



The role of diffusion MR Imaging in diagnosis and follow up of pharyngeal carcinoma

Thesis

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Radiodiagnosis*

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وَقُلْ اَعْمَلُوا فَسَيَرَى اللّٰهُ
عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ





*First of all I thank **God** who blessed me in all my steps.*

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 *Basman Radhi*

A decorative illustration in the top right corner of the text area. It features a green vine with yellow flowers, a blue butterfly, and a small brown insect. The entire text and illustration are enclosed in a double-lined black border.

**To my
Family and
my Wife**

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List of Abbreviations

ADC	Apparent Diffusion coefficient
AJCC	American Joint Committee on Cancer
CE MRI	Contrast enhanced magnetic resonance imaging
CT	Computed tomography
DW / DWI	Diffusion weighted / Imaging
EBV	Epstein-Barr virus
EPI	Echoplanar imaging
FDG-PET	18F-fluorodeoxyglucose positron emission tomography
HPC	Hypopharyngeal carcinoma
HPV	Human papilloma virus
LN	Lymph node
MR / MRI	Magnetic resonance / Imaging
NPC	Nasopharyngeal carcinoma
OPC	Oropharyngeal carcinoma
PACS	Picture archiving and communication system
PMS	Pharyngeal mucosal space
PVS	Paravertebral space
RPS	Retropharyngeal space
SCC	Squamous cell carcinoma
T1WI/T2WI	T1 / T2 weighted images
TE	Echo time
TR	Repetition time
WHO	World health organization

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Anatomy of Pharynx

The pharynx is a fibromuscular tube that is semicircular in cross section and is situated directly anterior to the vertebral column. It extends from the skull base to the lower border of the cricoid cartilage. Six muscles are predominantly responsible for the voluntary actions of the pharynx: three pharyngeal constrictor muscles that are roughly circularly layered on top of one another and three vertically oriented muscles (stylopharyngeus, salpingopharyngeus, and palatopharyngeus) (*Auger and Dalley, 2009*).

The pharynx serves as a continuation of the digestive cavity, providing a route from the oral cavity proper to the esophagus. In addition, the pharynx communicates with the nasal cavity, the middle ear cavity, and the larynx. The pharynx is often described from an exterior view and an interior perspective. Based on the location, the interior of the pharynx is often separated into three sections-the nasopharynx, oropharynx, and laryngopharynx (*Berkovitz and Moxham, 2002*).

Gross Anatomy

To best interpret the anatomy of the pharynx, the pharynx is often divided into exterior and interior sections. The external surface is typically described from posterior and lateral views and includes external surface muscles that compose the wall of the pharynx, associated nerves, and blood supply. However, the interior of the pharynx is typically described from either a sagittal cross-section or a posterior view as a dissection in which the external wall of the pharynx is split midline. The remaining halves are retracted laterally to reveal the internal anatomical landmarks and muscles of nasopharynx, oropharynx, and laryngopharynx (*Rosse et al., 1997*).

The following sections describe the exterior and interior pharynx in detail.

1. Exterior of the Pharynx

From the posterior view, the exterior surface of the pharynx lies anterior to the cervical vertebrae. It connects to the occipital bone anterior to the foramen magnum. The exterior surface of the pharynx consists of voluntary muscle covered externally by a fine buccopharyngeal fascia, which is continuous with the external surface of the buccinator muscle.

Found directly on top of the buccopharyngealfascia are the pharyngeal venous plexus and the pharyngeal nerve plexus. Posterior to the buccopharyngeal fascia but anterior to the alar fascia (prevertebral fascia), a loose connective tissue-occupying space exists, known as the retropharyngeal space. Specifically, the retropharyngeal space extends superiorly to the skull base and inferiorly to the infrahyoid region of the neck (*Rosse et al., 1997*).

Within the retropharyngeal space slightly superior to the bifurcation of the carotid artery is a large retropharyngeal lymph node along with minor lymph nodes that drain most of the pharynx's lymphatics. Continuous with the retropharyngeal space but extending laterally around the pharynx exist the left and right parapharyngeal spaces. The parapharyngeal spaces are bound superiorly by the skull base, but unlike the retropharyngeal space extend inferiorly only to the sheath of the submandibular gland in the suprahyoid region. These spaces are bound medially by the pharynx and laterally by pterygoid muscles of the infratemporal fossa and the parotid fascia (*Rosse et al., 1997*).

The exterior wall of the pharynx consists primarily of four muscles: superior pharyngeal constrictor, middle pharyngeal constrictor, inferior pharyngeal constrictor, and stylopharyngeus. The three pharyngeal constrictor muscles are quite simply arranged as they overlap each other in a vertical arrangement. Although the three pharyngeal constrictor muscles have different origins anteriorly, their fibers all insert in the midline posteriorly to form the pharyngeal raphe (**Figure1.1**) (*Rosse et al., 1997*).

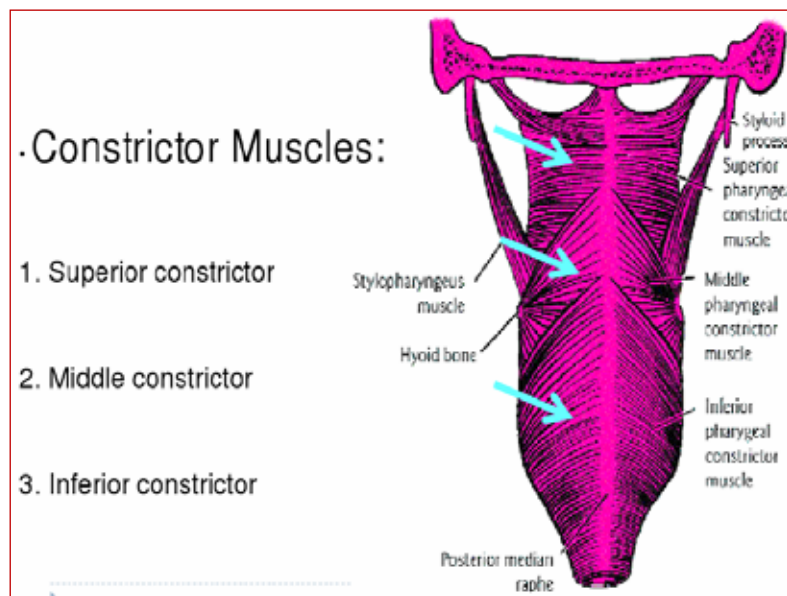


Fig. (1.1): Muscles of pharynx demonstrating the superior, middle and inferior constrictor muscles (*Quoted from Rosse et al., 1997*).

- **The superior pharyngeal constrictor muscle**

Originates from multiple anatomical sites on the lateral aspect of the face prior to forming the posterior wall of the pharynx. Specifically, it originates from the posterior border of the pterygomandibular raphe, pterygoid hamulus of the sphenoid bone, posterior end of the mylohyoid line of the mandible, and lateral aspect of the tongue. Once the fibers reach