Endoscopic Trans-nasal Approach to the Pterygopalatine Fossa

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CONTENT

LIST OF ABBREVIATIONS

CT: Computed tomography

HRCT: high resolution computed tomography

ICA: Internal Carotid artery

IMA: Internal Maxillary artery (Maxillary Artery)

IOC: Infraorbital canal

ION: Infraorbital nerve

ITF: infratemporal fossa

JNA: Juvenile nasopharyngeal angiofibroma

MRI: Magnetic resonance image

PPF: Pterygopalatine fossa

PPG: pterygopalatine ganglion

SPA: Sphenopalatine artery

SPF: sphenopalatine foramen

V2: maxillary nerve

Abstract

The past two decades there has been increased use of the endoscope which allows access to the maxillary sinus pathology through the nose with the use of angled-lens endoscopes. This advance in the endoscope coupled with improvement of radiological modalities helps in understanding the radiological and the endoscopic anatomy of the PPF and identification of several landmarks to guid the approach to this area.

Key word

Approach_ Endoscopic_ Fossa

INTRODUCTION

In recent years, there has been increasing interest in the use of endoscopic techniques for the resection of benign sinonasal tumors. The use of the endoscope was accepted for resection of tumors confined to the nasal cavity with limited paranasal sinus involvement but remains controversial for tumor extension outside the sinus cavities. These tumors present the next frontier for endoscopic resection ***(Wormald & Robinson, 2006***).

Several investigators had recently described endoscopic approaches to the pterygopalatine fossa (PPF) for the biopsy of lesions in this region as well as using a minimally invasive endoscopic approach to the PPF was considered as an avenue to nearby structures that are difficult to access via established invasive modalities ***(Statham & Tami, 2006).***

The pterygopalatine fossa (PPF) is a relatively small deep anatomical region. It is of particular surgical interest due to its neurovascular contents and its connections with several intracranial and extracranial compartments. Because of its deep location, and its small size, it can acquire extensive surgical approaches especially for invasive cranial base lesions ***(Alfieri et al., 2003).***

When the PPF needs to be addressed, the standard procedure is through a Caldwell-Luc (transantral) approach, violating the anterior and posterior walls of the maxillary sinus and exposing the PPF for microscopic or headlight evaluation. This is the method commonly used for internal maxillary artery ligation. This method provides limited exposure with the possibility of neural and vascular injury. It can also result in irreversible changes in the maxillary sinus, with resultant chronic sinusitis and the possibility of an oroantral fistula ***(DelGaudio, 2003***).

To gain a wide exposure of the PPF, the most common surgical approach was through the infratemporal fossa approach although its significant morbidity and surgical time associated ***(Lane & Bolger, 2003).***

Endoscopic surgeons accessed this region for transnasal repair of laterally based meningoencephaloceles, sphenopalatine artery ligation and Vidian neurectomy. The most common tumor extends into the PPF is the juvenile nasopharyngeal angiofibroma (JNA). It was thought that the endoscopic approach alone was not enough to manage the PPF tumors because of the vascularity, inability to control hemorrhage. Advances in interventional radiology with the effective embolization and resultant devascularization, as well as advances in hypotensive anesthetic techniques have allowed endoscopic techniques to deal with these tumors ***(Wormald & Robinson, 2006***).

The first endoscopic endonasal approach to the sphenoid lateral recess was described in a case report by **Bolger and Osenbach (1999).** This area was approached through the PPF by creation of a separate lateral opening into the sphenoid lateral recess in an attempt to avoid the medially based neural structures ***(Bolger & Osenbach, 1999).***

Three different approaches to PPF were performed: the middle meatal transpalatine approach, the middle meatal transantral approach, and the inferior turbinectomy transantral approach. The start of the middle meatal transpalatine approach was made between the middle turbinate and the lateral wall of the nasal cavity. When the crista ethmoidalis and the sphenopalatine artery were identified, the sphenopalatine foramen was enlarged to expose the PPF contents. The middle meatal transantral approach was made through the middle meatus by enlarging the maxillary ostium. When the infraorbital nerve was identified in the roof of the maxillary sinus, the posterior wall of the maxillary sinus was drilled medially to it. In the inferior turbinectomy transantral approach, a total inferior turbinectomy was made, and the medial wall of the maxillary sinus was removed more extensively. The maxillary sinus was entered, and its posterior wall was drilled medially and inferiorly ***(Alfieri et al, 2003).***

Al-Nashar ***(2004)*** described their medial to lateral approach to the PPF. Although these investigators described the anatomy of this region, they omitted a description of their intraoperative treatment of its neural structures except the Vidian nerve and the greater palatine nerve were identified and spared, also they did not report postoperative neural deficits in their description.

