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# Thermosemiotics of chronic tonsillitis

## Termosemiotyka przewlekłego zapalenia migdałków

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Streszczenie

**Wstęp:** Opracowanie dotyczy termosemiotyki przewlekłego zapalenia migdałków poprzez określenie specyfiki fal podczerwonych w okolicy podżuchwowej, na dłoniach, kolanach i w centrum sklepienia stopy. Badania obejmowały zdrowych ludzi oraz chorych z zapaleniem migdałków. Uzyskane wyniki zdrowych ochotników porównano z odpowiednimi wskaźnikami pacjentów z przewlekłym zapaleniem migdałków.

**Opis przypadku:** Zbadaliśmy 32 zdrowych ochotników z prawidłową temperaturą ciała i brakiem historii patologii migdałków, od 20 do 56 lat ze średnią wieku 28,3±2.3. Było 19 mężczyzn (59,4%) i 13 kobiet (40,6%). Ich średni wiek był podobny — 30,2±3.3 lat u mężczyzn i 36,4±3.6 lat u kobiet.

**Wnioski:** **1**. Obserwowaliśmy umiarkowany całkowity wzrost temperatury w okolicy szyi i pośrodku dłoni u pacjentów z przewlekłym zapaleniem migdałków w fazie zaostrzenia. Jednocześnie średnie wskaźniki temperatury w stawach kolanowych i środku sklepienia stopy przekroczyły odpowiednie wskaźniki zdrowych osób — 35,4±0.8 versus 32,5±0.6°C (P <0,01) oraz 35,1±0.8 versus 28,4±0.5°C (P <0,05).

**2**. Stopień kompensacji przewlekłego zapalenia migdałków można ocenić, porównując stopień różnic temperatur w kolanie, dolnej części kości udowej, centrum sklepienia stopy i jej okolicach: ΔT w zakresie 0,6–1,6ºC wskazuje postać skompensowaną, a ΔT więcej niż 1,6°C zwykle wskazuje na obecność zdekompensowanej postaci przewlekłego zapalenia migdałków.

**Słowa kluczowe:** przewlekłe zapalenie migdałków, termografia, miejsca anatomiczne

Abstract

**Background:** Research Objective — to develop thermosemiotics of chronic tonsillitis by determining specifics of infrared waves in the submandibular region and on the palms, knees and in the center of foot vault in healthy people and comparison of the obtained results with the corresponding indices of patients with chronic tonsillitis.

**Case Report:** Patients and methods. We examined 32 healthy volunteers with normal body temperature and no history of tonsillar pathology, between 20 and 56 years with average age (28,3±2.3). There were 19 males (59,4%) and 13 females (40,6%). Their average age was similar — (30,2±3.3) years in males and (36,4±3.6) years in females.

**Conclusions:** **1**. We observed a moderate total increase in temperature in the neck area and center of the palms in patients with chronic tonsillitis in the phase of exacerbation. At the same time, the average temperature indices at the knee joints and the center of the foot vault exceeded corresponding indices of healthy people — (35,4±0.8) vs (32,5±0.6)°C (P<0.01) and (35,1±0.8) vs (28,4±0.5)°C (P <0.05) respectively.

**2**. Degree of compensation of chronic tonsillitis can be assessed by comparing degree of temperature differences over the knee, lower part of the femur, center of foot vault and nearby regions: ΔT in the range 0.6–1.6ºC indicates the compensated form, and ΔT more than 1,6ºC usually indicates the presence of a decompensated form of chronic tonsillitis.

**Key words:** chronic tonsillitis, thermography anatomical regions

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## Introduction

Most common pathogens in infectious tonsillitis are Streptococcus spp. Tonsillitis infrequently develops on the background of acute respiratory disease, but usually manifests itself as a separate disease. Suppression of local immune response on cold exposure, malnutrition, physical exhaustion, blockage of nasal pathways by adenoid tissue, chronic sinusitis, deviation of the nasal septum, chronic rhinitis are favorable set ssup for tonsillitis formation [1–3].

