Endoscopic and CT Radiographic Imaging of the Pterygopalatine and Infratemporal Fossae: Improving Surgical Landmarks

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Objectives

The aim of this study was to provide metric and objective data of the pterygopalatine fossa (PPF) and infratemporal fossa (ITF) anatomy with a focus on the osseous anatomy from an endoscopic perspective.

Introduction

Surgical access to the pterygopalatine fossa (PPF) and infratemporal fossa (ITF) is challenging due to their location, size, and complex anatomy. Traditional craniofacial resection approaches to the PPF and ITF are more invasive than endoscopic approaches and are associated with significant morbidity rates.⁵⁶ Several studies have described the soft tissue anatomy of these regions⁵⁶. Mass-occupying lesions have the potential to disrupt normal soft tissue anatomy, so a firm understanding of relevant osseous landmarks is especially vital in cases where normal soft tissue anatomy is absent.

The PPF is anterior to the pterygoid plates of the sphenoid bone, posterior to the maxillary sinus, and lateral to the nasopharynx and sphenopalatine foramen (SPF). The PPF is connected to the middle cranial fossa via the foramen rotundum and pterygoid canal, as well as to the ITF via the pterygomaxillary fissure. The ITF is connected to the middle cranial fossa via the foramen spinosum and foramen ovale. The ITF is situated lateral to the lateral pterygoid plate, medial to the ramus of the mandible, anterior to the styloid process of the temporal bone, and posterior to the zygoma.

Materials and Methods

Eleven fresh cadavers were submitted to computed tomography (CT) and endoscopic dissection. We used 3-dimensional (3-D) CT reconstruction and endoscopic video imaging for analysis of the bony and soft tissue landmarks. One fixed cadaver head was grossly dissected to confirm the endoscopic anatomic findings.

Results

CT and 3D-reconstruction measurements were made between the lateral border of the pterygoid canal and the medial border of foramen rotundum (Figure 1, Table). The distance from the anterolateral edge of the pterygoid process to the anterior border of foramen ovale was measured (Figure 2, table). A newly described bony ridge (pterygoid ridge) running along the anterior face of the pterygoid process, between foramen rotundum and pterygoid canal and pterygoid plate was characterized and measured (figure 3, table). This landmark was seen in all specimens.

The vascular anatomy was defined within the PPF (Figure). The site of PPF entry by the maxillary artery was found to be posterior to the temporalis tendon and anterior to the lateral pterygoid muscle (superior and inferior heads) (Figure).

Table: DISTANCE MEASUREMENTS

<table>
<thead>
<tr>
<th>3D</th>
<th>Mean (mm)</th>
<th>SEM (mm)</th>
<th>SD (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC-FR</td>
<td>5.09</td>
<td>0.38</td>
<td>1.84</td>
</tr>
<tr>
<td>PR</td>
<td>7.84</td>
<td>0.33</td>
<td>1.55</td>
</tr>
<tr>
<td>PPF-FO</td>
<td>17.1</td>
<td>0.43</td>
<td>2.1</td>
</tr>
<tr>
<td>CT</td>
<td>4.36</td>
<td>0.44</td>
<td>2.06</td>
</tr>
</tbody>
</table>

Table Legend: (Data from 22 PPF and ITF sides). 3-D: 3-dimensional reconstruction; PC-PTerygoid canal; FR - foramen rotundum; PPF - pterygopalatine fossa; FO - foramen ovale; CT - computed tomography

Discussion

To our knowledge, this study is the first to identify and characterize the bony ridge on the anterior face of the pterygoid process of the sphenoid bone (“pterygoid ridge”). Our data adds to current data confirming the relative anatomy of many soft tissue structures within the PPF and the ITF. Additionally, we provide data regarding the average distances between key osseous landmarks and foramen which may be encountered by the endoscopic surgeon during transnasal approaches. These landmarks may prove especially helpful to surgeons when soft tissue anatomy is distorted by pathology.

In the past, the SPA has typically been described as a singular vessel travelling through a single foramen when traversing the lateral nasal wall (via the sphenopalatine foramen). In our study, she SPA branched prior to crossing the lateral nasal wall in 22% of cases. This resulted in multiple foramen posterior to the cribriform plate, and should be considered in surgical cases requiring identification or control of the SPA³⁴.

The tendency of the IMA to separate the temporalis and lateral pterygoid muscle groups can help in their identification during extended transnasal endoscopic surgical approaches. Additionally, meticulous hemostasis is required when mobilizing the venous pterygoid plexus in this area.

This study also raised the question of PPG location. In our study, the PPG was at the same level, or slightly inferior to the SPF. This contrasts with Isaacs and Goyal, who reported the PPG positioned at or superior to the level of the SPF. One explanation to this difference could be due to our use of fresh cadavers, and our colleague’s use of fixed cadavers. The fixation process itself, or perhaps soft tissue degeneration experienced by our fresh cadavers could create variations in the observed location of the PPG within the PPF.

Conclusions

The pterygoid ridge is a novel and reliable osseous landmark that could assist surgeons during endoscopic surgery on the PPF and ITF. Important neurovascular and muscular anatomic relationships were characterized for both the PPF and the ITF.

References