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RESEARCH ARTICLES

# When should we perform surgery in orbital complication due to rhinosinusitis?

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## ABSTRACT

**Objective:** In our study, we aimed to find out which factors the treatment method depends on in orbital complications and to shape the treatment scheme according to these factors.

**Material and Methods:** Patients who were treated and followed up for orbital complications of rhinosinusitis in the Karadeniz Technical University Faculty of Medicine, Department of Otorhinolaryngology, between 2007 and 2018 were retrospectively analyzed. A total of 64 patients were included in the study. Abscess volume and proptosis values of the patients with subperiosteal and orbital abscesses were calculated. The operative approach was recorded in patients treated surgically.

**Results:** It was determined that 48.4% of the patients were children and 51.6% were adults. The mean age was calculated as 26.3±20.5 years. Of these, 25% of the patients were female and 75% were male. Abscess was detected in 10 patients (15.6%). Subperiosteal abscesses were detected in 3 patients and orbital abscesses in 7 patients. The patients were classified as those with preseptal and orbital cellulitis (Group I), and those with subperiosteal abscess (SPA) and orbital abscess (Group II). Proptosis, restricted eye movements and fever were found to be significantly higher in Group II ($p<0.05$). The mean abscess volume of the patients in Group II was found to be 3210±1614 $mm^3$, and the mean value of proptosis was found to be 4.24±1.7 mm. Surgery was performed on 24 patients. The mean abscess volumes in the surgical group and the non-surgical group were found to be 3800 $mm^3$ and 850 $mm^3$, respectively (p=0.034). The mean proptosis values in the surgical group and the non-surgical group were 4.91 mm and 1.55 mm, respectively (p=0,036).

**Conclusion:** Whether patients presenting with orbital complications should be treated conservatively or surgically remains a topic of debate in the current literature. In this discussion, it is important to predict which patients will progress to a subperiosteal or an orbital abscess. In our study, we found that proptosis, limited eye movements, and high fever (>37.5 °C) were associated with abscess development, and abscess volume and proptosis value were also important in terms of surgical necessity.

**Keywords:** orbital complication, sinusitis

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## INTRODUCTION

Rhinosinusitis can be defined as an inflammatory response that occurs in the mucosa lining the nasal cavity and paranasal sinuses, and/or in the underlying bone (1). Although the use of antibiotics has reduced the prevalence of sinus infections and their complications, acute rhinosinusitis is still the leading cause of orbital inflammation and visual impairment. Although it can occur at any age, it is more common in children since upper respiratory system infections are more common at these ages and easily spread to the nose and sinuses. In addition, with the continuous development of treatment regimens, the number of patients living with suppressed immunity such as those with diabetes, kidney failure, organ transplants, or those receiving chemotherapy or radiotherapy is gradually increasing. These patients, in addition to being susceptible to other opportunistic infections, are at risk of developing sinusitis and its complications that will rapidly develop.

Therefore, medical treatment and surgical interventions for orbital complications of rhinosinusitis have gained importance. Our study aims to more effective intervention strategies for these complications through retrospective examination.

## MATERIAL AND METHOD

After obtaining ethics committee approval, patients who were treated and followed up due to orbital complications of rhinosinusitis between 2007 and 2018 in the Karadeniz Technical University Faculty of Medicine, Department of Otorhinolaryngology, were retrospectively analyzed. A total of 770 patients with acute (J01.9) and chronic (J32.9) sinusitis diagnoses of ICD were analyzed, and 64 patients with the orbital complications of rhinosinusitis were included in the study. Since the patients in our study underwent intervention for complications, there were no exclusion criteria.

Demographic, clinical, radiological, and microbiological data were collected for each patient. The medical comorbidities, vital values at the time of admission, laboratory values, and medical and surgical treatment characteristics of the patients were examined. The operations were performed by the same surgical team with nearly 20 years of experience. The characteristics and duration of the antibiotherapy administered to the patients were evaluated.

Abscess volume and proptosis values were calculated by examining pre-operation scans of patients with subperiosteal and orbital abscesses. Proptosis values were evaluated by measuring the distance between the interzygomatic line and the anterior corneal edge at the midglob level in the axial computed tomography (CT) section (Figure 1). Abscess volumes were calculated using the GE Advantage Workstation (GE Healthcare Dharmacon, Chicago, Illinois, USA) software program. The abscess circumference of all patients was drawn manually by the same radiologist. The abscess volumes were calculated using the GE Advantage Workstation measurement tools. The surgical approach was recorded for all patients treated surgically.

### Statistical analysis

SPSS (Statistical Package for the Social Science) 23.0 was used for statistical analyses. Descriptive statistics for categorical variables are presented as numbers and percentages. Mean, standard deviation, minimum and maximum values are reported for numerical variables. The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to test the distribution normality. The Mann-Whitney U Test was used to compare the numerical variables non-normally distributed. The Fisher's Exact Test was used to compare categorical variables. A p-value of $<0.05$ was considered statistically significant in all analyses.

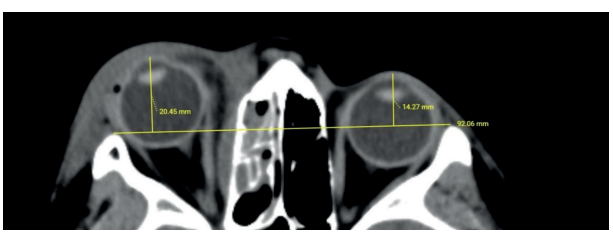


**Figure 1.** Proptosis measurement of the 13-year-old male patient in Figure 3.

## RESULTS

The demographic information and medical history of the patients participating in the study are shown in Table 1. It was found that 31 patients (48.4%) were children (<18 years old), and 33 (51.6%) were adults. The mean age of all patients was 26.3±20.5 (2-90) years. The mean age of children was 9.84 years (2-17). In adults, the mean age was 41.7 (20-90). Of the total, 16 patients (25%) were females and 48 (75%) were male. It was observed that 89.1% of the patients had a history of sinusitis, 9.4% had a history of previous functional endoscopic sinus surgery (FESS), 4.7% had a history of diabetes mellitus, 14.1% had a history of dental infection, 1.6% had a history of maxillofacial trauma, and 1.6% had immunosuppression.