In clinical practice, it is often necessary to distinguish acute tonsillitis from chronic, because they are fundamentally different diseases.

Recurrent acute tonsillitis that is frequently undertreated is commonly seen as preceding factor in development of chronic tonsillitis. Follicular form of tonsillitis is considered most unfavorable as it leads to scar formation in lymphoid tissue therefore diminishing its protective properties.

Tonsillolith are formed consisting of desquamated epithelium, microbes, inflammatory exudate. They are difficult to evacuate and causing lacunar expansion, formation of retention cysts [4, 5].

Tonsilitis is notorious for its complications, such as myocarditis, rheumatic diseases, nephritis. Exacerbation may occur on the background of chronic inflammatory process.

Therefore, special attention needs to be directed to patient reported history, particularly frequency and duration of exacerbations.

Exacerbation of chronic tonsillitis is accompanied by symptoms of general intoxication — subfebrile temperature, pain in joints, decreased tolerance to physical exertion, fatigue. The tonsils, as a rule, are enlarged, have submucosal purulent follicles (however, in the absence of signs of acute tonsillitis, hyperemia and inflammatory infiltration may be present), caseosus-purulent masses in cicatricial lacunae. Regional lymph nodes are enlarged, dense, sometimes painful. Tonsil-cardial syndrome is often observed with subjective sensations of pain in the region of the heart, heart intermission, palpitation. There may be vasomotor symptoms — pallor or hyperemia of the skin, xerodermia or increase perspiration functional heart murmurs, myocarditis [4].

**Research Objective** — to develop thermosemiotics of chronic tonsillitis by determining specifics of infrared waves in the submandibular region, on the palms, in the projection of kneecaps, and in the center of foot vault both in patients with chronic tonsillitis and healthy persons.

## Case Report

### Patients and methods

Diagnosis of chronic tonsillitis in the phase of exacerbation was made according to clinical, laboratory, and instrumental examinations. Hyperemia, thickening of the edges of the palatine arches, scarring of tonsillar parenchyma, cicatricial adhesions between the walls of the lacunae and between the tonsils and palatine arches, caseosus-purulent masses in desquamated epithelium, microbes, and inflammatoty exudate were features of tonsillitis. In addition, there was regional lymphadenitis, tonsilogenic intoxication and prolonged subfebrile temperature. Particular attention was paid to anamnestic information about manifestations of decompensation like frequent recurrent acute tonsillitis. To determine etiology of tonsillitis, the Centor [6] scale of clinical symptoms evaluation was used. Paratonzillite, parontozyral abscess and other complications, as well as concomitant inflammatory diseases were criteria for exclusion from the study.

Thermographic evaluation was performed using medical thermal imager TI-120 (China). Analysis of thermograms was carried out with the program package „IRSee Software", and evaluated visually by comparing the color palette with nearby τ anatomical regions. If thermal asymmetry was observed, the thermograms were described by such algorithm: presence of thermal asymmetry; localization of the zone with increased and reduced intensity of infrared radiation; temperature values and their difference from a symmetric zone. The values of temperatures at all points of the image program were recorded automatically.

Particular attention was paid to a carotid triangle that corresponds to the position of the carotid artery and submandibular lymph nodes, the projection of the larynx and head-nod muscles, palms. We assessed a temperature of the thenar, fingertips, hypothenar, and the middle of the palm, projection of patella, metatarsus, and distal 1/4 part of the femur.

To determinedistinct characteristics of infrared radiation in the submandibular region and on the palms, we examined 32 healthy volunteers with normal body temperature and no history of tonsillar pathology, between 20 and 56 years with average (28,3±2.3). There were 19 males (59,4%) and 13 females (40,6%). Their average age was similar — (30,2±3.3) years in males and (26,4±3.6) years in females (P>0,05).

