“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. The appropriateness criteria of ESS (except oncological pathology) focus on defining three clinical factors: 1) the need for objective evidence of chronic rhinosinusitis (CRS) using computed tomography (CT) imaging, 2) the degree of patient-reported disease burden using the 22-item SinoNasal Outcome Test (SNOT-22), and 3) the medical therapy used prior to offering ESS. But the decision to perform ESS should be made after an informed patient makes a preference-sensitive decision to proceed with surgery. Although 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 sinonasal landmarks, so it is necessary to have a detailed study of
radiological images in order to assess each patient individually\textsuperscript{(12)}. Checklists based on radiological images have been used to improve ESS and reduce avoidable surgical mistakes, through the systematization of the necessary steps during surgery\textsuperscript{(13-15)}. 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 Keros, 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\textsuperscript{*}. From the simultaneous visualization in a single screen of the CT using triplane images, Horos\textsuperscript{*} 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)\textsuperscript{(16)} 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 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\textsuperscript{*} 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 3D-MPR 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\textsuperscript{(17)} 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\textsuperscript{*}. 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\textsuperscript{*} 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.**
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 weret 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.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Radiological Planes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Alignment of the nasal septum and its relationship with the middle meatus</td>
<td>Coronal = Axial &gt; Sagittal</td>
</tr>
<tr>
<td>2. Identification and dissection of the agger nasi</td>
<td>Coronal &gt; Sagittal &gt; Axial</td>
</tr>
<tr>
<td>3. Identification and dissection of the uncinate process. Relationship between the uncinate process and the maxillary sinus</td>
<td>Coronal = Axial &gt; Sagittal</td>
</tr>
<tr>
<td>4. Identification of the anterior ethmoidal artery</td>
<td>Coronal &gt; Sagittal &gt; Axial</td>
</tr>
<tr>
<td>5. Identification of the sphenopalatine artery</td>
<td>Axial &gt; Coronal &gt; Sagittal</td>
</tr>
<tr>
<td>6. Identification and dissection of the ethmoidal bulla and the bulla complex</td>
<td>Coronal = Sagittal = Axial</td>
</tr>
<tr>
<td>7. Identification and dissection of the frontoethmoidal cells</td>
<td>Coronal = Sagittal = Axial</td>
</tr>
<tr>
<td>8. Identification and dissection of the middle turbinate and its attachments. Basal lamella of the middle turbinate</td>
<td>Coronal = Sagittal = Axial</td>
</tr>
<tr>
<td>9. Identification and total dissection of ethmoids</td>
<td>Coronal = Sagittal = Axial</td>
</tr>
<tr>
<td>10. Identification and dissection of the sphenoid sinus. Sphenoidal approach</td>
<td>Coronal = Sagittal = Axial</td>
</tr>
<tr>
<td>11. Identification of the frontal recess. Dissection of the frontal sinus</td>
<td>Coronal = Sagittal = Axial</td>
</tr>
</tbody>
</table>