The comparison of the medical histories between the pediatric and adult patients participating in the study is shown in Table 2. Histories of sinusitis, FESS, diabetes mellitus, dental infection, trauma, and immunosuppression were found to be more common in adults. Of these, only FESS history was found to be significantly higher in adults compared to children (p <0.05).

The clinical complaints and examination findings of the patients participating in the study are shown in Table 3. Periorbital pain was observed in 73.4% of the patients, periorbital edema in 96.9%, periorbital erythema in 68.8%, proptosis in 12,5%, and limited eye movements in 4.7%. It was determined that 43.8% of the patients had a history of antibiotic use. The mean body temperature of the patients at admission was 36.8±0.8 °C, the mean C-reactive protein (CRP) level was 7.16 mg/L, and leukocytosis was observed in 67.2% of the patients.

**Table 1.** The demographical information and medical histories of the patients participating in the study.

| | |
|---|---|
| **Age** | |
| Mean overall age(years) | 26,3±20,5 |
| Mean child age(years) | 9,84 |
| Mean adult age(years) | 41,7 |
| Range of ages(years) | 2-90 |
| Child(n) | 31(%48.4) |
| Adult(n) | 33(%51.6) |
| **Sex** | |
| Male | 48(%75) |
| Female | 16(%25) |
| **Medical History** | |
| Sinusitis | 57(%89,1) |
| Prior FESS | 6(%9,4) |
| Diabetes mellitus | 3(%4,7) |
| Dental infection | 9(%14,1) |
| Trauma | 1(%1,6) |
| Immunosuppression | 1(%1,6) |

FESS: functional endoscopic sinus surgery.

**Table 2.** Comparison of medical histories of pediatric and adult patients participating in the study.

| Medical History | Child | Adult | P |
|---|---|---|---|
| Sinusitis | 29(%93,5) | 28(%84.8) | 0,428 |
| Prior FESS | 0(%0,0) | 6(%18,2) | 0,025 |
| Diabetes mellitus | 0(%0,0) | 3(%9,1) | 0,239 |
| Dental infection | 4(%12,9) | 5(%15,2) | 0,100 |
| Trauma | 0(%0,0) | 1(%3) | 0,100 |
| Immunosuppression | 0(%0,0) | 1(%3) | 0,100 |

FESS: functional endoscopic sinus surgery.

**Table 3.** Findings and laboratory values of the patients participating in the study.

| Complaints and Findings | |
|---|---|
| Periorbital pain | 47(%73,4) |
| Periorbital edema | 62(%96,9) |
| Periorbital erythema | 44(%68,8) |
| Proptosis | 8(%12,5) |
| Limited eye movement | 3(%4,7) |
| Body temperature(mean)( °C) | 36,8±0,8 |
| Leukocytosis ($10^3$/ µL) | 43(%67,2) |
| CRP(mean) (mg/L) | 7,1663 |
| Prior antibiotic use | 28(%43,8) |

CRP: C Reactive Protein.

The presence of abscess based on the CT features of the patients participating in the study is shown in Table 4. An abscess was detected in 10 patients (15.6%), of whom 3 had subperiosteal abscesses and 7 had orbital abscesses. In 3 patients with subperiosteal abscess, the abscesses were found to be medial to the orbit. Among the orbital abscesses, 4 were located superiorly, 1 inferiorly, 1 laterally, and 1 superolaterally.

The treatment regimens administered to the patients participating in the study are shown in Table 5. 1.6% of the patients were treated with amoxicillin/clavulanic acid, 32.8% with ceftriaxone, 65.6% with ampicillin/sulbactam, 79.7% with clindamycin, 1.6% were given meropenem, 1.6% were given posacanosal, and 1.6% were given amphotericin B. The duration of antibiotherapy and hospitalization of the patients participating in the study is shown in Table 6. Accordingly, the mean duration of antibiotherapy and hospitalization were 13.4±2.8 (7-21) days and 9.1±4.6 (1-23) days, respectively.

**Table 4.** Presence and localization of abscesses according to CT features of the patients participating in the study.

| **ABSCESS** | |
|---|---|
| **Presence of abscess** | 10(%15,6) |
| **Localization of abscesses** | |
| medial | 3(%4,7) |
| superior | 5(%7,8) |
| lateral | 1(%1,6) |
| inferior | 1(%1,6) |

**Table 5.** Treatment regimens applied to patients participating in the study.

| **Treatment regimens** | |
|---|---|
| Amoxicillin/clavulanic acid | 1(%1,6) |
| Ceftriaxone | 21(%32,8) |
| Ampicillin/sulbactam | 42(%65,6) |
| Clindamycin | 51(%79,7) |
| Meropenem | 1(%1,6) |
| Posacanosal | 1(%1,6) |
| Amphotericin B | 1(%1,6) |

The number of surgical procedures performed on the patients participating in the study is shown in Table 7. Surgery was performed on 24 (37.5%) patients. Of these, 14 patients underwent an endonasal approach only, 9 underwent combined endonasal and external approaches, and 1 patient was treated with an external approach alone.

Patients participating in the study were classified according to Chandler's classification (2), and those with preseptal and orbital cellulitis were named Group I and those with subperiosteal abscess (SPA) and those with orbital abscess were named Group II. Group I and Group II were compared according to age, sex, medical history, complaints and findings, and laboratory results (Table 8). Proptosis, limited eye movements, and fever were found to be significantly higher in Group II ($p < 0.05$) than in Group I.

When the priorly antibiotic use, duration of antibiotherapy, hospitalization period, and type of surgery performed on both groups were compared (Table 9), it was found that the duration of antibiotic therapy and hospitalization were significantly longer in the abscess group ($p<0.05$). Among the surgical interventions, it was seen that the external approach was performed significantly more in the abscess group ($p < 0.05$).