Group of patient with chronic tonsillitis in the stage of exacerbation consisted of 23 persons. In 9 of them we diagnosed with compensated, and in other 14 patients — decompensated form of inflammation.

Statistical processing of data was carried out with computer program „Microsoft Excel" and „Statistica for Windows" ver. 6.0, StatSoft Inc. (USA).

## Discussion

By assessing thermal radiation in submandibular area we found 7 patients to be in isothermal state, and 16 persons in hyperthermic state.

In patients with exacerbation of chronic tonsillitis who had isothermal pattern, the temperature of all investigated areas was very similar to the thermotogram of healthy persons without showing any statistically significant differences. In healthy persons, temperature distribution of the right and left submandibular regions and both palms was symmetrical according

to average indices, and had no statistically significant differences.

In patients with chronic tonsillitis in the phase of exacerbation, the thermotogram of the anterior part of the neck revealed a moderate overall increase in skin temperature a symptom of a „collar", where on the background of insignificant hyperthermia, there were e isolated, brighter focuses of luminescence in the projection of lymph nodes, mainly submandibular — ΔT=0,6ºC (tab. 1).

Tabela 1: Distribution of average temperature indices in patients with exacerbation of chronic tonsillitis and in healthy persons, (M±m)°C

| | Average temperature | | |
|---|---|---|---|
| | Patients with exacerbation of chronic tonsillitis | | |
| Anatomical region | isothermal distribution, n=7 | hyperthermal distribution, n=16 | Healthy persons (norm), n=32 |
| Carotid triangle | 34,3±0.9 | 37,2±0.0 | 34,±0.7 |
| Middle of the palm | 34.3±0.7 | 36.3±0.6* | 34.2±0.7 |
| Projection of patella | 32.9±0.8 | 35.4±0.8* | 32.5±0.6 |
| Middle of the metatarsus | 32.6±0.9 | 35.1±0.8* | 32.7±0.7 |

* significant differences as compare with the healthy persons (P<0,05–0,001)

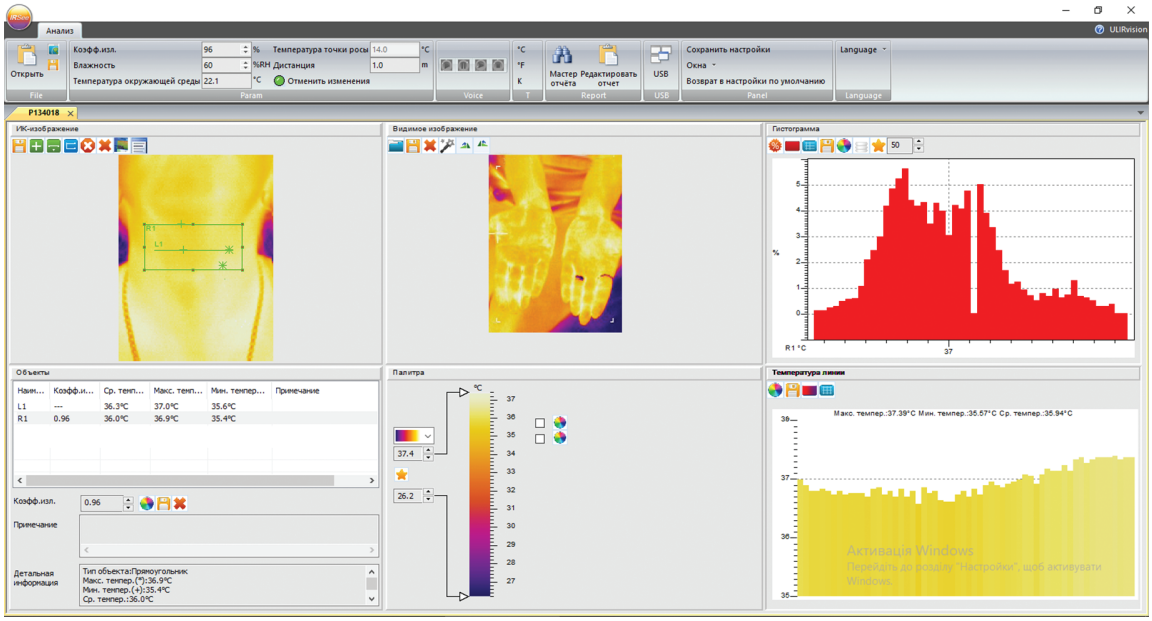
Such data was observed in the center of the palms, where temperature was higher than in healthy persons — (36,3±0.6) vs (34,2±0.7)ºC (P<0.05).

