“ABCDEF Checklist” based on 3D radiological images for preoperative planning of endoscopic sinus surgery*

Abstract
Background: Endoscopic sinus surgery (ESS) is performed on endonasal landmarks that have great anatomical variability, therefore a detailed preoperative study of these structures is necessary.

Objective: To develop a checklist for the systematic identification of the paranasal sinuses and the skull base, based on 3D images that guide the planning and implementation of ESS to minimize complications and improve surgical outcomes.

Methods: This study evaluates the usefulness of the “ABCDEF Checklist”, in a randomized study involving 30 otolaryngologists with more than 2 years of practical experience in ESS evaluating preoperative radiological examination and subsequent surgical performance in the sinus of 30 cadavers.

Results: Differences between groups in identifying the essential anatomical references were significant in 9 of the 11 essential anatomical references for the Checklist Group Surgical procedures and surgical mistakes were performed systematically less often in the Checklist group but the differences did not reach significance after Bonferroni correction.

Conclusions: The use of “ABCDEF Checklist” prior to ESS facilitates the identification of the essential anatomical references for the preoperative and systematized planning of the surgical procedures. However, in this small sample of 15 participants per group the differences found in the performance of the surgical procedures did not reach significance.

Key words: paranasal sinuses, nasal surgical procedures, chronic rhinosinusitis, education radiology, sinus surgery, pre-operative checklist, endoscopic sinus surgery

Introduction
Endoscopic sinus surgery (ESS) is one of the surgical procedures most frequently performed in otolaryngology

hough ESS is a surgery with high success rates, it is a procedure with potentially serious complications such as damage to the orbit, severe epistaxis or cerebrospinal fluid leak (CSF leak), due to the proximity of the paranasal sinuses to other key structures

Knowledge and study of anatomical references through images and videos, as well as training programs with cadaver dissection, do not always prevent complications or improve outcomes for neither experienced surgeons nor otolaryngology residents.

There is great diversity in sinonasal anatomy and sinusonal landmarks, so it is necessary to have a detailed study of
In a single screen of the CT using triplane images, Horos was the free software Horos. From the simultaneous visualization of anatomic landmarks of the “ABCDEF Checklist” were determined by the systematization of the necessary steps during surgery. Technological development of radiological and imaging technologies has been complemented by the widespread use of computer software programs that allow surgeons to see and manipulate radiological images from DICOM files without relying on hospital image systems. The main contribution of these programs lies in that they offer three-dimensional recreations (3D) of anatomical structures and therefore it is possible to visualize these structures simultaneously in the three planes of space.

The major contribution of this study is the development of a checklist of the paranasal sinuses and the anterior skull base, based on 3D images that guide the planning and implementation of ESS to minimize complications and improve surgical outcomes.

Materials and Methods
Design of the ABCDEF mnemonic rule for anatomical references.
A checklist was developed for the systematic identification of the sinonasal and skull base relevant anatomical structures, using the abbreviation ABCDEF, with the aim of demonstrating its usefulness in the 3D planning of ESS, based on an improvement in the identification of endonasal landmarks when performing surgical procedures, and thus minimizing complications. Through this mnemonic rule, each letter corresponds to the initial of a relevant anatomical landmark or an endonasal area (Figure 1). In brief, the checklist is designed as follows: Letter “A,” stands for Alignment of the nasal septum, Agger Nasi, the apophysis of the uncinate process and 3 arteries (anterior and posterior ethmoidal artery, and the sphenopalatine artery) were analyzed. Letter “B” refers to the ethmoidal Bulla. The following region refers to the Middle Turbinate, but in order to comply with the mnemonic rule “ABCDEF,” the letter “T” (turbinate in English) was transformed into “C” (Concha Nasi in the anatomical terminology taken from “Latin”). Letter “D” represents the Dimensions corresponding to the Classification of Kerros, the narrowest area of the ethmoidal infundibulum and the symmetry between the right and left lamina papyracea. Finally, letter “E” corresponds to the Ethmoid and the Sphenoid, while letter “F” refers to the Frontal sinus.