The abscess volumes, proptosis measurements and type of surgery performed in patients with subperiosteal or orbital abscess are demonstrated in Table 10. The mean abscess volume and the mean proptosis value were found to be 3210±1614 $mm^3$, and

**Table 6.** Duration of antibiotherapy and hospitalization of the patients participating in the study.

| Duration of antibiotics (day) | 13,4±2,8 (7-21) |
|---|---|
| Duration of hospitalization (day) | 9,1±4,6 (1-23) |

**Table 7.** Surgical procedures performed on patients participating in the study.

| **Surgery type** | **n** | **%** |
|---|---|---|
| endonasal | 14 | 58,33 |
| external | 1 | 4,16 |
| combined | 9 | 37,5 |

**Table 8.** Comparison of preseptal-orbital cellulitis and subperiosteal-orbital abscess group

| **Age** | **Grup I** | **Grup II** | **P** |
|---|---|---|---|
| Mean overall age (years) | 27,6±21,3 | 19,2±14,3 | 0,300 |
| **Sex** | | | |
| Male(%) | 85,4 | 14,6 | 0,701 |
| Female(%) | 81,3 | 18,8 | |
| **Medical history** | | | |
| Sinusitis | 82,5 | 17,5 | 0,584 |
| Prior FESS | 66,7 | 33,3 | 0,234 |
| Diabetes mellitus | 100 | 0 | 0,1 |
| Dental infection | 100 | 0 | 0,333 |
| Trauma | 100 | 0 | 0,1 |
| Immunosuppression | 100 | 0 | 0,1 |
| **Complaints and Findings** | | | |
| Periorbital pain | 83,0 | 17,0 | 0,1 |
| Periorbital edema | 85,5 | 14,5 | 0,290 |
| Periorbital erythema | 79,5 | 20,5 | 0,152 |
| Proptosis | 0 | 100 | 0,000 |
| Limited eye movement | 0 | 100 | 0,003 |
| Body temperature(mean)( °C) | 36,7±0,7 | 37,5±0,9 | 0,007 |
| Leukocytosis ($10^3$/ µL) | 79,1 | 20,9 | 0,146 |
| CRP(mean) (mg/L) | 6,6±7,7 | 10,4±6,6 | 0,053 |

FESS: functional endoscopic sinus surgery; CRP: C Reactive Protein.

4.24±1.7 mm, respectively. The mean abscess volume was significantly greater in the surgical group than in the non-surgical group (3800 $mm^3$ versus 850 $mm^3$, P=0.034). The mean proptosis value was significantly greater in the surgical group than in the non-surgical group (4.91 mm versus 1.55 mm, P=0.036). The mean percentage of orbital volume occupied by the abscess was also greater in the surgical group than in the non-surgical group (%38.025 versus %9.8, P=0.036) (Table 11).

## DISCUSSION

Acute rhinosinusitis is a self-limiting illness with medical treatment. In adults, acute bacterial rhinosinusitis is diagnosed when the sudden onset of nasal congestion or nasal flow is accompanied by facial pain/pressure sensation or a decreased/loss of smell. In children, acute bacterial rhinosinusitis is diagnosed based on the presence of two symptoms: nasal congestion and nasal flow or cough (day or night) lasting less than 1 week. It can often be cured completely with early diagnosis and treatment.

Sinusitis is the primary cause of orbital complications with a rate of 74-85% of the cases. Complications in children mostly occur due to ethmoid sinusitis. Defects in the lamina papyracea are the primary cause of the spread of paranasal sinus infection. Apart from sinusitis, orbital complications may also develop due to local skin trauma, penetrating injuries, and surgical interventions. Delay in diagnosis and treatment may lead to complications such as visual impairment or brain abscess. Even today, the incidence of visual

**Table 9.** Comparison of preseptal-orbital cellulitis and subperiosteal-orbital abscess groups in terms of duration of antibiotherapy duration, length of stay and the type of surgery performed.

| | Grup I | Grup II | P |
|---|---|---|---|
| Prior antibiotic use (%) | 38,9 | 70 | 0,090 |
| Duration of antibiotics(day) | 13,1±2,7 | 15,3±2,8 | 0,029 |
| Duration of hospitalization(day) | 8,5±4,4 | 11,8±5,1 | 0,033 |
| Surgery (%) | | | |
| endonasal | 29,6 | 60 | 0,080 |
| external | 7,4 | 60 | 0,000 |

**Table 10.** Abscess volumes and proptosis measurements of patients with subperiosteal or orbital abscess, and the surgery type performed.

| Patient no | Abscess volumes ($mm^3$) | Proptosis (mm) | Surgery type |
|---|---|---|---|
| 1 | 5900 | 3.9 | combined |
| 2 | 4500 | 3.5 | combined |
| 3 | 4000 | 6.1 | combined |
| 4 | 900 | 1.6 | None |
| 5 | 2000 | 6.1 | combined |
| 6 | 800 | 1.5 | None |
| 7 | 4000 | 5,3 | combined |
| 8 | 3000 | 4 | combined |
| 9 | 4000 | 6,2 | combined |
| 10 | 3000 | 4,2 | external only |
| Mean | 3210 | 4,24 | |

**Table 11.** Comparison of mean abscess volume, mean proptosis values of surgical and non-surgical patients with subperiosteal or orbital abscess.

| | Surgical | Non-surgical | P |
|---|---|---|---|
| Mean abscess volume ($mm^3$) | 3800 | 850 | 0,034 |
| Mean proptosis values (mm) | 4.91 | 1.55 | 0,036 |
| Mean abscess volume (%) | 38.025 | 9.8 | 0,036 |

impairment is reported to be 3-11%, while mortality rates range between 1-2.5% (3,4). Because of these complications, a multidisciplinary approach including otolaryngologists, ophthalmologists and pediatricians should be applied.