At the same time, the average temperature indices of projections of kneecaps exceeded the values of healthy people significantly — (35,4±0.8) against (32,5±0.6)°C (P<0,01). At the same time, there were no other clinical signs of knee synovitis.

Thermal (picture of the center of metatarsus changed similarly. In particular, in patients with chronic tonsillitis in the phase of exacerbation, there was a significant increase in temperature in the indicated area as compared with healthy people — (35,1±0.8) vs (28,4±0.5)°C (P<0,05).

In almost 50% of patients with chronic tonsillitis in exacerbation phase temperature gradient (temperature difference when compared with adjacent skin) of the carotid triangle and middle of palms was in the range of 0,6–1,1ºC (tab. 2).

Degree of compensation for chronic tonsillitis can be determined based on a temperature difference over the knees, distal femur and middle of metatarsus In our study 9 out of 14 patients with decompensated tonsillitis, ΔT was significant (more than 1,6ºC), and in 7 out of 9 persons with the compensated form of disease it was mild to moderate (0,6–1,6ºC).



**Pic. 1.** Thermogram of anterior part of the neck and palms in patient M.V. (39 y.o.) with chronic tonsillitis in the phase of exacerbation, decompensated (hyperthermia in the projection of carotid triangle — ΔT = 1.4ºC and in the middle of palms — ΔT = 1.6ºC

## Clinical case

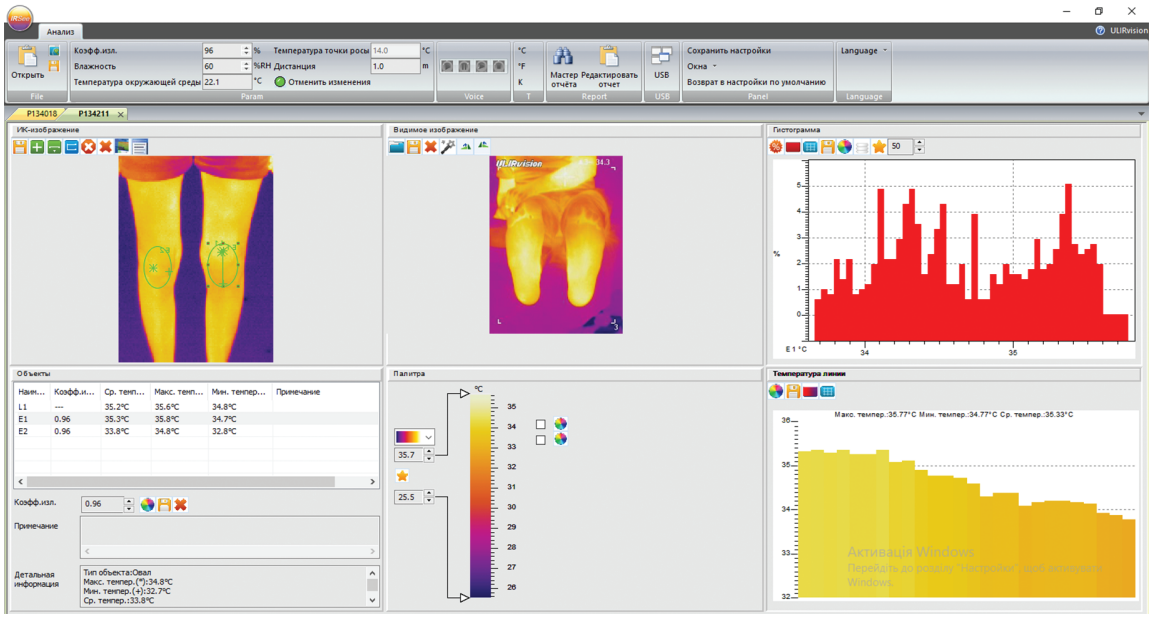
Patient M.V., 39 years old, complains of xerosis of the mucous membrane of the pharynx, pain, foreign body sensation during swallowing, periodic pain in the region of the heart, increase in body temperature to 37,3°C, presence of foul odor from the mouth, fatigue.