Statham and Tami reported that the medial to lateral approach is conceptually the easiest way to access the PPF. However, they stressed that, in some patients, the medially located neural structures may impede surgical access through this method **(Statham & Tami, 2006).**

A combined endonasal and transmaxillary endoscopic approach to the PPF was reported by **Har-El (2005).** Although this investigator supports this combined approach as a direct route through the maxillary sinus, he did not comment on the degree the transnasal approach was used to expose the PPF or treatment of its neural structures ***(Har-El, 2005)***.

Aim of the work

We are aiming to assess the technique of endoscopic transnasal approach to the PPF in different lesions and evaluate its value, advantages and limitations.

REVIEW OF LITERATURE

Chapter 1: Anatomy of the pterygopalatine fossa

The Pterygopalatine fossa (PPF) is an inverse pyramid-shaped cleft bounded by the posterior wall of the maxillary sinus anteriorly, anterior border of the pterygoid process of the sphenoid bone posteriorly, greater wing of the sphenoid bone superiorly, and perpendicular lamina of palatine bone medially. Laterally, it communicates with the infratemporal fossa via pterygomaxillary fissure. The apex of the pyramid (most inferior portion of PPF) is continuous with greater palatine canal; the base of the pyramid is formed by the adjacents portions of the body and the greater wing of the sphenoid bone **(*Erdogan et al., 2003*).**

The pterygoid process of the sphenoid bone, positioned inferior to the body and greater wing, consists of a base and a medial and lateral pterygoid plates. The anterior surface of the base forms a shallow recess that forms most of the posterior wall of the PPF and contains the openings of the foramen rotundum superiorly and the vidian (pterygoid) canal infromedial to it**.** The medial and the lateral pterygoid plates are fused anteriorly and a vertical sulcus, the pterygopalatine groove**,** descends on the front of the line of fusion. The plates are separated below by an angular cleft, the pterygoid fissure**,** the margins of which are rough for articulation with the pyramidal process of the palatine bone **(*Daniels et al., 1998*)**.

Superiorly the medial pterygoid plate is prolonged on to the under surface of the body of the sphenoid bone as a thin lamina, named the vaginal process, which articulates in front with the sphenoidal process of the palatine bone. The angular prominence between the posterior margin of the vaginal process and the medial border of the scaphoid fossa is named the pterygoid tubercle**,** and immediately above this is the posterior opening of the pterygoid canal. On the under surface of the vaginal process is a furrow, which is converted into a canal by the sphenoidal process of the palatine bone, for the transmission of the pharyngeal branch of the internal maxillary artery and the pharyngeal nerve from the sphenopalatine ganglion. The anterior margin of the plate articulates with the posterior border of the vertical part of the palatine bone ***(Daniels et al., 1998).***

The palatine bone fuses anteriorly with the maxillary bone and posteriorly and superiorly with the sphenoid bone. The perpendicular plate fuses anteriorly with the rough posterior part of the medial wall of the maxillary bone, thus covering part of the maxillary hiatus of the maxillary sinus. Posteriorly, the perpendicular plate fuses with the medial surface of the medial pterygoid plate**.** Inferiorly, the pyramidal process of the palatine bone attachs to the separated pterygoid plates. At the upper part of the perpendicular plate of the palatine bone, two processes are present; the orbital process which extends superolaterally and the sphenoidal process which extends superomedially to attach to the base of the medial pterygoid plate **(Daniels *et al.,* 1998)**.

The PPF is an important crossing point which communicates with seven different regions; the infratemporal fossa, orbit, nasal cavity, middle cranial fossa, foramen lacerum, pharynx, and palate. As a pathway for spread of diseases, being familiar with PPF and its communications is necessary **(Soames, 1995)**.

