images were precisely fused with the software option using three referent points so as to exclude the possibility of false positive results arising from skin inflammations. The areas with the highest temperature were determined as active sites of focal infection. The analysis of the infrared thermal picture showed two sites with hidden infection – the first one of from dental origin, the first left mandibular molar with periapical granuloma (figure 4, figure 5 and figure 6); the second site was in the genital area – a thermal picture of endometriosis (figure 8), this diagnosis being confirmed by a gynecologist afterwards (figure 9).

The patient had no complaints from the genital area and claimed regular gynecological check-ups. On the basis of the infrared thermography findings, an ultrasound examination of the uterus was administered and confirmed the diagnosis of endometriosis – a pathological overgrowth of the inner layer of the uterus, which in this case led to alopecia but if persisting for too long might lead to infertility as well.
The first left mandibular molar was retreated after an allergology test for the dental materials followed by iontophoresis with iodine for full root canal disinfection (figure 7). A gynecological operation has been performed for the endometriosis. After elimination of both sites of focal infection, the hairless lesion recovered fully (figure 10).

That’s why infrared thermography is a powerful screening method not only for the maxillo-facial area but for the whole body as well. Bearing in mind that this method does not use any radiation and is non-contact and non-invasive makes this diagnostic safe and suitable for pregnant women and children as well.

3. Case report 2 – Alopecia areata of the beard

The second case report is of a 34-year-old healthy male with alopecia areata of the beard and no other complaints (figure 11). The infrared imaging followed the same protocol as described for case 1. It detected active sinusitis of the ethmoidal left sinus (figure 12). A blood test and a microbiology test of the nasal secretion were administered. There was no pathology in the blood test, but the microbiology test confirmed the presence of a significant amount of Staphylococcus Aureus (figure 13).
After 10 days of a full course antibiotic, a second microbiology test proved negative and gradually for one month the hairs recovered fully (figure 14 and figure 15). Thus, the only clue for the presence of the sinus infection was provided by the infrared thermography. Even the inflammation markers in the blood tests were normal. Therefore, the infrared thermography is a non-invasive diagnostic tool that yields information not only for teeth but for the whole head and body as well.

4. Discussion
Focal infection can be the real cause for some diseases (ear infections, pyelonephritis, arthritis, alopecia areata) or an aggravating factor for others. Very often even doctors consider directing patients for focal infection diagnostics only when they have run out of therapeutic possibilities, although the reversibility of the pathology caused by hidden inflammations depends on the time they have been active.

This is why focal infections are a major medical problem and there is a serious need of a reliable method for their detection. Pogrel, Yen et al. [13] have used a highly sensitive infrared camera for thermographic assessment of different physiological and pathological processes in the head and neck area. According to them, the infrared thermography has a diagnostic importance in cases with no clear pain syndromes in the maxillo-facial area and TMJ disorders; because of the huge difference in the normal values between different people, they have claimed that standardization is extremely difficult. Gratt and Sickles [14] have studied the normal values of irradiated heat in healthy individuals and patients with different kinds of pain syndromes and have established significant differences in both kinds of thermal images. In healthy people, the results have shown a high degree of symmetry relative to the midline in the face area (0.1 °C). According to the authors, a difference of 0.4 °C between symmetrical face areas might serve as a threshold for existing pathology. They determine the thermography as a non-ionizing, non-invasive alternative for solving different diagnostic problems. Our experience with the case reports confirms their statement.
Recently, Sikdar, Khandelwal et al. published a review of the infrared thermography and its application in dentistry [15]. They pointed to infrared thermography as a precise tool for diagnostics of mandibular nerve injury, hidden inflammations, TMJ disorders, detection of labial herpes in prodromal stage, control of endodontic treatment, sinusitis, neoplastic processes, myofascial pain syndrome, neuralgia. The infrared thermography is a real “preventive medicine” because it provides early detection of the different functional disorders and gives opportunity for assessment of the effectiveness of the different therapeutic approaches.

5. Conclusion
Infrared thermography is a very useful diagnostic tool not only in dental medicine but in general medicine as well. It is a non-invasive, non-contact thermo-diagnostic method that has no contraindications. It can be performed on pregnant women and children as well. The only disadvantage of the method is application in patients with severe, wide skin inflammations before the structural changes lead to temperature change necessary to measure the temperature of the underlying structures cannot be objectively measured. Further investigations are necessary to find a proper method for focal diagnostics in such patients. All pathological processes that lead to temperature changes can be detected by an infrared camera in the stage of malfunction long before the structural changes – inflammation, regenerative processes, allergic inflammation, hyper and hypothyroidism, neoplastic proliferation etc. Infrared thermography is highly sensitive and can detect the onset of a pathological process long before any changes in the blood counts occur. Infrared thermography is a novel and highly informative diagnostic method that helps detecting associated oral and systemic pathological conditions.

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