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# From ophthalmologist to dentist via radiology

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## Summary

**Background:** The aim of this paper was to analyze the causes of orbital cellulitis in connection with covert dental changes as well as to establish the role of radiological procedures in the final diagnosis and further treatment of such cases.

**Material/Methods:** Thirty-two patients, aged 25–56, 22 women and 10 men were diagnosed and treated between January 2007 and April 2011 at the Pomeranian Medical University in Szczecin. The patients were examined in the infirmary of the ophthalmological department due to unilateral blepharo-oedema, abrupt pain and vision disturbances; in 5 cases, body temperature increased up to 37.8°C was observed. Next, the patients underwent conventional X-ray examinations of the orbit to exclude any foreign bodies in the eyeball, as well as pantomographies to evaluate the dental status. Visible periapical or periodontal changes in dentition were analyzed with intraoral X-rays with the use of DIGORA System 2.1. Changes found in 3 patients on pantomograms and connected with iatrogenic procedures were further evaluated with CT (64 lines and 128 layers) in frontal, sagittal and axial projections. Orbital disorders were also diagnosed by an ophthalmologist and radiologist with Doppler ultrasound (US) examinations. A linear transducer of 7.5–10 MHz to observe the morphology and vascularity of the eyeball was applied.

**Results:** Iatrogenic treatment was the cause of sinusitis and cellulitis in three cases: incorrectly implanted dental implant in one case, root of the 3rd molar pushed into the sinus in the second case, and communication between the maxillary alveolar process and the sinus after extraction in case of the third patient. Asymptomatic periapical osteolysis, periodontal disease or dead teeth were found in all cases. Diagnosis of orbital cellulitis of dental origin was determined on the basis of clinical, radiographic and ultrasound findings. Ophthalmologic and dental treatment was applied simultaneously.

**Conclusions:** Co-operation between ophthalmologists, radiologists and dentists is necessary during the treatment of such orbital diseases.

**Key words:** orbital cellulitis of dental origin • radiological diagnostics • Doppler US • complex treatment • low induction magnetic field treatment

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## Background

Radiologist is very often the "second" diagnosing physician of patients with ophthalmological disturbances such as abrupt pain with hyperesthesia of the orbit, blepharo-oedema, winking and dystopia. These patients are first examined by an ophthalmologist in the infirmary and after the clinical examination they are transferred to the radiology

department so that a foreign body or bone changes of the orbit could be excluded. If an X-ray of the orbit rules out these symptoms, it is necessary to find the cause of orbital disorders. At the beginning of the diagnostic procedures, changes in maxillary sinuses and teeth should be excluded. The previously mentioned ophthalmological disturbances may be symptoms of cellulitis and uveitis; in some cases, dental infection is the main predisposing factor. Sinusitis of odontogenic origin is well known, and its incidence has been reported to be approximately 10 percent [1], but acute orbital infections of odontogenic origin are still rare with a prevalence of 1.3% [2]. Anatomical routes of spread of odontogenic infections to the orbit from the maxillary teeth have three directions: 1. a direct spread to the maxillary and ethmoid sinus through emissary veins in the orbital walls to the orbit, 2. via infratemporal and pterygopalatine fossae, inferior ophthalmic vein, pterygoid venous plexus to the orbit and 3. from canine space, periorbital and medial canthal region, through connections between facial, angular and ophthalmic veins to the orbit [3].

Sinusitis with dental etiology accounts for changes in the orbit and soft tissue of the eyeball. It occurs when the Schneiderian membrane undergoes changes. This may take place among people with maxillary teeth affected by complicated caries or maxillary dental trauma, usually iatrogenic [4]. Dental extractions, dental implants and endodontic treatment are mentioned to be the causes of sinusitis and ostitis of dental origin in this area [5–9].

It is also stressed that radiological procedures such as intraoral X-rays, pantomography, CT or imaging techniques like Doppler ultrasonography (DUS) and magnetic resonance (MR) are very helpful in making the diagnosis.

