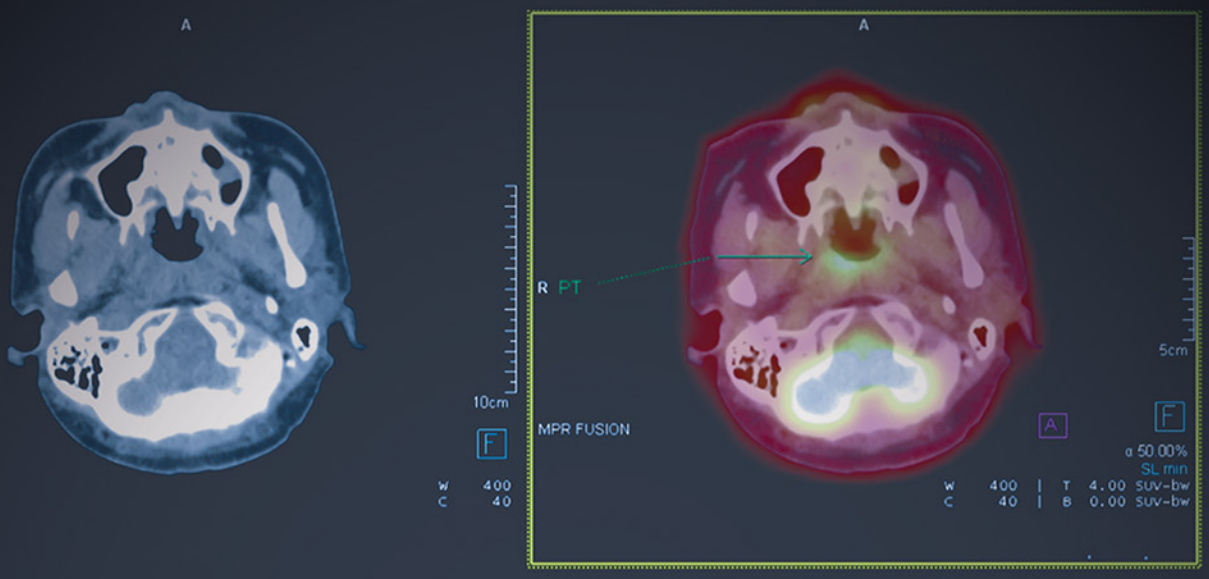


# An Evidence-Based Approach to the Management of Nasopharyngeal Cancer

## From Basic Science to Clinical Presentation and Treatment

Edited by
Baharudin Abdullah
Anusha Balasubramanian
Norhafiza Mat Lazim

# An Evidence-Based Approach to the Management of Nasopharyngeal Cancer

This page intentionally left blank

# An Evidence-Based Approach to the Management of Nasopharyngeal Cancer

## From Basic Science to Clinical Presentation and Treatment


Edited by

Baharudin Abdullah

*Senior Consultant, Department of Otorhinolaryngology - Head and Neck Surgery, School of Medical Sciences, Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia*

Anusha Balasubramanian

*Head and Neck Unit, The Royal Marsden Hospital, Chelsea, London, United Kingdom*

Norhafiza Mat Lazim

*Consultant Otorhinolaryngology-Head and Neck Surgery, Department of Otorhinolaryngology-Head and Neck Surgery, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan, Malaysia*




ACADEMIC PRESS

An imprint of Elsevier

Academic Press is an imprint of Elsevier
125 London Wall, London EC2Y 5AS, United Kingdom
525 B Street, Suite 1650, San Diego, CA 92101, United States
50 Hampshire Street, 5th Floor, Cambridge, MA 02139, United States
The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, United Kingdom



**Notices**
Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

**British Library Cataloguing-in-Publication Data**
A catalogue record for this book is available from the British Library

**Library of Congress Cataloging-in-Publication Data**
A catalog record for this book is available from the Library of Congress

ISBN: 978-0-12-814403-9



*Publisher:* Stacy Masucci
*Acquisitions Editor:* Rafael Teixeira
*Editorial Project Manager:* Tracy Tufaga
*Production Project Manager:* Poulouse Joseph
*Cover Designer:* Matthew Limbert

Typeset by MPS Limited, Chennai, India

# Dedication

**Baharudin Abdullah**
To my loving wife, Dr. Eka Sumianti, who has always been patient with me and my two beautiful girls, Clarissa Andini and Carneisha Aleeya. I will always love and cherish you all until the end of time.