Chandler's classification (2) of orbital complications has been widely accepted because it provides a clinical summary of secondary orbital inflammations. According to Chandler, the first stage is preseptal cellulitis with inflammatory edema. At this stage, deterioration of visual acuity is not observed, but edema of the eyelid is present. The second stage is orbital cellulitis, resulting from inflammatory infiltration of the orbital adipose tissue. The third stage is subperiosteal abscess. It is characterized by the accumulation of pus between the periorbita and the bony wall and originates mostly from the ethmoid or

frontal sinus (5). The fourth stage is orbital abscess. It is characterized by the pus accumulation in the orbital tissues after cellulite. Exophthalmos, chemosis, and ophthalmoplegia are observed. The fifth stage is cavernous sinus thrombosis resulting from the further progression of ethmoid or orbital phlebitis. In this stage, exophthalmos, chemosis, ophthalmoplegia, and visual impairment occur in the opposite eye of the toxic-looking patient who had complaints in one eye previously. This situation is explained by the transmission of the infection to the opposite side through the intercavernous sinus. The mortality rate in cavernous sinus thrombosis is 50-80%.

Erickson et al. (6) found that the age distribution of patients with orbital cellulitis and subperiosteal abscess did not differ significantly between adults and children. According to the study of Gavriel et al. (7) found no significant relationship between age and the presence of superior subperiosteal abscess for children and adults. In alignment with these studies, 31 of 64 patients participated in our study treated for orbital complications were children, and 33 were adults. The patients were between the ages of 2-90 (26.3±20.5). When the literature was reviewed, limited data were found regarding the management of orbital complications in adults. In our study, adult patients were more likely to present with predisposing factors such as sinusitis, a history of previous sinus surgery, diabetes mellitus, dental infection, trauma, and immunosuppression, which may lead to orbital complications, similar to the findings of the study by Erickson et al. (6). However, among these predisposing factors, only a history of previous sinus surgery was showed a statistically significant difference between children and adults ($p<0.05$).

Orbital infections secondary to sinusitis have been reported as preseptal cellulitis at a rate of 85-95%, and as postseptal infections at a rate of 5-15% (8). In the study by Kinis et al., subperiosteal abscesses were found in 11 patients (42.3%), preseptal cellulitis in 13 patients (50%), and orbital cellulitis in 2 patients (7.7%) (9). In our study, preseptal cellulitis was found in 48 (75%) patients, orbital cellulitis in 6 (9.4%) patients, subperiosteal abscess in 3 (4.7%) patients, and orbital abscess in 7 (10.9%) patients.

Coronal and axial paranasal CT scans, supported by cranial CT in determining the treatment method, play a key role in the localization of sinusitis, differentiation of preseptal and postseptal involvement, as well as the decision of emergency surgery. The need for a CT scan remains controversial, however, there is consensus that CT is necessary in cases with diplopia, limited visual acuity, proptosis, impaired visual acuity, and postseptal orbital complications on a visual examination performed at the time of admission. CT is especially harmful to children, as it causes radiation exposure. In addition, it may be insufficient in the evaluation of small abscesses and may give false positive or false negative results for SPA. In our study, 58 patients underwent CT evaluation.

A subperiosteal abscess is defined as a collection of pus between the orbital wall (most commonly the cortex) and the orbital periosteum. It usually develops secondary to acute ethmoiditis. It can cause proptosis, chemosis, and limited eye movement. Although SPAs are most commonly located medially, they may also occur in superior or superomedial locations. In their study, Kinis et al. (9) found 5 medial, 5 superomedial, and 1 inferolateral subperiosteal abscesses. In our study, we found all 3 of the subperiosteal abscesses were medially located. In our study, superior orbital abscesses were observed in 4 patients. And inferior orbital abscesses were observed in 1 patient. A lateral orbital abscess was observed in 1 patient. A superolateral orbital abscess was observed in 1 patient.

The ideal treatment for sinusitis with orbital complications is controversial, however, the current consensus suggests that patients with preseptal cellulitis should receive parenteral antibiotherapy immediately after the initial examination. The most common pathogenic agents in sinusitis are Haemophilus influenzae, Streptococcus pneumoniae, Moraxella catarhalis, Staphylococcus aureus, and Streptococcus pyogenes (2). Therefore, ampicillin-sulbactam or ceftriaxone-metronidazole combination treatments are recommended for preseptal and orbital cellulitis (10). In our study, ampicillin/sulbactam-clindamycin combination was administered to 36 patients, and ceftriaxone-clindamycin combination was administered to 13 patients. All patients in the cellulite group recovered with antibiotherapy. The

mean duration of antibiotherapy for the patients in the cellulitis group and in the abscess group was 13.1 days and 15.3 days, respectively, and it was found that antibiotherapy was statistically longer in the abscess group ($p<0.005$).

Some studies have investigated which symptoms and signs predict abscess development and when surgery should be performed. Gavriel et al. (11) reported a strong relationship between limited eye movements and proptosis, and abscess formation. Erickson et al. (6) also found a significant correlation between limited eye movements and abscess formation. According to Oxford et al., surgery should be performed in the presence of limited eye movements in one or more gaze directions, intraocular pressure of 20 mm or more, proptosis of 5 mm or more, and an abscess collection of 4 mm or more on CT (12). In the study of Ryan et al., it was found that the patients who underwent surgery were older (8.3 vs. 6.2), had abscesses larger than 10 mm, required longer hospitalization (10.2 vs. 6.6 days), and had higher body temperature values at admission (38.0°C vs. 37.3°C) (13). In our study, proptosis, limited eye movements, and fever were found to be significantly higher in the abscess group ($p<0.05$). According to the study of Soon et al. (14), there is a significant relationship between the leukocyte count in the complete blood count of the patients and the development of an abscess; however, no significant relationship was found in our study ($p>0.05$).