Literature also mentions that many patients who underwent dental interventions as well as laryngological treatment with complications ended their treatment course in the ophthalmological or other departments [10]. Nonetheless, covert dental problems diagnosed first by a radiologist and later by an ophthalmologist is rather uncommon.

The purpose of this study was to analyze the causes of orbital cellulitis in connection with covert dental changes as well as to establish the role of radiological procedures in the final diagnosis and further treatment in such cases.

## Material and Methods

Thirty-two patients aged 25–56, 22 women and 10 men were diagnosed and treated between January 2007 and April 2011 in the Ophthalmology Clinic, Department of General and Dental Radiology, Department of Dental Propedeutics and Physiodiagnostics and Department of Dental Surgery at the Pomeranian Medical University in Szczecin.

The above mentioned patients were examined in the infirmary of the ophthalmological department due to unilateral blepharo-oedema, abrupt pain and vision disturbances – 12 on the right side and 20 on the left. In 5 cases, body temperature increased to 37.8°C was observed.

Next, the patients were transferred to the Radiology Department to undergo conventional X-ray of the orbit to exclude any foreign bodies in the eyeball, evaluate the bone structure of the orbit as well as radiolucency of the frontal and maxillary sinuses. Then the diagnostics were carried out to investigate changes in the eyeball and to confirm the dental origin of orbital symptoms. In the Radiology Department, radiologists questioned the patients about their dental status, last visit to the dentist or any dental procedures performed prior to eyeball problems. Other symptoms, like nasal discharge, nasal obstruction, headache were also considered in history taking.

All X-ray procedures were carried out only after the patients and the ophthalmologists had given their consent. Pantomography was recommended for patients who had not visited the dentist for the previous 6 months. Waters' projection was assessed whenever a level of fluid was expected or when it was necessary to visualize the bone structure and radiolucency of the maxillary sinuses. The pantomograms were evaluated and described by radiologists and when periapical or periodontal changes were visible in dentition, intraoral X-rays were carried out with the use of DIGORA System 2.1. Clinically suspicious changes found on pantomograms of 3 patients were further investigated with CT (64 lines and 128 layers) in frontal, sagittal and axial projections.

Orbital disorders were also diagnosed by ophthalmologists and radiologists with Doppler ultrasound (US). A linear transducer of 7.5-10 MHz to observe the morphology and vascularity of the eyeball was applied. The technique of orbital Doppler US was previously described [11,12]. In the ophthalmic artery (OA), central retinal artery (CRA) and short posterior temporal ciliary arteries (SPTCA), the following parameters of blood flow velocity were determined: maximal, minimal and mean velocity.

Student's t-test was applied for statistical analysis of the differences between study parameters. In cases of a lack of normal variance, Mann -Whitney U test was used.

Patients were treated by an ophthalmologist and dentists. Extractions and complications caused by dental implants as well as ostitis were treated at the Dental Surgery Department, while endodontic treatment of the periapical and periodontal disease was carried out at the Dental Propedeutics and Physiodiagnostics Department. All control X-rays and Doppler US were performed in the Radiology Department. Broad – spectrum antibiotics were applied during ophthalmological and dental therapies.

## Results

Ophthalmological and Doppler ultrasound examinations indicated unilateral preseptal anterior cellulitis among all examined patients.

X-rays diagnostics showed changes of dental origin in the maxillary and orbital regions – Table 1.

Iatrogenic treatment effects were the cause of sinusitis and cellulitis in three cases: incorrectly inserted dental implant

**Table 1.** Results of diagnostic procedures.

| Radiological diagnosis | Number of patients |
|---|---|
| 1. Periapical and periodontal changes | 32 |
| 2. Maxillary sinus opacification due to palatal root of the molar | 1 |
| 3. Maxillary sinus opacification due to incorrect maxillary implant | 1 |
| 4. Iatrogenic defect between alveolar process and sinus | 1 |
| 5. Polypus and chronic maxillary sinusitis | 1 |

**Figure 1.** Pantomogramme. Parodontopathy, deep caries, residual roots 18,24,46, periapical changes 37, 48 and lack in dentition Pseudopolypus in the left maxillary sinus.