**Anusha Balasubramanian**
To my beloved parents, husband, godparents, teachers, patients, colleagues and friends; thank you for guiding me through the path of life, I remain eternally grateful and indebted to you. God bless.

**Norhafiza Mat Lazim**
I would like to dedicate this book to my caring husband Associate Professor Dr. Zul Izhar Mohd Ismail, who has been very supportive through the journey of completing the chapters for this book. My sincere gratitude also goes to my three beloved children, Arieff Iskandar, Adry Zahrin, and Alyssa Yasmin, who have been my endless motivation for me. I am deeply grateful and blessed to have continuous support and encouragement from my other immediate family members, friends and close colleagues at work.

# Contents

# List of Contributors

**Baharudin Abdullah** Department of Otorhinolaryngology-Head and Neck Surgery, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan, Malaysia

**Kahairi Abdullah** Department of ORL-Head and Neck Surgery, Kuliyyah of Medicine, International Islamic University Malaysia, Kuantan, Pahang

**Murtala B. Abubakar** Department of Physiology, Faculty of Basic Medical Sciences, College of Health Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria; Human Genome Centre, School of Medical Sciences, Universiti Sains Malaysia, Kubang Kerian, Malaysia

**Marlinda Adham** Otorhinolaryngology Head&Neck Department, Faculty of Medicine Universitas Indonesia, Dr. Cipto Mangunkusumo Hospital, Jakarta, Indonesia

**Gokula Kumar Appalanaido** Advanced Medical & Dental Institute, Universiti Sains Malaysia, Pulau Pinang, Malaysia

**Anusha Balasubramanian** Head and Neck Unit, The Royal Marsden Hospital NHS Foundation Trust, Chelsea, London, United Kingdom

**Paolo Boscolo-Rizzo** Department of Surgery, Oncology and Gastroenterology, section of Oncology and Immunology, University of Padova, Padova, Italy

**Roman Carlos** Department of Otolaryngology-Head and Neck Surgery, Hospital Universitario Reina Sofía, Cordoba, Spain

**Siew Hua Gan** School of Pharmacy, Monash University Malaysia, Jalan Lagoon Selatan, Bandar Sunway, Malaysia

**Francis Ho** National University Cancer Institute, National University Health System, Singapore

**Zul Izhar Mohd. Ismail** Department of Anatomy, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan, Malaysia

**Hasnan Jaafar** Department of Pathology, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, Kota Bharu, Malaysia

**Norhafiza Mat Lazim** Department of Otorhinolaryngology-Head and Neck Surgery, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan, Malaysia

**Karman Ka Ying Leung** Department of Otorhinolaryngology, Head and Neck Surgery, The Chinese University of Hong Kong, Shatin, P.R. China

**Irfan Mohamad** Department of Otorhinolaryngology-Head and Neck Surgery, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan, Malaysia

**Prepageran Narayanan** Department of ORL-HNS, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia

**Mai Abdel Haleem Abu Salah** Department of Medical Microbiology and Parasitology, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, Kota Bharu, Malaysia

**Sharifah Emilia Tuan Sharif** Department of Pathology, School of Medical Sciences, Universiti Sains Malaysia, Kubang Kerian, Malaysia; Hospital Universiti Sains Malaysia, Kubang Kerian, Malaysia

**Norasnieda Md Shukri** Department of Otorhinolaryngology-Head and Neck Surgery, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan, Malaysia

**Giacomo Spinato** Department of Neurosciences, Section of Otolaryngology and Regional Centre of Head and Neck Cancer, University of Padova, Treviso, Italy; Department of Surgery, Oncology and Gastroenterology, section of Oncology and Immunology, University of Padova, Padova, Italy

**Sharon D. Stoker** Department of Otorhinolaryngology-Head and Neck Surgery, AmsterdamUMC, The Netherlands

**Ing Bing Tan** Department of Otolaryngology-Head and Neck Surgery, Maastricht University Medical Center, Maastricht, The Netherlands; Department of Otolaryngology-Head and Neck Surgery, Gadjah Mada University, Yogyakarta, Indonesia; Department of Head and Neck surgery of The Netherlands Cancer Institute, Amsterdam, The Netherlands

**Ing Ping Tang** Department of ORL-HNS, Faculty of Medicine & Health Sciences, Universiti Malaysia Sarawak, Sarawak, Malaysia