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 cribiform 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 multitesting 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>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 SD: 0.64</td>
<td>p = 0.665</td>
</tr>
<tr>
<td>Yes</td>
<td>Control group</td>
<td>Mean: 1.09 points SD: 0.68</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Checklist group</td>
<td>Median: 2.15 points Range: 3.06</td>
<td>p &lt; 0.001*</td>
</tr>
<tr>
<td>No</td>
<td>Control group</td>
<td>Median: 8.17 points Range: 8.16</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Checklist group</td>
<td>Median: 1.96 points Range: 4.19</td>
<td>p &lt; 0.001*</td>
</tr>
<tr>
<td>No</td>
<td>Control group</td>
<td>Median: 7.50 points Range: 7.66</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Checklist group</td>
<td>Median: 2.31 points Range: 3.64</td>
<td>p &lt; 0.001*</td>
</tr>
<tr>
<td>No</td>
<td>Control group</td>
<td>Median: 5.85 points Range: 7.11</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>Checklist group</td>
<td>Mean: 2.33 points SD: 0.95</td>
<td>p &lt; 0.001*</td>
</tr>
<tr>
<td>Yes</td>
<td>Control group</td>
<td>Mean: 3.77 points SD: 1.08</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Checklist group</td>
<td>Median: 2.42 points Range: 3.45</td>
<td>p &lt; 0.001*</td>
</tr>
<tr>
<td>No</td>
<td>Control group</td>
<td>Median: 7.97 points Range: 6.11</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Checklist group</td>
<td>Median: 4.63 points Range: 2.85</td>
<td>p &lt; 0.001*</td>
</tr>
<tr>
<td>No</td>
<td>Control group</td>
<td>Median: 8.98 points Range: 2.88</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Checklist group</td>
<td>Median: 2.19 points Range: 2.89</td>
<td>p &lt; 0.001*</td>
</tr>
<tr>
<td>No</td>
<td>Control group</td>
<td>Median: 7.66 points Range: 6.09</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>Checklist group</td>
<td>Mean: 3.33 points SD: 0.87</td>
<td>p &lt; 0.001*</td>
</tr>
<tr>
<td>Yes</td>
<td>Control group</td>
<td>Mean: 5.50 points SD: 1.17</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>Checklist group</td>
<td>Mean: 1.53 points SD: 0.84</td>
<td>p = 0.017</td>
</tr>
<tr>
<td>Yes</td>
<td>Control group</td>
<td>Mean: 2.06 points SD: 0.82</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Checklist group</td>
<td>Median: 2.37 points Range: 5.08</td>
<td>p &lt; 0.001*</td>
</tr>
<tr>
<td>No</td>
<td>Control group</td>
<td>Median: 8.84 points 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 optico-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% Control group 53.3%</td>
<td>p = 0.028</td>
</tr>
<tr>
<td>2. Complete dissection of the uncinate process</td>
<td>Checklist group 80% Control group 53.3%</td>
<td>p = 0.028</td>
</tr>
<tr>
<td>3. Frontal sinus dissection.</td>
<td>Checklist group 86.7% Control group 60%</td>
<td>p = 0.020</td>
</tr>
<tr>
<td>4. Ethmoidal bulla dissection.</td>
<td>Checklist group 76.7% Control group 46.7%</td>
<td>p = 0.017</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% Control group 10%</td>
<td>p &lt; 0.001*</td>
</tr>
<tr>
<td>6. Total ethmoidectomy. Anterior and posterior ethmoidectomy to the ethmoidal roof.</td>
<td>Checklist group 80% Control group 73.3%</td>
<td>p = 0.542</td>
</tr>
<tr>
<td>7. Sphenoidotomy and sphenoidal dissection.</td>
<td>Checklist group 80% Control group 63.3%</td>
<td>p = 0.152</td>
</tr>
</tbody>
</table>

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

tool for the preoperative planning of the ESS reduced the risk of mistakes or complications by the ENT surgeon.

**Discussion**

An improvement in the results of the aspects evaluated regarding the use of the “ABCDEF Checklist”, and its 3D reproducibility for the pre-surgical planning of ESS make us consider its overall potential for this type of ENT surgery. The most relevant results may be summarized in that more than 80% of the anatomical references essential for ESS were better identified with the use of the Checklist; Most of the surgical procedures proposed during the cadaveric dissection were better executed, although not significantly better, by those surgeons who planned them with the Checklist, with special mention to the dissection of the different variants of frontoethmoidal cells (since it is a very variable sinonasal anatomical area that requires a particularly detailed study) that was performed significantly better by the checklist group.

The finding of failed surgeries and the persistence and recurrence of sinonasal diseases after ESS due to causes attributable to the surgeon\(^\text{23,24}\), repeatedly raises the need for support toward the radiological location of anatomical landmarks and their inter-relations oriented to the preoperative planning of surgery, despite knowledge of the advantages of navigation during image-guided surgery\(^\text{25,26}\). 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\(^\text{27,28}\), and an improvement of 36% in the rate of foreseeable failures associated with the ESS treatment of the sellar region and the skull base\(^\text{29,30}\). Even so, checklists have not prevented ESS from unsatisfactory outcomes, such surgeries constituting one of the main sources of legal demands in otolaryngology\(^\text{31,32}\). 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 0, 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\(^\text{27}\), 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\(^\text{28,29}\). It is possible that one of the determining factors of this low use lies in the lack of consensus on terminology, which in many cases is ambiguous. In 2014, a European consensus on the terminology of the paranasal sinuses was published\(^\text{30}\) in response to this need. Another new nomenclatures of fronto-ethmoidal cells was proposed by Wormald\(^\text{31}\), oriented towards a novel classification on different surgical extensions of the same. This nomenclature is the basis of the “ABCDEF Checklist”, presenting in an orderly fashion the fundamental
time than with the use of 2D images\textsuperscript{35,36}.

This scenario reinforces the need both to have new tools that overcome the deficiencies and limitations observed, and to assume 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 multiplane 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 dependence 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{[35]} 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 references for obtaining an overview of each individual patient. The basic difference between the “CLOSE” methodology\textsuperscript{35} and the “ABCDEF” design lies in the fact that the first one analyzes in detail those structures that during the ESS are especially susceptible 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” could 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{35,36-38}. 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-
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 “ABCD EF 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.

31. Wormald PJ, Hosemann W, Callejas C, Weber...
3D Checklist for endoscopic sinus surgery


Juan Manuel Maza-Solano, MD, PhD
Rhinology and Anterior Skull Base Department Section
University Hospital Virgen Macarena,
Av. Doctor Fedriani 3
E-41071, Sevilla
Spain
Tel.: +34 605133748,
E-mail: juan.maza.solano@gmail.com