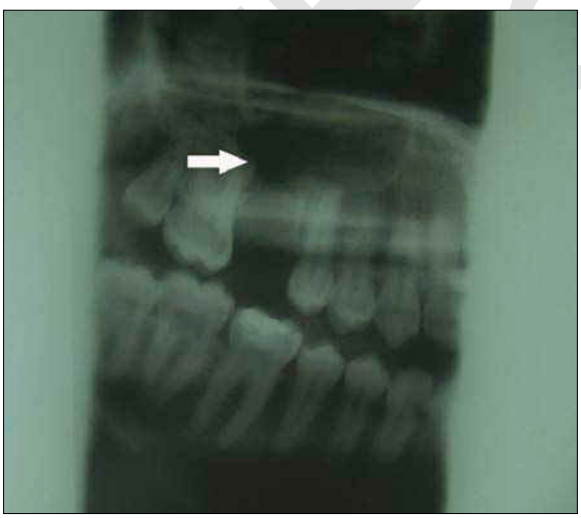

**Figure 2.** Scanogramme. Iatrogenic bone defect after extraction 16 – oro-antral fistula (arrow).

in one case, root of the 3rd molar pushed into the sinus in the second case and communication between the maxillary alveolar process and the sinus after extraction in case of the third patient. Asymptomatic periapical osteolysis, periodontal disease or dead teeth were found in all cases.

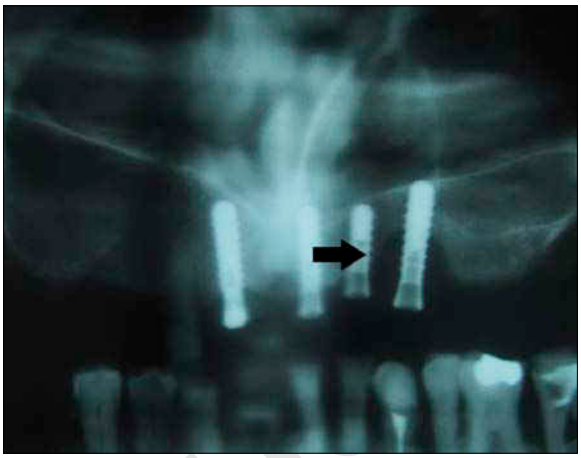

**Figure 3.** Scanogramme. Implants in region 11,21,22,23. Osteolytic defect and lack of osseous integration in 22 and 23 regions (arrow).

**Figure 4.** Viofor JPS apparattus with dental applicator.

Pantomograms and intraoral X-rays revealed periapical radiolucencies, radical cysts, profound caries, bone sockets, periodontal disease (Figure 1). Moreover, in one case, a defect between the alveolar process and the sinus was seen after extraction (Figure 2) and in another case, an impacted molar root in the sinus was observed. The patient with maxillary implants showed osteolytic bone reaction in the region of the implant and a minimal osseous integration of the implant (Figure 3).

Combined surgical and conservative dental treatments were applied depending on clinical and X-ray findings.

During surgical treatment, residual roots in jaw bones as well as malpositioned and non-integrated implants were extracted. Foreign bodies and polyps were removed from the maxillary sinuses by antrectomy. In the case of an oro-antral fistula, a plastic repair of soft tissue was performed. In all cases, the antibiotic therapy was applied – Dalacin or Augmentin two times a day, 1 g intraorally or intramuscularly.

Teeth with diagnosed dead pulp and visible periapical osteolysis were treated endodontically (filled with Gutta-percha and with Diaket) with side condensation technique and simultaneous use of low induction magnetic field (ELF-FM). In order to shorten the duration of treatment of periapical and decalcified foci, the ELF-FM technique with an elliptic