“Step by step” for the 3D recreation of the “ABCDEF Checklist”.
Location, shape, dimensions and relationships of each anatomical landmark of the “ABCDEF Checklist” were determined by the free software Horos. From the simultaneous visualization in a single screen of the CT using triplane images, Horos was used to synchronize positioning, thus obtaining a 3D recreation from the two-dimensional static images of the original DICOM file. Below, the procedure applied to the Agger Nasi cell (AN) is exemplified in Figure 2. The remaining anatomical references included in the “ABCDEF Checklist” are evaluated with the same methodology, with the variation of the main execution plane during the procedure (axial, coronal or sagittal) (Table 1). AN is the most anterior part of the ethmoid, (Figure 2A) and may be seen on intranasal examination as a small prominence on the lateral nasal wall just anterior to the attachment of the middle turbinate. The proposed steps for pre-surgical 3D planning of the AN with Horos are: 1) Study selection: with the largest number of images to reduce the pixelation of 3D reconstruction, 2) 3D viewer “Tridimensional Multiplanar Reconstruction” (3D-MPR): mode allows direct reconstruction in 3D using volumes, surfaces and endoscopic images. However, the choice of 3DMPR mode as a previous step to three-dimensional reconstructions is a highly recommended option to make a simultaneous navigation in the three planes of space, since it allows selecting those regions of interest (ROIs) that are going to be reconstructed. (Figure 2B), 3) The preoperative planning with the 3DMPR to AN begins in the coronal views, with the anteroposterior sliding of the DICOM images that will appear in close connection to the frontal beak (Figure 2C), 4) In the sagittal, axial and coronal view, the relationship of other structures with respect to the position of AN can be determined (Figure 2D). 5) Finally, the 3D volumetric interpretation of each of the anatomical regions studied is performed through the 3D Volume Rendering function (Figure 2E). 6) The final 3D sequence is achieved (Figure 2F).

Design of the study
The study analyzed the potential of this “ABCDEF Checklist” in the correct identification of essential anatomical references in ESS, and in the evaluation of the adequate approach in the different surgical procedures carried out in 60 nasal cavities of frozen cadaver (n = 60, 30 left and 30 right nasal cavities), by 30 otolaryngologist with more than 2 years of practical experience in ESS, distributed in two groups. The surgeons were randomly assigned by drawing cards from a shuffled stack including 15 cards with number “1” (Use the CHECKLIST) and the other 15 with the number “2” (DO NOT use the CHECKLIST).

The Checklist Group carried out the pre-surgical planning before each proposed surgical procedure following the “ABCDEF checklist” step by, and recreating the structures three-dimensionally with Horos®. Parallely, surgeons in Control Group carried out pre-surgical planning based on their own experience, without the support of the “ABCDEF checklist”, although all of the members of this group also had the Horos® program installed in their workstations to evaluate scans prior to dissection. All surgeons participating in the dissection accepted the randomization process by which they could belong to either the group can go.
Figure 1. "ABCDDEF checklist" for preoperative planning of ESS.
Statistical analysis

Three types of outcomes were analyzed between the two study groups with an agreement between evaluators by Cohen’s Kappa coefficient was 0.85.

First, the difficulty of identifying the 11 essential anatomical references for the correct and safe management of ESS was assessed (Table 1.1). The difficulty was measured by a self-administered numerical scale with values from 0 to 10 (0 meant the least possible difficulty during the dissection and 10 the greatest difficulty). The mean difficulty to identify each reference found by each study groups was compared using the t-Student when data were normally distributed, and the Mann-Whitney U test when they were not. Normality was tested through the Shapiro-Wilk test. After Bonferroni correction for multtesting a p value <0.005 was considered to be significant.

Second, a post-dissection CT control was performed to evaluate the 7 surgical procedures performed (18). Each post-dissection CT was anonymized to ensure blinding by the evaluators. The assessors didn’t know whether the identification of essential anatomical references, the surgical procedures and the mistakes...
Table 1. Anatomical references, proposed surgical procedures and complications detected during ESS.

1. Essential anatomical references and radiological planes for pre-surgical planning.

| 1. | Alignment of the nasal septum and its relationship with the middle meatus (Coronal = Axial > Sagittal). |
| 2. | Identification and dissection of the agger nasi (Coronal > Sagittal > Axial). |
| 3. | Identification and dissection of the uncinate process. Relationship between the uncinate process and the maxillary sinus (Coronal = Axial > Sagittal). |
| 5. | Identification of the sphenopalatine artery (Axial > Coronal > Sagittal). |
| 6. | Identification and dissection of the ethmoidal bulla and the bulla complex (Coronal = Sagittal = Axial). |
| 7. | Identification and dissection of the frontoethmoidal cells (Coronal = Sagittal = Axial). |
| 9. | Identification and total dissection of ethmoids (Coronal = Sagittal = Axial). |
| 10. | Identification and dissection of the sphenoid sinus. Sphenoidal approach (Coronal = Sagittal = Axial). |