According to the study of Tabarino et al., the larger the abscess volume, the greater the need for surgery (15). Tabarino et al. argued that surgery is necessary in 100% of cases with abscesses larger than 500 $mm^3$ or 5% of the orbital volume, while Ryan et al. (13) argued that surgery should be performed in patients with an abscess larger than 1 cm in diameter. Likewise, Rahbar et al. (16) and Todman et al. (17) argued that abscess volume is important in terms of surgical necessity. According to Rahbar et al. (16), the mean abscess volume of the surgical group was 1452 $mm^3$, while the abscess volume of the non-surgical group was 600 $mm^3$. According to Todman et al. (17), the mean abscess volume of the surgical group was 3446.3 $mm^3$, while the abscess volume of the non-surgical group was 420.5 $mm^3$. Todman et al. found that the threshold value for surgery was 1250 $mm^3$.

In our study, we found the mean volume of the abscess was significantly greater in the surgical group than in the non-surgical group (3800 $mm^3$ versus 850 $mm^3$, $P=0.034$). Similarly, the mean percentage of the of the orbital volume occupied by the abscess was also greater in the surgical group than in the non-surgical group (38.025% versus 9.8%, $P=0.036$). We believe that the larger abscess volumes reported in both Todman et al. (17) and our study may be attributable to differences in the calculation methods or formulas used. According to Tabarino et al. (15), proptosis measurement is also an important surgical indicator in patients with orbital complications: proptosis greater than 4 mm increases the likelihood of requiring surgery, while proptosis less than 2 mm suggests a lower likelihood. According to Oxford and McClay (12), the threshold value for proptosis is <5 mm for medical treatment. In our study, we found the mean proptosis value was significantly greater in the surgical group than in the non-surgical group (4.91 mm versus 1.55 mm, $p=0.036$).

Whether a subperiosteal abscess should be treated conservatively or surgically is still a matter of debate in the current literature. In the study of Eviatar et al., all 48 patients younger than 2 years of age who were diagnosed with preseptal cellulitis showed improvement with antibiotherapy (18). However, in the study of Harris et al., it was reported that surgery should be performed even if the patients presented with cellulitis to prevent orbital and intracranial complications in children over 9 years (19). Advocates of the conservative method argued that the orbital periosteum, which is a flexible barrier, contributes to the localization and resolution of the abscess (20). Harris et al., on the other hand, argued that surgery should be performed after abscess formation (19). Though we agree that conservative treatment may be appropriate for patients without visual impairment, provided that they are closely monitored by an ophthalmologist, and we also emphasize that surgical drainage is warranted at the slightest suspicion of vision or worsening clinical presentation. Therefore, in our study, surgical drainage was performed early in one patient with a subperiosteal abscess (Figure 2a–d) and seven patients with orbital abscesses, due to the following reasons: patients were referred from other healthcare institutions after initiating antibiotic therapy, radiological persistence of abscesses despite