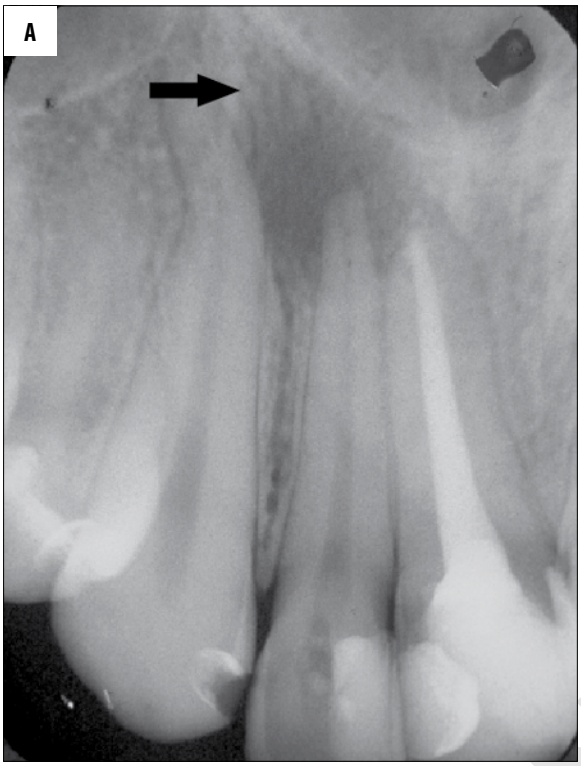


**Figure 5A.** Intraoral X-ray. Osteolytic periapical focus and secondary caries in region 12 before treatment (arrow).

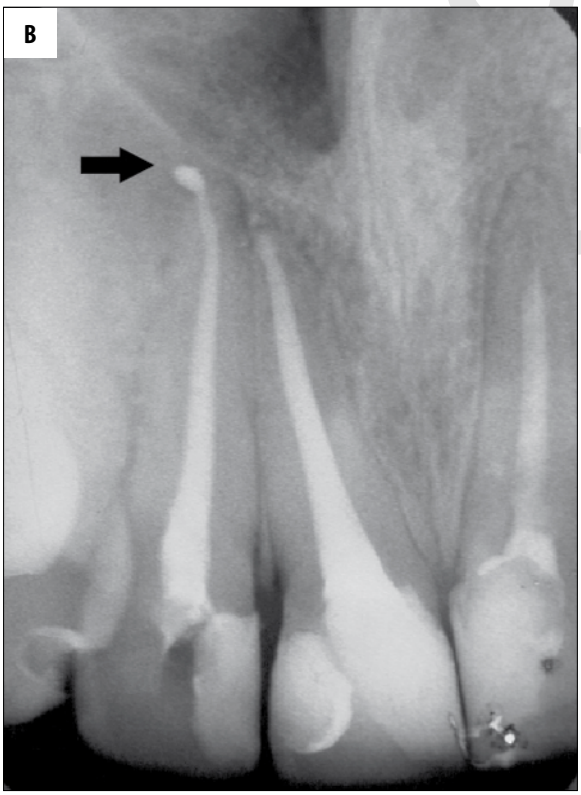


**Figure 5B.** Intraoral X-ray after the complex treatment. Endodontic treatment of the tooth 12 and 30 applications of the low magnetic field. Very good regeneration of the bone structure in the apical region (arrow).