Patients reported frequent exacerbation of tonsillitis up to 3–5 times a year, which usually arise after exposure to extreme temperature or stress.

## Physical examination

Submandibular lymph nodes were enlarged, painful. Pharyngeal erythema, thickening, eodema of palatine arches, tonsils covered with semi translucent mucous patches, lacunar caseous-purulent crusts, scar tissue formation between tonsils and palatine arches Heart sound are mildly weakened, there is soft, probably, functional systolic murmur on the apex which disappears when changing body position Heart rate 72 bpm. Blood pressure130/80. Internal organs — without pathology.

Labs: RBC, Hb normal, WBC 9.8´1012/l, bands — 11%, segmented neutrophils — 65%, lymphocytes — 23%, monocytes — 18%. ESR 30 mm/hr, ECG — without pathology, Microprecipitation test for syphilis — negative, antistreptolisyn O test in serum 212,6 IU/ml (reference <200 IU/ml). Tonsillar swab culture grew different species of Streptococci and Staphylococci in high concentration.



**Pic. 2.** Thermogram of projections of kneecaps and middle of metatarsus in the same patient (hyperthermia in a center of the left knee — ΔT = 1,0ºC, and middle of the left foot — ΔT = 1,0ºC)

## Clinical diagnosis

Exacerbation of chronic recurrent tonsillitis (streptococcal and staphylococcal association), moderate degree of severity. On the thermogtram — uneven distribution of temperature in tissues of the submandibular regions and palms. Point of maximum warming (37,2ºC) localized in left carotid triangle, as opposed to nearby area — 35,8ºC. Temperature gradient was 1,4ºC. Eemperature of the middle of the left palm was 36,9ºC, as opposed to — 35,3ºC in adjacent anatomical region. Temperature gradient was 1,6°C (pic. 1).

It is necessary notice a significant increase in temperature over kneecaps and in the middle of metatarsus. For example, maximum temperature in the projection of the left kneecap was 35,77ºC (higher than in healthy persons), as opposed to temperature over nearby region of the lower ¼ part of the left shin was 34,77ºC, temperature gradient ΔT = 1,0ºC. The middle of the left metatarsus had a temperature of 35,15ºC, the nearby toe tips temperature was 34,05ºC, ΔT = 1,1ºC (pic. 2).

Therefore type of described thermal radiation corresponds to the state of hyperthermic asymmetric distribution in the region of carotid triangle, palms, knees and feet. Small temperature gradient was seen in projection of kneecaps and middle ofmetatarsus indicates compensation of chronic tonsillitis in this patient.

A well-known fact, host response to tissue penetration by an infectious agent is a development of inflammatory process in pharyngeal tonsils It is manifested by altered blood circulation„ increased vascular permeability, local immunosuppression, and as a consequence, by activation of endogenous microflora with gradual development of acute inflammatory response in palatine tobsils [7].

We assume that strong relationship between the temperature of submandibular region and corresponding palm is associated with reflex autonomic changes that lead not only to a dysregulation of the vascular tone, but also remotely reflect inflammation in Zakharyin-Ged zones. There is a well-known anatomical and functional (metameric) relationship between the skin and internal organs through the segmental apparatus of the spinal cord. In the process of development of such relationship functional state of nervous system plays an important role.