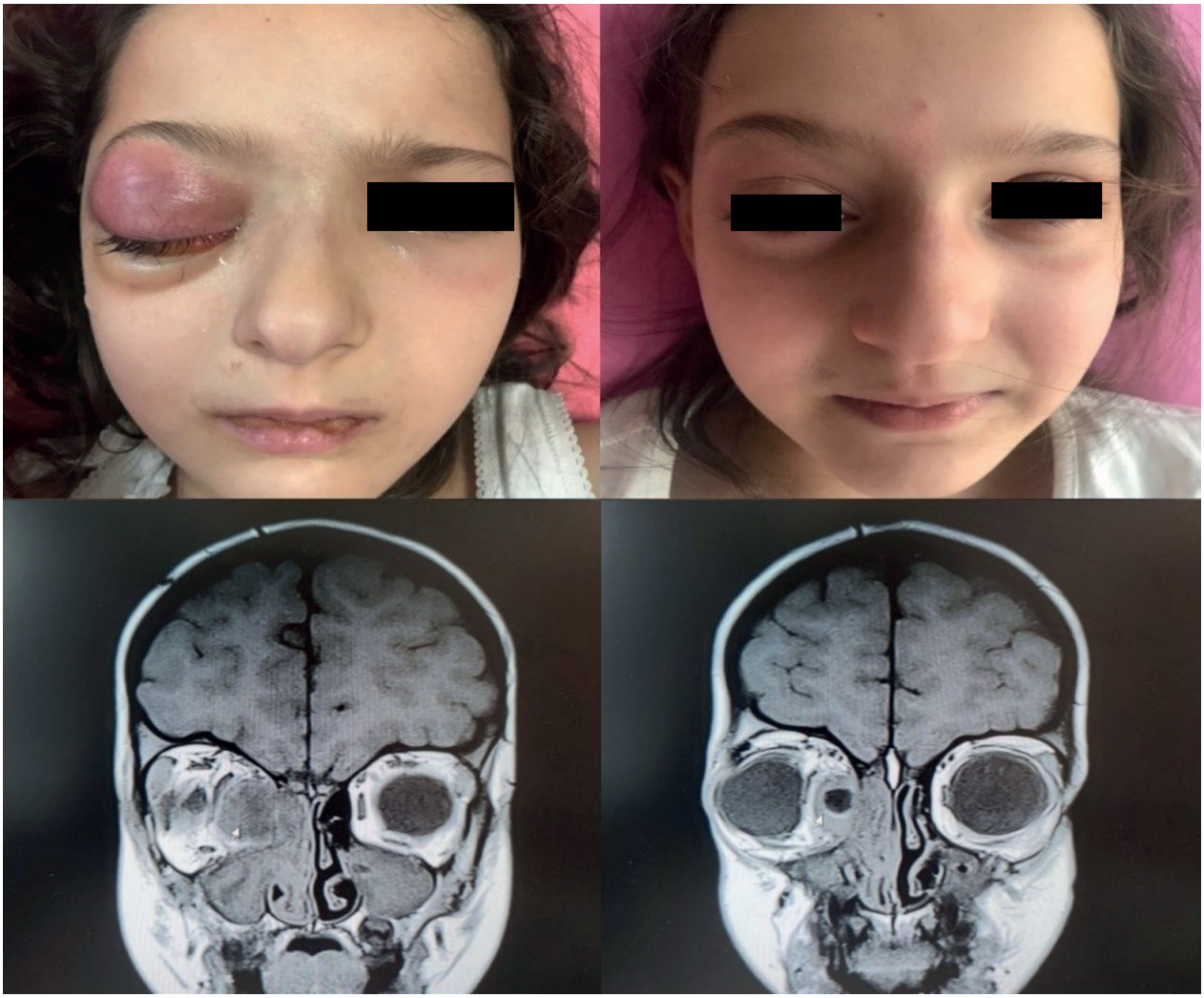

**Figure 2. a:** 10-year-old female patient, clinical status at admission, exophthalmos, chemosis, ophthalmoplegia are present; **b:** Clinical status on the 10th postoperative day; **c and d:** Orbital MRI at the time of admission: In the right retroorbital area, there is a hyperintense collection in the T1A of the abscess with the size of 15x19x35 mm, which is located extraconally, adjacent to the medial rectus muscle, and contains an air-fluid level.

broad-spectrum antibiotics, and presence of ocular findings at presentation. A combined approach was applied to 6 patients with orbital abscesses. External approach was applied to 1 patient with an orbital abscess. The other 2 patients with subperiosteal abscesses were followed up and treated with antibiotherapy (Figure 3a-d) (Figure 4a-d). Elective endoscopic sinus surgery was performed in 13 patients due to sinusitis findings after the recovery of the orbital complication in the acute period. Three patients were treated by including the external approach with the endoscopic approach due to the presence of frontal osteoma after the recovery from orbital complication in the acute period. As there were only 3 cases of subperiosteal abscess in our series, it is difficult to decide whether medical treatment is truly effective.

The method of surgical drainage depends on the location of the abscess. Although external ethmoidectomy was preferred in the past, nowadays, endoscopic sinus surgery is the standard and immediate approach. Endoscopic sinus surgery is a safe method in the treatment of both subperiosteal and orbital abscesses. In addition to abscess drainage, endoscopic

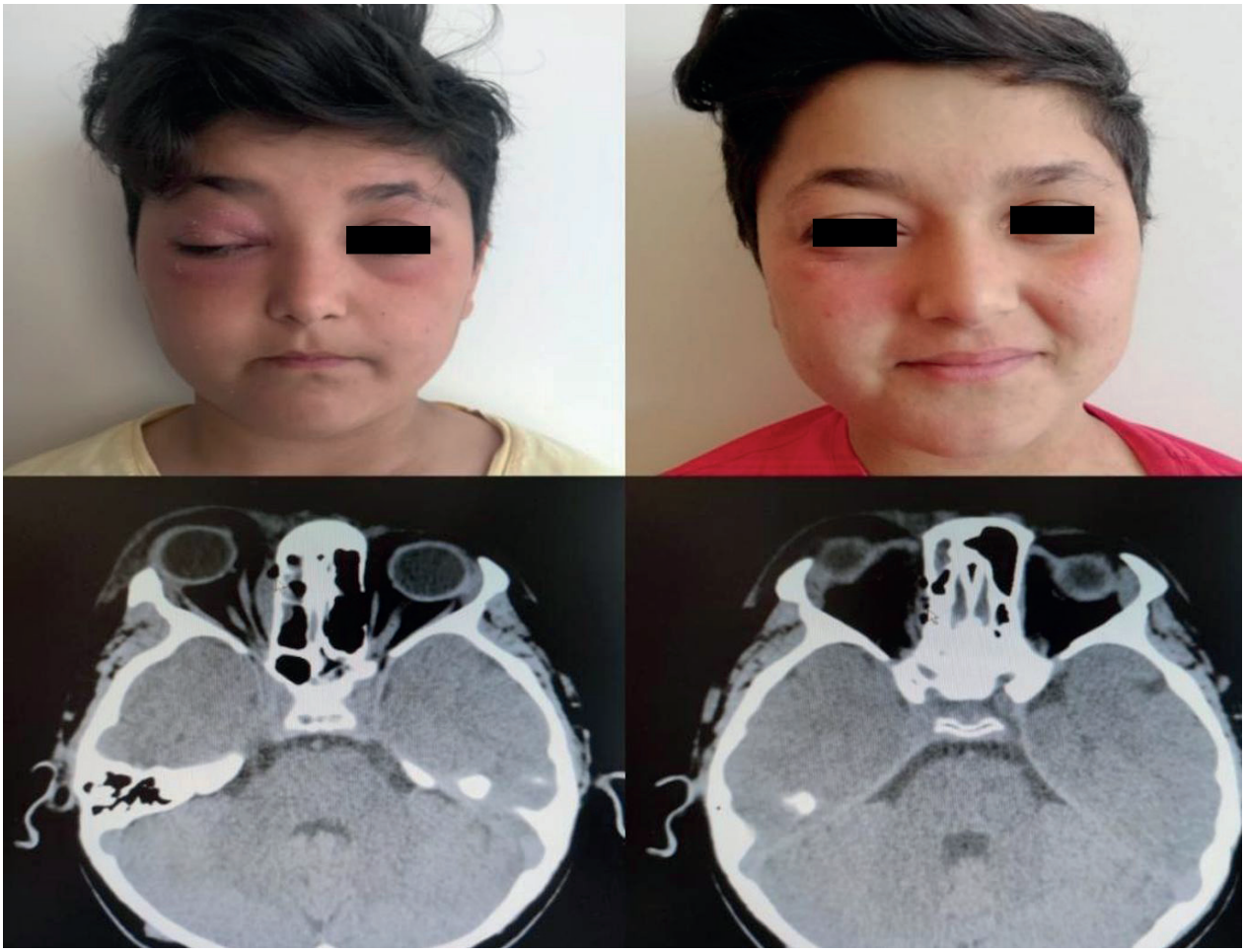

**Figure 3. a:** The clinical status of a 13-year-old male patient at the time of admission, periorbital edema and periorbital ecchymosis are present, ophthalmoplegia is not; **b:** Clinical status after 8 days of treatment; **c and d:** Orbital CT at the time of admission: Subperiosteal abscess with air values monitored within 25x5mm in the medial part of the right retrobulbar area, adjacent to the bone.

methods prevent facial scarring and reduces hospital stay duration.