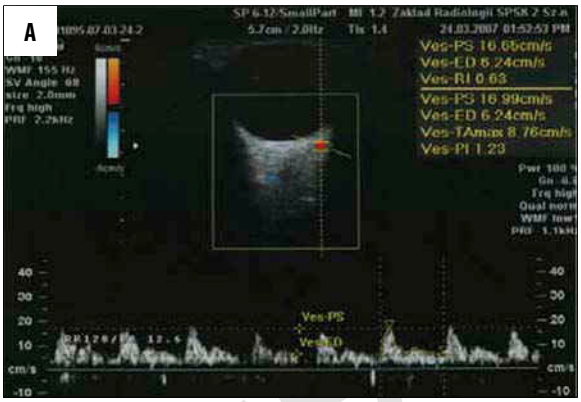


**Figure 6A.** Doppler ultrasonography – blood flow in OA.

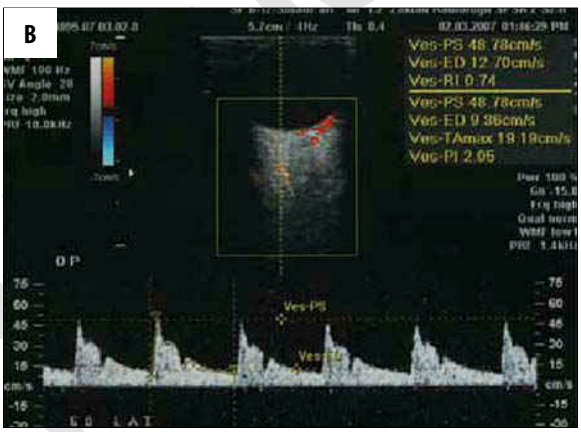


**Figure 6B.** Doppler ultrasonography – blood flow in CRA.

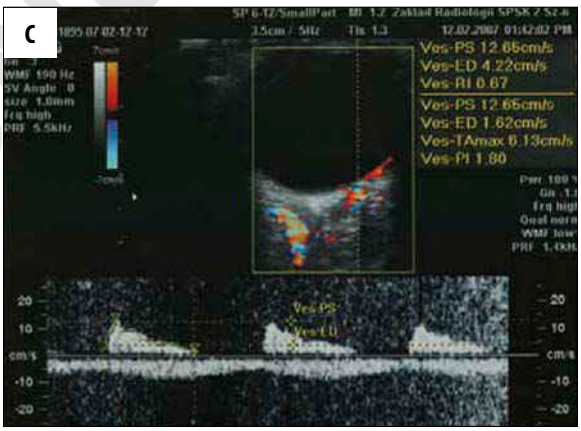


**Figure 6C.** Doppler ultrasonography – blood flow In PCA.

extraoral applicator of VIOFOR IMS (CE 0120) unit was used (Figure 4). From the first day of endodontic treatment, a program with an ionic cyclone resonance P3 with a constant intensity M1 not higher than 6 (range from 0.5 to 12 units) was used. Thirty sessions were performed with the use of ELF-FM. Follow-up intraoral X-rays were taken after that treatment in order to confirm regeneration of bone structure in the examined area (Figure 5A,B).

## Doppler US findings

The orbital muscles were not enlarged on ultrasound and the mean velocities (MV) in orbital vessels in Doppler US

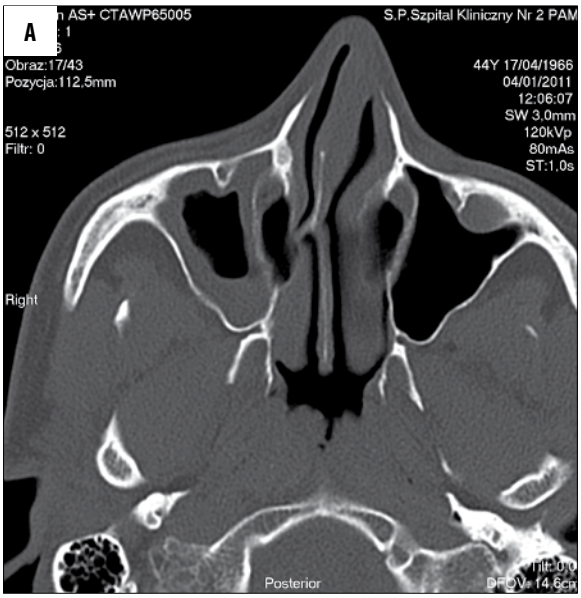


**Figure 7A.** Axial CT scan – chronic maxillary sinusitis, polypus in left maxillary sinus (arrow), deviated nasal septum.