**Michael Chi Fai Tong** Department of Otorhinolaryngology, Head and Neck Surgery, The Chinese University of Hong Kong, Shatin, P.R. China

**Raymond K. Tsang** Department of Surgery, The University of Hong Kong, Pokfulam, Hong Kong SAR, China

**William Ignace Wei** Department of Surgery, Hong Kong Sanitorium and Hospital, Happy Valley, Hong Kong SAR, China

**Maarten A. Wildeman** Department of Otorhinolaryngology Alrijne Hospital, Leiderdorp, The Netherlands

**Aidy Irman Yajid** Department of Pathology, School of Medical Sciences, Universiti Sains Malaysia, Kubang Kerian, Malaysia; Hospital Universiti Sains Malaysia, Kubang Kerian, Malaysia

**Chan Yean Yean** Department of Medical Microbiology and Parasitology, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, Kota Bharu, Malaysia

**Norzaliana Zawawi** Department of Pathology, School of Medical Sciences, Universiti Sains Malaysia, Kubang Kerian, Malaysia; Hospital Universiti Sains Malaysia, Kubang Kerian, Malaysia; School of Dental Sciences, Universiti Sains Malaysia, Kubang Kerian, Malaysia

4

# Surgical anatomy of the nasopharynx

*Ing Ping Tang*[1], *Prepageran Narayanan*[2] *and Zul Izhar Mohd. Ismail*[3]

[1]Department of ORL-HNS, Faculty of Medicine & Health Sciences, Universiti Malaysia Sarawak, Sarawak, Malaysia [2]Department of ORL-HNS, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia [3]Department of Anatomy, School of Medical Sciences, Universiti Sains Malaysia, Health Campus, Kubang Kerian, Kelantan, Malaysia

## Introduction

The pharynx is a conical fibromuscular tube that forms the upper part of the air and food passages. It is approximately 14 cm long and extends from the base of the skull to the lower border of the cricoid cartilage where it becomes continuous with the esophagus. The pharyngeal wall consists of four layers. They are the mucous membranes, pharyngobasilar fascia, muscular coat, and buccopharyngeal fascia. Anatomically, the pharynx is divided into the nasopharynx, oropharynx, and laryngopharynx.

## Surgical anatomy of nasopharynx

The nasopharynx lies posterior to the nasal cavities in between the floor of the sphenoid sinus and the soft palate. It has a roof, a floor, an anterior wall, a posterior wall, and lateral walls. The roof is supported by the body of the sphenoid and the basilar part of the occipital bone. A collection of lymphoid tissue, called the pharyngeal tonsil, is present in the submucosa of this region. The floor is formed by the sloping upper surface of the soft palate. The pharyngeal isthmus is the opening in the floor between the free edges of the soft palate and the posterior pharyngeal wall. The posterior wall forms a continuous sloping surface with the roof. It is supported by the anterior arch of the atlas. The anterior wall is formed by the posterior nasal apertures, separated by the posterior edge of the nasal septum (Snell, 1992). Located on each side of the lateral wall is the pharyngeal orifice of the Eustachian tube. It is bounded posterosuperiorly by a mucosal elevation called the torus tubarius. It is an elevation formed by the cartilage of the Eustachian tube. Located superior and posterior of the tubal

**An Evidence-Based Approach to the Management of Nasopharyngeal Cancer.**
**DOI:** https://doi.org/10.1016/B978-0-12-814403-9.00004-5