The main problem encountered in endoscopy is mucosal hypertrophy, which can increase intraoperative bleeding mucosal hypertrophy, which can increase intraoperative bleeding and complicates the surgery. Therefore, it should be performed by experienced surgeons. The surgeries in our study were performed by the surgical team working in the same center for more than 20 years.

Many studies report that the use of endoscopic sinus surgery alone is suitable for medial abscesses, while a combined approach or external approach should be used in superomedial abscesses (21). Since it is difficult to approach superiorly located abscesses endoscopically, diseased sinuses should be treated endoscopically in addition to an external approach over the upper orbital rim (Figure 5 a-b). Of the 24 surgical interventions we performed in our study, 14 were endoscopic approaches, 9 were combined approaches, and only 1 was an external approach. After the surgeries, the patients recovered without any problems.

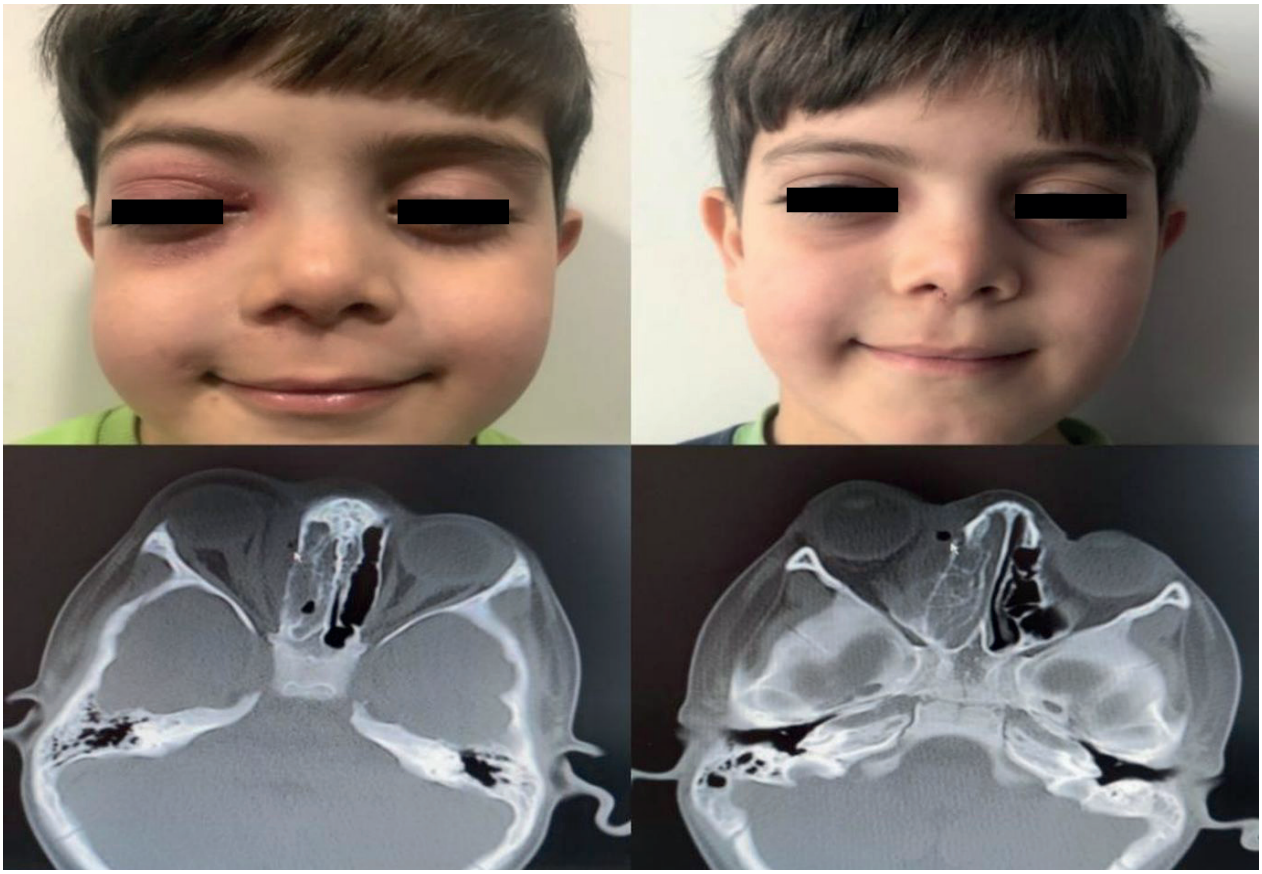

**Figure 4. a:** The clinical status of an 8-year-old male patient at the time of admission, periorbital edema and periorbital ecchymosis are present, ophthalmoplegia is not; **b:** Clinical status after 6 days of treatment; **c and d:** Orbital CT at the time of admission: Subperiosteal abscess with air values observed within 15x5mm, in the medial part of the right retrobulbar region, adjacent to the bone.

In the study of Tanna et al., the mean hospital stay was found to be 2.9 days (22). It was reported as 5 days in the study of Oxford et al. (12). In our study, the mean hospitalization time was 8.5 days for patients in the cellulitis group and 11.8 days for patients in the abscess group. A statistically longer hospital stay was observed in the abscess group ($p<0.05$).

## CONCLUSION

In the treatment of orbital complications secondary to rhinosinusitis, early diagnosis and appropriate treatment are of vital importance. It is still a matter of debate whether patients presenting with orbital complications should be treated conservatively or surgically. In this discussion, it is important to predict which patients are at risk of progression to a subperiosteal or an orbital abscess. In our study, we found that proptosis, limited eye movements, and fever (>37.5°C) were associated with abscess development, and abscess volume and proptosis value were also important in terms of surgical necessity. We think that predicting the need for surgical treatment of the patient followed up may reduce morbidities, such as blindness, intracranial complications, and even mortality.