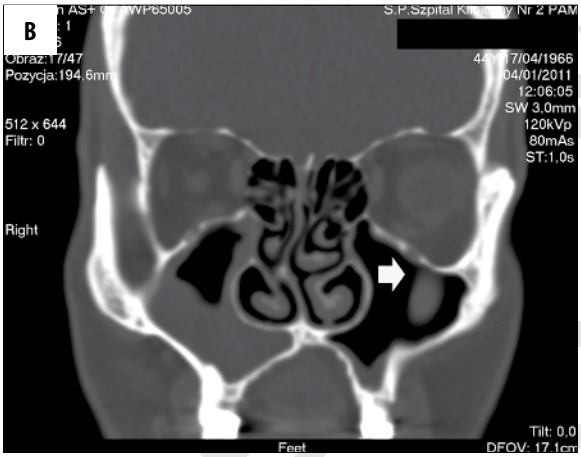


**Figure 7B.** Frontal CT scan of the same patient with chronic sinusitis and polypus of the left side.

were as follows: OA – 23.12 cm/sec, CRA – 6.81 cm/sec, SPTCA - 7.65-8.00 cm/sec. Resistance index (RI) was as follows: OA – 0.68 while in CRA - 0.62 and SPTCA – 0.50-0.60. These findings were interpreted as normal – values of normal blood flow in the mentioned arteries were presented in the previous publication [13]. Orbital morphology and normal blood flow are presented in Figure 6A–C.

CT scans in axial and frontal planes presented thickening of the mucosa in the right maxillary sinus and a pseudopolyp in the left sinus as chronic sinusitis. Opacification of the right maxillary sinus and presence of the molar in the left alveolar recess were observed in 1 patient. Mucosal thickening of the sinuses without fluid was observed in a patient with implant-related complications (Figures 7A,B and 8A,B].

## Discussion

A correlation between cellulitis and focal dental infectious disease was noticed in the literature in 3-5% of patients,

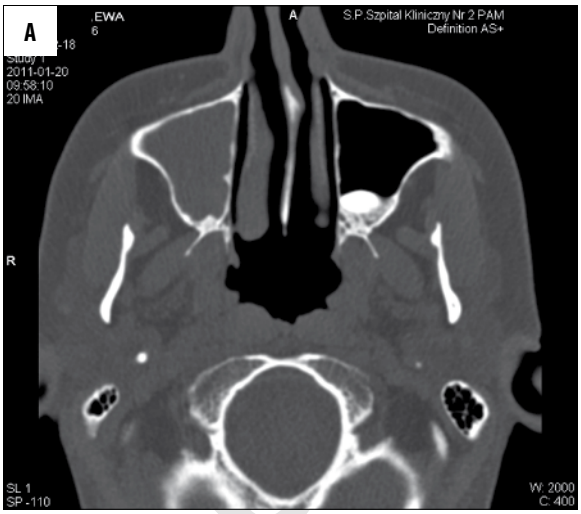


**Figure 8A.** Axial CT scan. Maxillary molar root in the left sinus, opacification without fluid level of the right maxillary sinus.

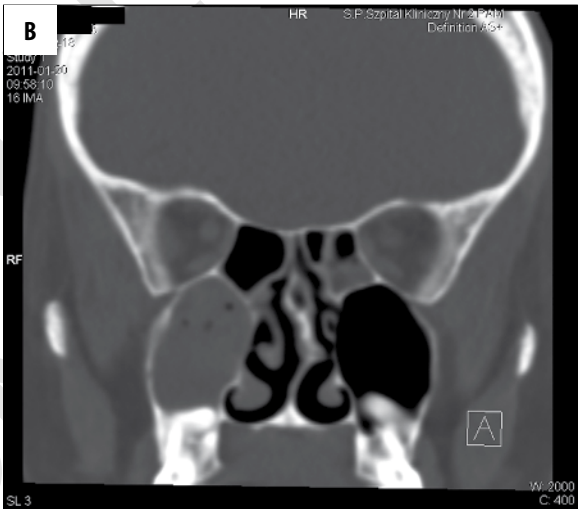


**Figure 8B.** Frontal CT scan of the same patient. Left ethmoidal cells are partially changed.

including allergic pathogenicity (ocular adnexal diseases). Some dental damages associated with cellulitis, such as: radicular focal infections, periodontitis under prosthetic works, caries, dental chronic maxillary osteitis were mentioned [14,15]. The most likely source of this phenomenon was hematologic transport following a dental procedure [16].