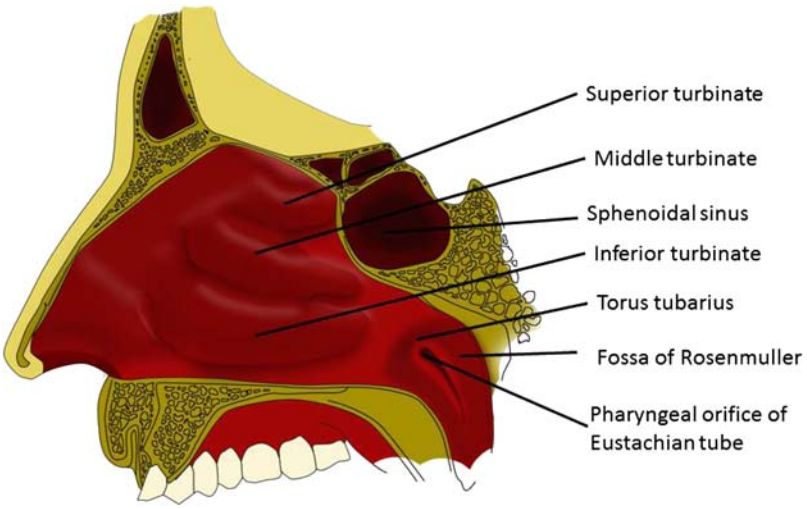


**Figure 4.1** Schematic diagram illustrating the lateral wall of the right nasal cavity and nasopharynx.

elevation is a recess called the fossa of Rosenmuller. There is a mucosal ridge extending from the inferior end of the torus tubarius to the lateral pharyngeal wall. This mucosal ridge is called the salpingopharyngeal fold. It is a mucosal fold formed by the salpingopharyngeus muscle (Dhingra, 2008) (Fig. 4.1).

The fossa of Rosenmuller is a bilateral projection of the nasopharynx just inferior to the skull base. It is also called the lateral pharyngeal recess or simply the pharyngeal recess. The fossa is covered by nasopharyngeal mucosa and is the most common site of origin of nasopharyngeal carcinoma. It is lined by pseudostratified ciliated columnar epithelium with goblet cells. It is located posterior to the torus tubarius, a prominence caused by the medial cartilaginous end of the Eustachian tube (Gray, 1918). The torus tubarius is larger on the superior and posterior lips of the Eustachian tube, effectively hiding the fossa (Fig. 4.2). The fossa extends through a defect between the fibers of the superior constrictor muscle and the base of the skull. The fibers of the superior constrictor muscle project from multiple parts of the lower oropharynx to the skull base, but the fibers only reach the skull base at the midline. The lateral defect, called the sinus Morgagni, is covered by a fibrous band known as the nasopharyngeal aponeurosis. Therefore the boundaries of the fossa of Rosenmuller are defined anteriorly by the Eustachian tube and the levator veli palatini muscle, posteriorly by the posterior wall of the nasopharynx and the retropharygngeal space, laterally by the parapharyngeal space and the tensor veli palatini muscle, and inferiorly by the upper edge of the superior constrictor muscle. The fossa's superior boundary is formed by the skull base with its various openings and prominences, including the foramen spinosum, the carotid canal, foramen lacerum, and foramen ovale. From its opening in the lateral nasopharynx, the fossa projects laterally posterior to the pharyngeal orifice of the Eustachian tube. At the apex of the fossa of

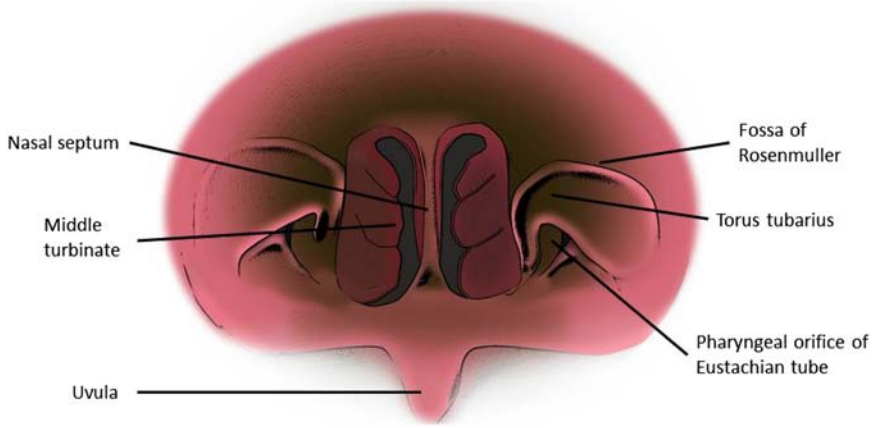


**Figure 4.2**
Anterior view of the nasopharynx as seen with a laryngoscope, depicting the fossa of Rosenmuller.

Rosenmuller, only a thin layer of fibroconnective tissue separates the mucosa from the cervical internal carotid artery (Amene et al., 2013).

The arterial supply of the nasopharynx is derived from branches of the ascending pharyngeal, the ascending palatine, the facial, the maxillary, and the lingual arteries. The veins drain into the pharyngeal venous plexus, which in turn drains into the internal jugular vein.