2. Surgical procedures

| 1. | Complete dissection of the agger nasi cell. |
| 2. | Uncinectomy. |
| 3. | Frontal sinus dissection. |
| 4. | Ethmoidal bulla dissection. |
| 5. | Complete dissection to the different variants of frontoethmoidal cells according to the number and type that existed in the planning TC. |
| 6. | Total ethmoidectomy. Anterior and posterior ethmoidectomy to the ethmoidal roof. |
| 7. | Sphenoidotomy and sphenoidal dissection |

3. Mistakes and complications.

| 1. | Damage of the lamina papyracea or the orbit. |
| 2. | Damage of the lacrimal sac. |
| 3. | Damage of the anterior ethmoidal artery. |
| 4. | Damage of the sphenopalatine artery. |
| 5. | Damage of the cribriform plate (CSF leak). |
| 6. | Damage of the ethmoidal roof and the sphenethmoidal recess (CSF leak). |
| 7. | Damage to the posterior wall of the sphenoid sinus (sella region). |
| 8. | Damage of the optico-carotid recess. |

1.1: Anatomical references considered essential in the ESS and radiological planes ordered according to the importance for pre-surgical planning.

1.2: Surgical procedures to be performed during cadaveric dissection. 1.3: Mistakes during dissection that lead to intraoperative complications.

Complications were considered for any of the 8 mistakes that could lead to surgical problems during a real surgical procedure comparable to the dissection performed on the cadaver.

were made by a surgeon in the checklist group or in the control group. The CT control was evaluated separately by two otolaryngologists with extensive experience in ESS, to reduce subjectivity during the evaluation. It was determined dichotomically (yes/no) if the objectives of the 7 surgical procedures proposed in the dissection were reached (Table 1.2), adjusting the proportion of agreement between the evaluators by Cohen’s Kappa coefficient. The achievement of each surgical procedure was compared between both groups through the Chi-square test.

After Bonferroni correction for mutlitesting a p value <0.007 was considered to be significant.

All pre and post-ESS Checklist data were de-identified, compiled, and analyzed using commercially available statistical software (SPSS v24).
Table 2. Values of mean, median, standard deviation, range and statistical significance between the study groups (Checklist group and Control group), according to the data of normal distribution for the 11 essential anatomical references considered in the study. The difficulty measured by the numerical scale indicates that 0 points is the least possible difficulty during identification and subsequent dissection, and 10 points is the greatest possible difficulty.

<table>
<thead>
<tr>
<th>1. Alignment of the nasal septum and its relationship with the middle meatus.</th>
<th>Normal Distribution</th>
<th>Groups</th>
<th>Mean and median scores, standard deviation (SD) and range with numerical scale (0 - 10), depending on whether there is a normal distribution</th>
<th>P value, according to the normal distribution (t-student), or not (Mann-Whitney U)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Checklist group</td>
<td>Mean: 1.02 points</td>
<td>SD: 0.64</td>
<td>p = 0.665</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>Mean: 1.09 points</td>
<td>SD: 0.68</td>
<td></td>
</tr>
<tr>
<td>2. Identification and dissection of the agger nasi.</td>
<td>No</td>
<td>Checklist group</td>
<td>Median: 2.15 points</td>
<td>Range: 3.06</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>Median: 8.17 points</td>
<td>Range: 8.16</td>
<td></td>
</tr>
<tr>
<td>3. Identification and dissection of the uncinate process. Relationship between the uncinate process and the maxillary sinus.</td>
<td>No</td>
<td>Checklist group</td>
<td>Median: 1.96 points</td>
<td>Range: 4.19</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>Median: 7.50 points</td>
<td>Range: 7.66</td>
<td></td>
</tr>
<tr>
<td>4. Identification of the anterior ethmoidal artery.</td>
<td>No</td>
<td>Checklist group</td>
<td>Median: 2.31 points</td>
<td>Range: 3.64</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>Median: 5.85 points</td>
<td>Range: 7.11</td>
<td></td>
</tr>
<tr>
<td>5. Identification of the sphenopalatine artery.</td>
<td>Yes</td>
<td>Checklist group</td>
<td>Median: 2.33 points</td>
<td>Range: 8.05</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>Median: 3.77 points</td>
<td>SD: 1.08</td>
<td></td>
</tr>
<tr>
<td>6. Identification and dissection of the ethmoidal bulla and the bulla complex.</td>
<td>No</td>
<td>Checklist group</td>
<td>Median: 2.42 points</td>
<td>Range: 3.45</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>Median: 7.97 points</td>
<td>Range: 6.11</td>
<td></td>
</tr>
<tr>
<td>7. Identification and dissection of the frontoethmoidal cells.</td>
<td>No</td>
<td>Checklist group</td>
<td>Median: 4.63 points</td>
<td>Range: 2.85</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>Median: 8.98 points</td>
<td>Range: 2.88</td>
<td></td>
</tr>
<tr>
<td>8. Identification and dissection of the middle turbinate and its attachments. Basal lamella of the middle turbinate.</td>
<td>No</td>
<td>Checklist group</td>
<td>Median: 2.19 points</td>
<td>Range: 2.89</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>Median: 7.66 points</td>
<td>Range: 6.09</td>
<td></td>
</tr>
<tr>
<td>9. Identification and total dissection of ethmoids.</td>
<td>Yes</td>
<td>Checklist group</td>
<td>Mean: 3.33 points</td>
<td>SD: 0.87</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>Mean: 5.50 points</td>
<td>SD: 1.17</td>
<td></td>
</tr>
<tr>
<td>10. Identification and dissection of the sphenoid sinus. Sphenoidal approach.</td>
<td>Yes</td>
<td>Checklist group</td>
<td>Mean: 1.53 points</td>
<td>SD: 0.84</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>Mean: 2.06 points</td>
<td>SD: 0.82</td>
<td></td>
</tr>
<tr>
<td>11. Identification of the frontal recess. Dissection of the frontal sinus.</td>
<td>No</td>
<td>Checklist group</td>
<td>Median: 2.37 points</td>
<td>Range: 5.08</td>
</tr>
<tr>
<td></td>
<td>Control group</td>
<td>Median: 8.84 points</td>
<td>Range: 2.44</td>
<td></td>
</tr>
</tbody>
</table>