Periodontal changes are also known to be the foci of decreased immunity and the cause of orbital infections via blood. The bacterial flora found in the periapical or periodontal region could be the same as the one in the pus collection in the sinuses or orbit [17].

Cellulitis does not require drainage of the orbit on a routine basis. Antibiotics are an effective adjunctive treatment in the therapy of relatively mild odontogenic orofacial infections, and especially in the treatment of acute infraorbital space infection [18,19].

Topographic anatomy of this region promotes spreading of pathological changes from teeth to maxillary sinus (MS)

and orbit. It is therefore necessary to examine, diagnose and treat the pathology of teeth and maxillary sinusitis at the same time, as ophthalmological disorders [20].

Maxillary sinusitis combined with a fistula into the maxillary sinus after extraction of teeth as well as implantological complications occur often enough.

Toothache and other clinical symptoms like unilateral nasal obstruction, nasal discharge, frontal headache were not mentioned by our patients during the first ophthalmological examination. They could have orbital features but they were recognized only after a detailed radiological anamnesis.

Orbital trauma was not mentioned as the cause of visit. An abrupt discomfort of the eyeball and infraorbital soft-tissue swelling were the factors that determined the patients' visits.

Chronic inflammatory processes of the periapical regions are in many cases asymptomatic. They may be discovered incidentally during intraoral X-rays or pantomography. Images can present osteolysis of various size and intensity; less frequent is a pathological condensation of the bone structure. Even an appropriate treatment of those osteolytic changes does not guarantee proper regeneration of the bone structure. Low-induction magnetic fields may accelerate bone regeneration due to the influence of the ion cyclone resonance on the cells in two sources: magnetomechanical and electrodynamic. This results in a higher cell membrane transmission and a better influence on the electroosmotic processes of the cells [21,22]. Such an additional method of treatment has been used for many years in our dental practice.

Orbits, paranasal sinuses as well as jaw bones were examined radiographically. The value of radiological diagnostics is well known – it is indispensable. Pantomography is the first-choice method in assessing dental status, radiolucency of the sinuses and nasal cavity as well as contrasting foreign bodies. Intraoral X-rays are necessary in the endodontic treatment and to follow up such a treatment. Also, the repairing processes in the periapical regions are better visible in such images [22].

CT must be performed for diagnosing maxillary sinuses and orbital changes in complicated cases. The value of CT in axial, sagittal and coronal planes was mentioned by many authors [1–10,14–23]. Less frequent is the mentioned use of Doppler ultrasound examinations in cellulitis of dental origin. Ultrasound examinations, being the method of choice in ophthalmological disorders, were helpful in quick, safe and repeatable diagnostics of the eyeball. Preseptal cellulitis has no specific US symptoms. Sometimes in the postseptal region, the orbital muscles and the posterior sclera could be thickened. However, no such case was recognized in our study. The blood flow in orbital vessels in all our cellulitis cases was normal. Quick diagnostics and treatment could have had an influence on this situation.

We made a diagnosis of orbital cellulitis on the basis of clinical, radiographic and ultrasound findings. In our material, there was no evidence of fluid collection or abscess either.

Radiologists examining patients with orbital diseases should always remember about the possibility of dental origin of changes. In many cases, like in our material, the patients did not expect orbital complications in connection with dental problems. They were very surprised when the radiologist asked them about dental problems and went through dental procedures. If it is possible, pantomography should be suggested to the clinician in such cases at the beginning of the diagnostic process. We therefore believe that education of patients during their visits at a dentist or ophthalmologist could play an important role in prophylaxis of orbital and dental diseases.

## Conclusions

1. Diagnostics of orbital cellulitis should include evaluation of the dental status as well as maxillary sinus disorders.
2. Radiographic and ultrasound examinations play a very important role in the diagnostics of cellulitis.
3. Co-operation between the ophthalmologist, radiologist and dentists is necessary during treatment of orbital diseases.
4. Periodontal, as well as surgical therapy should be included as an additional element of ophthalmological treatment.
5. Education of patients is also very important for prophylaxis of eye diseases of dental origin.

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