The nerve supply of the nasopharynx is mainly from the pharyngeal plexus. This plexus is formed from the branches of the glossopharyngeal, vagus, and sympathetic nerves. The sensory nerve supply of the mucous membrane of the nasal part of the pharynx is mainly from the maxillary nerve. The motor nerve supply is derived from the cranial part of the accessory nerve, which, via the branch of the vagus to the pharyngeal plexus, supplies all the muscles of the pharynx except the stylopharyngeus, which is supplied by the glossopharyngeal nerve (Snell, 1992).

The lymphatic drainage of the nasopharynx, including those of the adenoids and pharyngeal end of the Eustachian tubes, drain into upper deep cervical nodes either directly or indirectly through the retropharyngeal and parapharyngeal lymph nodes. They also drain into the spinal accessory chain of nodes in the posterior triangle of the neck. Lymphatics of the nasopharynx may also cross the midline to drain into contralateral lymph nodes.

## Important surgical adjacent structures

The infratemporal fossa (ITF) is an anatomical space located under the floor of the middle cranial fossa, posterior to the maxilla, medial to the ramus of the mandible, and lateral to the nasopharynx. The greater wing of the sphenoid

bone and the subtemporal surface of the temporal bone form the roof of the ITF. The lateral pterygoid plate along with the Eustachian tube forms its medial wall. The temporalis muscle attaching to the mandibular ramus and the temporomandibular joint form its lateral border (Fig. 4.3). The infratemporal fossa communicates with the pterygopalatine fossa (PPF) via the pterygomaxillary fissure, which is continuous with the inferior orbital fissure medially (Hosseini et al., 2012). It contains the parapharyngeal and masticator spaces. The styloid diaphragm, formed by the stylopharyngeal aponeurosis, separates the parapharyngeal space into pre- and poststyloid compartments. The prestyloid compartment is a narrow and fat-containing space between the medial pterygoid and the tensor veli palatini muscles. The poststyloid compartment contains the internal carotid artery, internal jugular vein, and lower cranial nerves (9th to 12th). The masticator space contains the masseter muscle, medial and lateral pterygoid muscles, the tendon of the temporalis muscle, the internal maxillary artery, the mandibular branch of the trigerminal nerve, the tensor and levator veli palatini muscles, the styloid diaphgram, and the Eustachian tube (Falcon et al., 2011; Fernandes, Lobo, Castro, Oliveira, & Som, 2013) (Fig. 4.4).

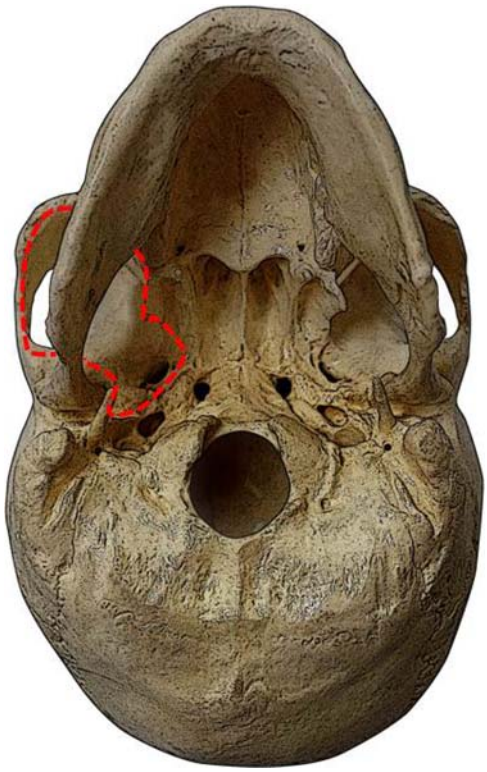

**Figure 4.3**
Inferior view of the base of skull. The boundary of infratemporal fossa is delineated by the *dotted line*.