(* Significance difference after statistical correction with the Bonferroni test)

Results
- Identification of essential anatomical references: Differences between groups to identify the essential anatomical references in the ESS were significant (p < 0.045 after Bonferroni correction) in 9 of the 11 essential anatomical references for the Checklist Group (ChG). No statistically significant difference was found for the “alignment of the nasal septum and its relationship with the middle meatus” and “identification and dissection of the sphenoid sinus” (Table 2, Figure 3).
- Complete and correct performed surgical procedures (checked at post-dissection CT): Six out of seven surgical procedures were performed equally well in both groups. Only “complete dissection to the different variants of frontoethmoidal cells according to the number and type that existed in the planning TC” was performed better in the ChG group (73.3%) compared to CG group (10%) (p < 0.001 after Bonferroni correction) (Table 3).
- Complications and mistakes during ESS cadaveric dissection: There was a higher rate of mistakes committed by the CG compared to the ChG although the differences did not reach significance. Damage of the lamina papyracea or the orbit (CG: 26.7%; ChG: 16.7%), Damage of the lacrimal sac (CG: 6.7%; ChG: 10%), Damage of the anterior ethmoidal artery (CG: 23.3%; ChG: 10%), Damage of the sphenopalatine artery (CG: 10%; ChG: 6.7%), Damage of the cribriform plate (CG: 26.7%; ChG: 10%), Damage of the ethmoidal roof and the sphenoethmoidal recess (CG: 6.7%; ChG: 0%), Damage to the posterior wall of the sphenoid sinus and sella region (CG: 6.7%; ChG: 0%), Damage of the optic-carotid recess (CG: 3.3%; ChG: 0%). So although in this relatively small group the differences did not reach significance we advocate the use of the “ABCDEF Checklist” as a
Table 3. Rate (%) of success in achieving surgical procedures, and Chi-square test values.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Rate (%) of success in achieving surgical procedures</th>
<th>P value (Chi-square test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Complete dissection of the agger nasi cell.</td>
<td>Checklist group: 80%</td>
<td>Control group: 53.3%</td>
</tr>
<tr>
<td></td>
<td>Checklist group: 80%</td>
<td>Control group: 53.3%</td>
</tr>
<tr>
<td>2. Complete dissection of the uncinate process</td>
<td>Checklist group: 86.7%</td>
<td>Control group: 60%</td>
</tr>
<tr>
<td></td>
<td>Checklist group: 76.7%</td>
<td>Control group: 46.7%</td>
</tr>
<tr>
<td>5. Complete dissection to the different variants of frontoethmoidal cells according to the number and type that existed in the planning TC.</td>
<td>Checklist group: 73.3%</td>
<td>Control group: 10%</td>
</tr>
<tr>
<td>6. Total ethmoidectomy. Anterior and posterior ethmoidectomy to the ethmoidal roof.</td>
<td>Checklist group: 80%</td>
<td>Control group: 73.3%</td>
</tr>
<tr>
<td>7. Sphenoidotomy and sphenoidal dissection.</td>
<td>Checklist group: 80%</td>
<td>Control group: 63.3%</td>
</tr>
</tbody>
</table>

(* Significance difference after statistical correction with the Bonferroni test).

