Introduction

Functional endoscopic sinus surgery (FESS) has become the state of the art in the management of chronic rhinosinusitis with nasal polyps (CRSwNP) and chronic rhinosinusitis without nasal polyps (CRSsNP) in case of failure of comprehensive medical therapy [1]. Frontal recess clearance is considered the most difficult step in FESS. In fact, frontoethmoid cells are the key for safe and effective endoscopic frontal sinus (FS) surgery [2], and the supraorbital ethmoid cell (SOEC) by far is one of the most challenging frontoethmoid cells to be handled during FESS [3,4].

The frontoethmoid cells including the SOEC have been well investigated by many researchers all over the world, and accordingly different classification systems were proposed [2,5–8]. The SOEC has been also thoroughly studied by many rhinology teams in different continents including North America [2,9], South America [10], Europe [11–15], and Asia [16–24], in addition to its effect on frontal and/or ethmoid sinus opacification [17,20,23]. To our knowledge, the SOEC has never been thoroughly studied in Middle Eastern or African countries, including Egypt, or with respect to its racial differences.

The aim of the current work is to study the incidence of the SOEC in Egyptians and its effect on frontal and/or ethmoid sinuses affection.

Patients and methods

This prospective study was conducted on 47 randomly selected patients of CRSwNP or CRSsNP proved by symptoms, endoscopy, and computed tomographic (CT) scan, presenting at the otorhinolaryngology outpatient clinic in Faculty of Medicine, Cairo University, Egypt. Patients younger than 14 years or having history of nasal trauma, surgery, granulomatous, or neoplastic disease were excluded.

Approval of ethical committee and patients’ consents were obtained. Imaging was performed on a multislice CT scanner, either Toshiba Aquilion 64 slice (Toshiba Medical Systems Corporation, Otawara, Japan) or Siemens Emotion 16 slice (Siemens Medical Systems, Erlangen, Germany) at the Radiology Department. Helical multislice scanning was performed with the axial images at 0.8-mm slice thickness. The images were studied by the radiology and rhinology team using Synedra triplanar viewer software for the pneumatization (Technologies GmbH Austria) of the orbital plate including the FS and SOEC in addition

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Supraorbital ethmoid cell: geographical and racial variations

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Background

Supraorbital ethmoid cell (SOEC) is one of the most difficult frontoethmoid cells addressed during frontal sinus surgery. It has never been studied in Middle Eastern countries. The aim of work is to study the incidence of SOEC in Egyptians and its effect on frontal and/or ethmoid sinuses affection.

Patients and methods

Computed tomographic scans of 47 patients of chronic rhinosinusitis were studied for supraorbital pneumatization; presence of the SOEC; its size, side, number, and relation to the anterior ethmoid artery; size of the frontal sinus; and opacity of the frontal and/or ethmoid sinuses.

Results

The SOEC was encountered in 41 sides (43.6%). The incidence of SOEC was least in Far Eastern countries (2.6–7.7%), followed by Europe (10.2–22%), and most prevalent in hot climate countries (35–45%).

Conclusion

It seems that the incidence of the SOEC has geographical and racial variations. Moreover, there is no association between the opacity of the SOEC and the incidence of frontal and/or ethmoid sinuses affection in chronic rhinosinusitis.
to the size, number, and extension of the SOEC. Moreover, opacity of the SOEC, FS, and/or ethmoid sinuses was recorded in addition to the relation of the anterior ethmoidal artery to the SOEC opening.

Statistical analysis
Data were statistically described in terms of mean ± SD, and range, or frequencies (number of cases) and percentages when appropriate. Correlation between various variables was done using Pearson moment correlation equation for linear relation of normally distributed variables and Spearman rank correlation equation for non-normal variables/nonlinear monotonic relation. P values less than 0.05 were considered statistically significant. All statistical calculations were done using computer program IBM SPSS (Statistical Package for the Social Science; IBM Corp., Armonk, New York, USA) release 22 for Microsoft Windows.

Results
This prospective study was conducted on 47 patients (94 sides) of CRSwNP or CRSsNP. There were 30 (63.8%) males and 17 (36.2%) females. The SOEC was encountered in 18 (38.3%) males and 10 (21.3%) females. Age ranged between 14 and 80 years with an average of 36 years and median of 33 years. Patients with SOEC were 17 patients in the age group of 20–39 years, seven patients in the age group of 40–59, two were younger than 20 years, and two older than 59 years.

There were 31 (66%) patients with supraorbital pneumatization on 50 (53.2%) sides. The supraorbital pneumatization was owing to FS alone on nine (9.6%) sides and both FS and SOEC on 41 (43.6%) sides. SOEC was unilateral in 15 (31.9%) patients and bilateral in 13 (27.7%) patients. There was no significance statistical correlation of either sex or age and incidence of SOEC (P>0.05).