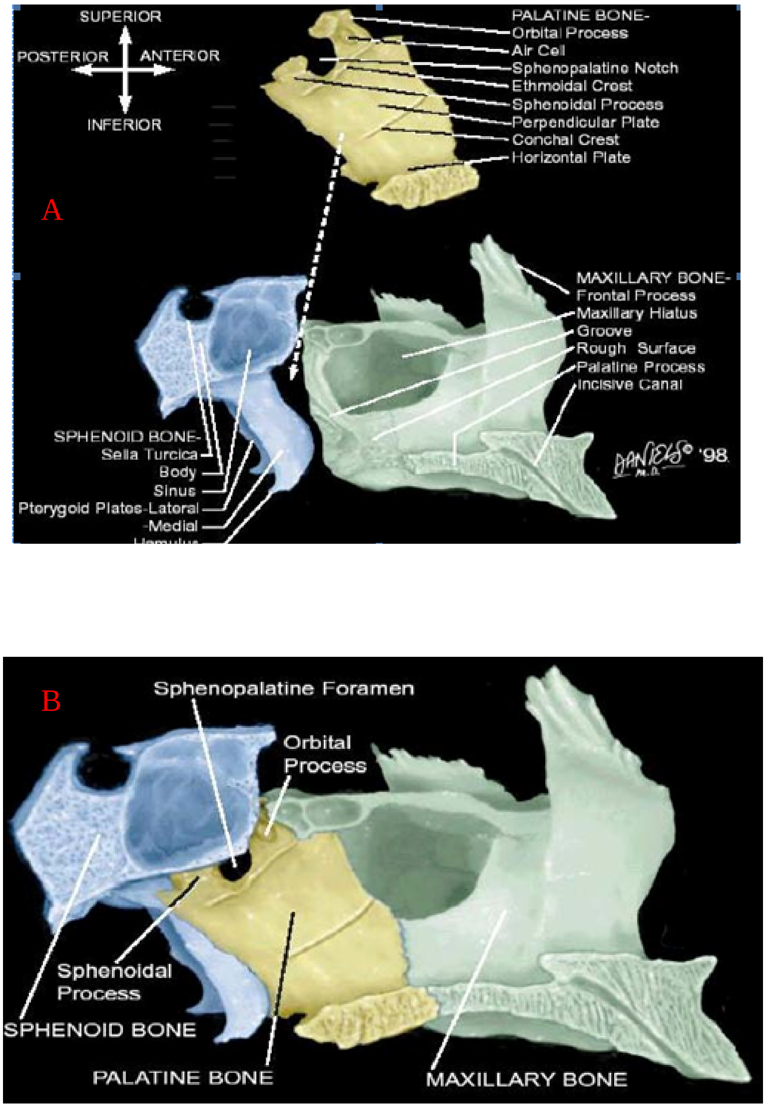

Figure (1) A & B: Medial views of the sphenoid (shown in part), palatine, and maxillary bones**.** To bridge the gap between the sphenoid and maxillary bones, the perpendicular plate of the palatine bone attaches to the posterior part of the medial wall of the maxillary bone (covering the posterior part of the maxillary hiatus) and to the anterior part of the medial surface of the medial pterygoid plate **(Digramatic illustration after Daniels *et al.*, 1998).**

The sphenopalatine foramen (SPF) is the main route of communication between the PPF and the nasal cavity, through which the main blood supply and larger nerves enter **(Wareing and Padgham, 1998).**

The SPF consists of a notch on the superior border of perpendicular plate of the palatine bone, between the orbital and sphenoidal processes; the notch becomes a foramen at the point in which the palatine bone articulates with the sphenoid bone in the lateral nasal wall. It may be a complete single orifice or traversed by one or more bony specules, suggesting more than one orifice. Its shape may vary, being oval, square, triangular or piriform. Its width ranges from four to seven millimeters and its height ranges from six to seven millimeters (**Lee *et al.*, 2002)**

Regarding the site of the SPF, **Wareing and Padgham (1998)** have reported three classes of the SPF**.** In class I (35%) the entire opening of the SPF lay above the ethmoidal crest. In class II (56%) the inferior bony margin of the SPF lay below the ethmoidal crest so that the foramen spanned the ethmoidal crest and opened into both the superior and middle meatuses**.** In class III (9%) there were two separate openings into the superior and middle meatuses.

The Greater palatine canal communicates the PPF with the oral cavity. It is formed by the apposition of an obliquely descending groove at the posteroinferior aspect of the medial wall of the maxillary bone and the greater palatine groove deep on the lateral surface of the perpendicular plate of the palatine bone. This canal opens inferiorly in the hard palate at the greater palatine foramen located at the junction between horizontal and perpendicular plates of the palatine bone. The lesser palatine canals extend from the greater palatine canal through the pyramidal process of the palatine bone to open at the lesser palatine foramina at the anterior aspect of the inferior surface of the pyramidal process **(Daniels *et al.*, 1998).**

The pterygomaxillary fissure (PMF) is the lateral opening of the PPF into the infratemporal fossa. It has a well-defined posterior margin formed by the lateral margin of the base of the pterygoid process and the fused pterygoid plates, and a less defined anterior margin, formed by the curving contour of the posterior wall of the maxillary sinus **(Daniels *et al.*, 1998).**

On the posterior wall of the PPF are three foramina with an oblique alignment. The foramen rotundum is lateral and superior to the vidian canal, which is, in turn, lateral and superior to the palatovaginal canal **(Rumboldt *et al.*, 2002)**.

The palatovaginal (pharyngeal) canal is a short bone tunnel formed by the application of the sphenoid process of the palatine bone to the vaginal process of the sphenoid bone and transmits pharyngeal vessels and nerve (**standring et al. 2005**). Several groups of researchers stated that the palatovaginal canal is either not or very rarely seen by imaging **(Osborn, 1979; *Borden et al.,* 1996** & **Kim *et al.*, 1996).** However **Rumboldt *et al.* (2002)** found that the easiest way to detect the palatovaginal canal on coronal CT images was to identify the pterygopalatine fossa and then follow its course posteriorly. In this direction, the shape of the pterygopalatine fossa changes from triangular to ovoid and oblique. Its superior and lateral aspects continue posteriorly as the vidian canal, and the medial and inferior portions become the palatovaginal canal. In this way the authors were able to find at least one palatovaginal canal in more than 50% of their patients and bilateral