**Figure 5. a:** Clinical condition of a 9-year-old male patient at admission, exophthalmos, chemosis, and ophthalmoplegia are present; **b:** Clinical condition 7 days after the combined surgical approach for right superior orbital abscess.

Since rhinologists play a very important role in the surgical management of orbital complications, patients should initially be followed up by rhinologists and timely intervention should be made when necessary. However, a multidisciplinary approach should be followed by pediatrics, ophthalmology and radiology departments in terms of pediatric patient follow-up, eye findings, and imaging evaluation.

## Ethical approval

This study has been approved by the Ethics Committee of Karadeniz Technical University, Faculty of Medicine (Approval date: 24/09/2018, Protocol number: 2018/191). Written informed consent was obtained from the participants.

## Author contribution

Surgical and Medical Practices: OB, HTS, HBÇ; Concept: HTS; Design: HTS; Data Collection or Processing: HTS; Analysis or Interpretation: OB, HBÇ; Literature Search: HTS; Writing: HTS. All authors reviewed the results and approved the final version of the article.

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### Conflict of interest

The authors declare that there is no conflict of interest.

## REFERENCES

1. Lanza DC, Kennedy DW. Adult rhinosinusitis defined. Otolaryngol Head Neck Surg. 1997; 117(3): 1-7. [Crossref]
2. Chandler JR, Langenbrunner DJ, Stevens ER. The pathogenesis of orbital complications in acute sinusitis. Laryngoscope. 1970; 80(9): 1414-28. [Crossref]
3. Younis RT, Lazar RH, Bustillo A, Anand VK. Orbital infection as a complication of sinusitis: Are diagnostic and treatment trends changing? Ear Nose Throat J. 2002; 81(11): 771-5.
4. Sobol SE, Marchand J, Tewfik TL, Manoukian JJ, Schloss MD. Orbital complications of sinusitis in children. J Otolaryngol. 2002; 31(3): 131-6. [Crossref]
5. Manning SC. Endoscopic management of medial subperiosteal orbital abscess. Arch Otolaryngol Head Neck Surg. 1993; 119(7): 789-91. [Crossref]
6. Erickson BP, Lee WW. Orbital cellulitis and subperiosteal abscess: A 5-year outcomes analysis. Orbit. 2015; 34(3): 115-20. [Crossref]
7. Gavriel H, Jabrin B, Eviatar E. Management of superior subperiosteal orbital abscess. Eur Arch Otorhinolaryngol. 2016; 273(1): 145-50. [Crossref]
8. Smith TF, O'Day D, Wright PF. Clinical implications of preseptal (periorbital) cellulitis in childhood. Pediatrics. 1978; 62(6): 1006-9.
9. Kinis V, Ozbay M, Bakir S, et al. Management of orbital complications of sinusitis in pediatric patients. J Craniofac Surg. 2013; 24(5): 1706-10. [Crossref]
10. American Academy of Pediatrics. Subcommittee on management of sinusitis and committee on quality improvement. Clinical practice guideline: Management of sinusitis. Pediatrics. 2001; 108(3): 798-808. [Crossref]
11. Gavriel H, Yeheskeli E, Aviram E, Yehoshua L, Eviatar E. Dimension of subperiosteal orbital abscess as an indication for surgical management in children. Otolaryngol Head Neck Surg. 2011; 145(5): 823-7. [Crossref]
12. Oxford LE, McClay J. Medical and surgical management of subperiosteal orbital abscess secondary to acute sinusitis in children. Int J Pediatr Otorhinolaryngol. 2006; 70(11): 1853-61. [Crossref]
13. Ryan JT, Preciado DA, Bauman N, et al. Management of pediatric orbital cellulitis in patients with radiographic findings of subperiosteal abscess. Otolaryngol Head Neck Surg. 2009; 140(6): 907-11. [Crossref]
14. Soon VTE. Pediatric subperiosteal orbital abscess secondary to acute sinusitis: A 5-year review. Am J Otolaryngol. 2011; 32(1): 62-8. [Crossref]
15. Tabarino F, Elmaleh-Bergès M, Quesnel S, Lorrot M, Van Den Abbeele T, Teissier N. Subperiosteal orbital abscess: Volumetric criteria for surgical drainage. Int J Pediatr Otorhinolaryngol. 2015; 79(2): 131-5. [Crossref]
16. Rahbar R, Robson CD, Petersen RA, et al. Management of orbital subperiosteal abscess in children. Arch Otolaryngol Head Neck Surg. 2001; 127(3): 281-6. [Crossref]
17. Todman MS, Enzer YR. Medical management versus surgical intervention of pediatric orbital cellulitis: The importance of subperiosteal abscess volume as a new criterion. Ophthalmic Plast Reconstr Surg. 2011; 27(4): 255-9. [Crossref]
18. Eviatar E, Gavriel H, Pitaro K, Vaiman M, Goldman M, Kessler A. Conservative treatment in rhinosinusitis orbital complications in children aged 2 years and younger. Rhinology. 2008; 46(4): 334-7.
19. Harris GJ. Subperiosteal abscess of the orbit: older children and adults require aggressive treatment. Ophthalmic Plast Reconstr Surg. 2001; 17(6): 395-7. [Crossref]
20. Spires JR, Smith RJ. Bacterial infections of the orbital and periorbital soft-tissues in children. Laryngoscope. 1986; 96(7): 763-7. [Crossref]
21. Froehlich P, Pransky SM, Fontaine P, Stearns G, Morgon A. Minimal endoscopic approach to subperiosteal orbital abscess. Arch Otolaryngol Head Neck Surg. 1997; 123(3): 280-2. [Crossref]
22. Tanna N, Preciado DA, Clary MS, Choi SS. Surgical treatment of subperiosteal orbital abscess. Arch Otolaryngol Head Neck Surg. 2008; 134(7): 764-7. [Crossref]