The anteroposterior dimension of the FS ranged between 5 and 54 mm, with a mean of 19.1 mm; transverse dimension ranged between 6 and 40 mm, with a mean of 21.4 mm; whereas the craniocaudal dimension ranged between 7 and 41 mm, with a mean of 24.2 mm. The anteroposterior dimension of the SOEC ranged between 3 and 24 mm, with a mean of 11.2 mm; transverse dimension ranged between 2 and 20 mm, with a mean of 7.1 mm; whereas the craniocaudal dimension ranged between 3 and 11 mm, with a mean of 5.6 mm. Although the size of the SOEC was inversely proportional to that of the FS, there was no statistical correlation between the dimensions of the FS and SOEC (P>0.05). The SOEC reached the middle of the orbital plate on 35 (85.4%) sides and the posterior orbital apex on six (14.6%) sides.

The SOEC was single on 39 (95.1%) sides and two cells on two (4.9%) sides arranged in an anteroposterior direction, separated by a vertical septum.

FS aplasia was noticed on two (2.2%) sides. FS opacification was demonstrated on 28 (30.4%) sides, in whom the SOEC was opaque on two sides (7.1%) sides, clear on eight (28.6%), and absent on 18 (64.3%). There was no significant statistical correlation between frontal sinusitis and SOEC affection (P>0.05).

The anterior ethmoids were opaque on 44 (46.8%) sides, in whom the SOEC was opaque on three (6.8%) sides, clear on 12 (27.3%), and absent on 29 (65.9%). There was no significant statistical correlation between anterior ethmoid sinusitis and SOEC affection (P>0.05).

The SOEC was opaque on four (9.8%) sides, in whom both the FS and anterior ethmoid air cells were opaque on two and clear on one, whereas the anterior ethmoid sinus only showed opacity on the fourth side. There was no significant statistical correlation between the SOEC opacity and the incidence of frontal and/or anterior ethmoid affection (P>0.05).

The anterior ethmoid artery was identified posterior to the SOEC opening in all cases.

Discussion
Although FESS has become the mainstay for surgical treatment of chronic sinusitis, there is still a dilemma regarding the frontoethmoid cells [1]. The frontoethmoid cells were thoroughly studied by researchers, and many classification systems were proposed. The SOEC as one of those cells cannot be excluded from this dilemma [1,2,5–8].

In the current study, the SOEC was encountered in 41 (43.6%) sides. Table 1 demonstrates the incidence of the SOEC in different countries including USA, European, Far Eastern, South American countries, and India in addition to the current study, arranged from least to the most [2,9,10,12–17,20–24]. It was noticed that the lowest incidence was reported in the Far Eastern countries, ranging between 2.6 and 7.7% (<10%). The incidence in European countries ranged between 10 and 22%, whereas the incidence increased remarkably in Brazil, Egypt, and India ranging...
between 35 and 45% (>35%) (Fig. 1). Although there was a clear trend of increased incidence from Far East to Europe to hot humid climate countries, including Brazil, Egypt, and India, there was no statistical significant difference between Far East and Europe or between Europe and hot climate countries. On the contrary, there was a significant statistical difference between Far East and hot climate countries.

Strangely, in USA, the highest incidence was in Ohio and Georgia (62%) compared with 23% in Minnesota. This may be attributed to the higher incidence of African American race population in the former two states (12.2 and 30.5%, respectively) compared with 5.2% in the latter [2,9]. Variations of sinonasal anatomy have been described in many studies [15,25–28], and racial differences were reported between white and Chinese populations regarding the pneumatization of the middle turbinate, paradoxical bending of the middle turbinate as well as the infraorbital, suprabullar, and sphenoethmoidal cells development [25].

In the current study, the SOEC was single on 39 (95.1%) sides and two cells on two (4.9%) sides. Lee et al. [2] operated on 50 patients (100 sides) and noticed the SOEC on 62 (62%) sides, being single in 92% and multiple on five (8%) sides. They did not mention the number of the multiple cells.

In the current study, the SOEC was unilateral in 15 (31.9%) patients and bilateral in 13 (27.7%) patients. Souza et al. [10] operated on 198 patients and identified the SOEC in 35%, being unilateral in 9% and bilateral in 26%.

In the current study, the size of the SOEC was inversely proportional to that of the FS. This is consistent with Lee et al. [2]. However, there was no statistical correlation between their dimensions (P>0.05).

There was no significant statistical correlation between the opacity of the SOEC and the frontal and/or the ethmoid sinuses and vice versa in the current study (P>0.05). Frontal sinusitis was detected in 28 sides, of which two sides only showed opacification of the SOEC. Anterior ethmoiditis was recorded on 44 sides, of which the SOEC was opaque on only three sides. These results are similar to what has been reported by Lien et al. [17] and Lai et al. [23]. On the contrary, others reported association between the opacity of the frontoethmoidal cells in general, and not the SOEC alone, and frontal sinusitis [17,20].

In the current work, the anterior ethmoidal artery was constantly found posterior to SOEC opening. This goes in agreement with previous research reports [12,29,30].

### Conclusion

It seems that the incidence of the SOEC has geographical and racial variations. Awareness of these differences is beneficial to radiologists and rhinologists during CT study and/or endoscopic surgery of the frontal recess of patients of different racial and/or geographical origins. Moreover, there is no association between the opacity of the SOEC and the incidence of frontal and/or ethmoid sinuses affection in chronic rhinosinusitis.

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Conflicts of interest
There are no conflicts of interest.

References