In modern perspective Ged zones may be interpreted as areas with changed sensitivity of a skin and other tissue (e.g. muscles, bones) which is a complex vasomotor and motor-trophic reflex that reflects a metameric projection of an ailing inner organ on the skin. In these zones tenderness on palpation, changes of trophicity, skin electric conductivity, perspiration, skin temperature and a disorder of algesia [8].

This assumption is supported by the study of H. Asada et al. (2003), who on the basis of a thermographic examination of 131 patients with chronic tonsillitis in remission found that 2–4 hours after mechanical massage of the tonsils, temperature of palms in some patients increased on by ≥1ºC. It is interesting to note that in this group of patients was observed more favorable outcome after tonsillectomy. This is the reason why re-

searchers suggest to use thermographic technique and above referenced provocative palmar test as a marker to prognosticate outcomes of tonsillectomy [9]. Same authors point out that in area between shoulder girdle and submandibular area hyperthermia had distinct contours and resembles „collar", which is a characteristic feature of the toxicoallergic form of chronic tonsillitis.

Tabela 2: Temperature gradient carotid triangle, middle of the palms, knees and feet (as compared with nearby areas – ΔT) in patients with exacerbation of chronic tonsillitis (n = 23)

| ΔT (ºC) | Anatomical region | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | carotid triangle | | middle of the palm | | projection of kneecaps | | middle of metatarsus | |
| | abs. number | M %±m % | abs. number | M %±m % | abs. number | M %±m % | abs. number | M %±m % |
| 0–0,5 (norm норма) | 7 | 30,4±9.6 | 7 | 30,4±9.6 | 7 | 30,4±9.6 | 7 | 30,4±9.6 |
| 0,6–1,1 | 11 | 47,8±10.4 | 10 | 43,5±10.3 | 4 | 17,4±7.9 | 3 | 13,0±7.0 |
| -(0,6–1,1) | 0 | 0,0±0.0 | 0 | 0,0±0.0 | 0 | 0,0±0.0 | 0 | 0,0±0.0 |
| 1,2–1,6 | 4 | 17,4±7.9 | 6 | 26,1±9.2 | 3 | 13,0±7.0 | 5 | 21,7±8.6 |
| -(1,2–1,6) | 0 | 0,0±0.0 | 0 | 0,0±0.0 | 0 | 0,0±0.0 | 0 | 0,0±0.0 |
| >1,6 | 1 | 4,3±4.2 | 0 | 0,0±0.0 | 9 | 39,1±9.7 | 8 | 34,8±9.9 |
| <(-1,6) | 0 | 0,0±0.0 | 0 | 0,0±0.0 | 0 | 0,0±0.0 | 0 | 0,0±0.0 |

Therefore above referenced thermographic features make it possible to significantly increase value of physical examination in patients with chronic tonsillitis in the phase of exacerbation, as well as to determine its form.

Specifics of thermosemiotics of chronic tonsillitis in exacerbation phase demonstrated in this study is patent protected [10].

## Conclusions

- We established moderate total warming of the neck and middle of the palms in patients with chronic tonsillitis in the phase of exacerbation. At the same time, the average temperature indices at the knee joints and the middle of the vault of the foot exceeded corresponding indices of healthy people — (35,4±0.8) vs (32,5±0.6)ºC (P<0.01) and (35,1±0.8) vs (28,4±0.5)ºC (P<0.05) respectively. Hyperthermia of projections of kneecaps and middle of metatarsus may be characteristic of chronic tonsillitis in the phase of exacerbation.
- Degree of compensation of chronic tonsillitis can be estimated by level of temperature differences over knees area, distal femur, in the center of foot vault and nearby regions: ΔT in the range 0.6–1.6ºC indicates compensated form, and ΔT more than 1,6ºC usually indicates presence of a decompensated form of chronic tonsillitis.

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