The finding of failed surgeries and the persistence and recurrence of sinonasal diseases after ESS due to causes attributable to the surgeon and an improvement of 36% in the rate of foreseeable failures associated with the ESS treatment of the sellar region and the skull base. Even so, checklists have not prevented ESS from unsatisfactory outcomes, such surgeries constituting one of the main sources of legal demands in otolaryngology. The aforementioned results were reproduced in our study, confirming that the use of the "ABCDEF Checklist" and its 3D reconstruction, reduced the mistakes rate, but did not eliminate it completely. For example, damage of the lamina papyracea of the orbit was reduced from 26.7% (CG) to 16.7% (ChG), or cribriform plate damage dropped from 26.7% (CG) to 10% (CG). Therefore, the use of this tool does not guarantee the range of error, but it does help to minimize potential damage that might occur during ESS. The insistence of the World Health Organization (WHO) to use checklists aimed at minimizing avoidable errors and reducing surgical morbidity and mortality, confirms the lack of widespread implementation of this tool in surgical settings. The repeated recommendations to use checklists in the training and planning of ESS reinforce the reality of their scarce use in routine clinical practice. Checklists based on the standardization and systematization of the evaluation by radiological images in 2D have translated into a reduction of complications in between 8% and 19% of the neurosurgical approaches, and an improvement of 36% in the rate of foreseeable failures associated with the ESS treatment of the sellar region and the skull base. Even so, checklists have not prevented ESS from unsatisfactory outcomes, such surgeries constituting one of the main sources of legal demands in otolaryngology. The aforementioned results were reproduced in our study, confirming that the use of the "ABCDEF Checklist" and its 3D reconstruction, reduced the mistakes rate, but did not eliminate it completely. For example, damage of the lamina papyracea of the orbit was reduced from 26.7% (CG) to 16.7% (ChG), or cribriform plate damage dropped from 26.7% (CG) to 10% (CG). Therefore, the use of this tool does not guarantee the range of error, but it does help to minimize potential damage that might occur during ESS. The insistence of the World Health Organization (WHO) to use checklists aimed at minimizing avoidable errors and reducing surgical morbidity and mortality, confirms the lack of widespread implementation of this tool in surgical settings. The repeated recommendations to use checklists in the training and planning of ESS reinforce the reality of their scarce use in routine clinical practice. Checklists based on the standardization and systematization of the evaluation by radiological images in 2D have translated into a reduction of complications in between 8% and 19% of the neurosurgical approaches.
in a safer way, with greater confidence, and in a shorter surgical

time than with the use of 2D images\textsuperscript{15,16}. This scenario reinforces the need both to have new tools that
overcome the deficiencies and limitations observed, and to as-
sume the WHO recommendations on checklists based on short,
simple and specific foundations, that are useful in patient care
practice\textsuperscript{37}. The "ABCDEF Checklist" constitutes a methodological
contribution that takes advantage of the use of radiological mul-
tiple 3D images with the integration of the Horos\textsuperscript{®} program
to facilitate the cerebral recreation of volumes and volumetric
relationships from 2D images, while minimizing the dependen-
cence on terminology ineffective surgical planning and also during
ESS. The abbreviation (ABCDEF) used for the checklist follows an
alphabetical sequence and represents a mnemonic support to
remember all the essential anatomical references in ESS, unlike
the "CLOSE" abbreviation proposed by O’Brien et al.\textsuperscript{3,15} which
fundamentally refers to structures subject to potential damage
during ESS. The simplicity of the concept is transferred to the
individual identification of each of the essential anatomical refe-
rences for obtaining an overview of each individual patient.
The basic difference between the "CLOSE" methodology\textsuperscript{15} and
the "ABCDEF" design lies in the fact that the first one analyzes in
detail those structures that during the ESS are especially suscep-
tible to being damaged, while the methodology that has been
analyzed in the present manuscript, integrates the structures
studied in the "CLOSE", interrelating them with all the essential
anatomical references and risk areas to be addressed during the
ESS. In addition, as mentioned above, the "ABCDEF Checklist"
follows a 3D recreation methodology with Horos that increases
the reproducibility of the preoperative findings in the paranasal
sinuses and the base of the skull, once the ENT surgeon is in the
surgery room, as the results of this study demonstrate (Tables 2 and 3). Perhaps the main drawback of the "ABCDEF Checklist"
would be that it is lengthier than other checklists. However,
the extension and format in which it is presented (Figure 1) is
justified by a rationale based on the new recommendations and
nomenclatures of the experts in the sinonasal area\textsuperscript{3,10,15}. The
outcomes showed in this article agree with the results
published by Syme-Grant et al.\textsuperscript{6} which accept that the learning
methods evaluated so far have not been proven sufficient to
achieve an adequate understanding of sinonasal anatomy to
avoid revision surgeries due to surgeon mistakes. Furthermore,
the methods of identification of these structures have not
allowed to successfully perform ESS without complications or
execution complications. The "ABCDEF Checklist" may become
a useful tool for otolaryngologists, from those who are starting
in this field, to more advanced specialists, and even for those
with more experience facing unexpected complications or failed
surgeries.