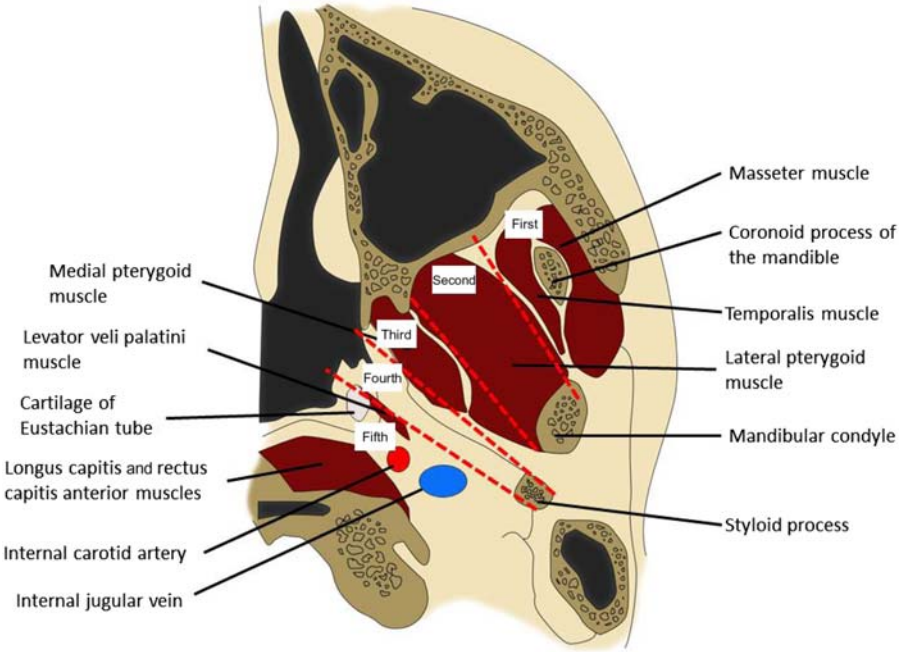


**Figure 4.4**
A cross-sectional view of the anatomical structures of the infratemporal fossa and its plane of dissection.

The ITF is defined in five planes of dissection, as we dissect from superficial to deep planes. The first plane of dissection lies between the lateral pterygoid muscle medially and the deep part of the temporalis muscle and mandibular ramus laterally. The second plane of dissection consists of the lateral pterygoid muscle. The third plane of dissection is located posterior to the lateral pterygoid plate, medial to the middle meningeal artery and mandibular nerve, and extends laterally to the temporomandibular joint. The fourth plane of dissection lies between the medial pterygoid and the tensor veli palatine muscles. The fifth plane of dissection lies in the poststyloid parapharyngeal space and contains the internal carotid artery (Hosseini et al., 2012).

The PPF is a pyramidal space limited by the pterygoid plates posteriorly, the palatine bone anteromedially, and the maxilla anterolaterally. The anterior compartment of the PPF contains the third portion of the internal maxillary artery and its terminal branches, whereas the posterior compartment contains the maxillary division of the trigeminal nerve and the sphenopalatine ganglion and its branches. The pterygomaxillary fissure forms the boundary as well as communication between the PPF and the infratemporal fossa. The fissure is also continuous with the infraorbital fissure. This portion of the infraorbital nerve delineates the border between the ITF and the PPF (Falcon et al., 2011) (Fig. 4.4).

## Conclusion

Surgical anatomy of the nasopharynx and adjacent structures is essential for understanding the diseases of this region and especially for planning of surgical interventions at the nasopharynx.

## References

Amene, C., Cosetti, M., Ambekar, S., Guthikonda, B., & Nanda, A. (2013). Johan Christian Rosenmuller (1771–1820): A historical perspective on the man behind the fossa. *Journal of Neurological Surgery. Part B, Skull Base*, *74*(4), 187–193.

Dhingra, P. L. (2008). *Diseases of ear, nose and throat*. New Delhi: Elsevier.

Falcon, R. T., Rivera-Serrano, C. M., Miranda, J. F., Prevedello, D. M., Snyderman, C. H., Kassam, A. B., & Carrau, R. L. (2011). Endoscopic endonasal dissection of the infratemporal fossa: Anatomic relationships and importance of Eustachian tube in the endoscopic skull base surgery. *The Laryngoscope*, *121*, 31–41.

Fernandes, T., Lobo, J. C., Castro, R., Oliveira, M. I., & Som, P. M. (2013). Anatomy and pathology of the masticator space. *Insights Into Imaging*, *4*(5), 605–616.

Gray, H. (1918). *Anatomy of the human body*. Philadelphia, PA: Lea & Febiger, Bartleby.com, 2000.

Hosseini, S. M., Razfar, A., Carrau, R. L., Prevedello, D. M., Fernandez-Miranda, J., Zanation, A., & Kassam, A. B. (2012). Endonasal transpterygoid approach to the infratemporal fossa: Correlation of endoscopic and multiplanar CT anatomy. *Head & Neck*, *34*, 313–320.

Snell, R. S. (1992). *Clinical anatomy for medical students*. Boston, MA: Little, Brown & Company.