**Conclusion**

The "ABCDEF checklist" based on 3D radiological images inte-

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**3D Checklist for endoscopic sinus surgery**

- Alignment of the nasal septum and its relationship with the middle
  meatus (Ref 1).
- Identification and dissection of the agger nasi (Ref 2).
- Identification and dissection of the uncinate process. Relationship
  between the uncinate process and the maxillary sinus (Ref 3).
- Identification of the anterior ethmoidal artery (Ref 4).
- Identification of the sphenopalatine artery (Ref 5).
- Identification and dissection of the ethmoidal bulla and the bulla
  complex (Ref 6).
- Identification and dissection of the frontoethmoidal cells (Ref 7).
- Identification and dissection of the middle turbinate and its attach-
  ments. Basal lamella of the middle turbinate (Ref 8).
- Identification and total dissection of ethmoids (Ref 9).
- Identification and dissection of the sphenoid sinus. Sphenoidal
  approach (Ref 10).
- Identification of the frontal recess. Dissection of the frontal sinus
  (Ref 11).

- (circle) No significant difference.
- (diamond) Significant difference.
- (square) No significant difference with Bonferroni test

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**Figure 3. Statistical significance to anatomical references considered essential in the ESS.**

- Identification of the frontal recess. Dissection of the frontal sinus
- Identification and dissection of the sphenoid sinus. Sphenoidal
  approach (Ref 10).
- Identification and total dissection of ethmoids (Ref 9).
- Identification and dissection of the ethmoidal bulla and the bulla
  complex (Ref 6).
- Identification and dissection of the frontoethmoidal cells (Ref 7).
- Identification and dissection of the middle turbinate and its attach-
  ments. Basal lamella of the middle turbinate (Ref 8).
- Identification of the anterior ethmoidal artery (Ref 4).
- Identification of the sphenopalatine artery (Ref 5).
- Identification of the sphenopalatine artery (Ref 5).
- Identification and dissection of the ethmoidal bulla and the bulla
  complex (Ref 6).
- Identification and dissection of the frontoethmoidal cells (Ref 7).
- Identification and dissection of the middle turbinate and its attach-
  ments. Basal lamella of the middle turbinate (Ref 8).
- Identification of the anterior ethmoidal artery (Ref 4).
- Identification of the sphenopalatine artery (Ref 5).
- Identification and dissection of the ethmoidal bulla and the bulla
  complex (Ref 6).
- Identification and dissection of the frontoethmoidal cells (Ref 7).
- Identification and dissection of the middle turbinate and its attach-
  ments. Basal lamella of the middle turbinate (Ref 8).
- Identification of the anterior ethmoidal artery (Ref 4).
- Identification of the sphenopalatine artery (Ref 5).
- Identification and dissection of the ethmoidal bulla and the bulla
  complex (Ref 6).
- Identification and dissection of the frontoethmoidal cells (Ref 7).
grates the most relevant anatomical sinonasal structures in an orderly fashion. Its use prior to ESS facilitates the identification of essential landmarks for systematized and preoperative planning of surgical procedures. The “ABCDDEF checklist” is a suitable tool to be included in the surgical management protocol of the pathologies in which ESS is indicated, as well as for training and learning.

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Authorship contribution


Conflict of interest

No conflicts of interest to disclose.

3D Checklist for endoscopic sinus surgery


