Review article

Imaging of the oropharynx and oral cavity

Part I: Normal anatomy

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Abstract. This article reviews the anatomy of the oropharynx and oral cavity, as seen on CT and MR imaging studies. Emphasis is placed on the description and illustration of the structures which are of importance to detect tissue alterations and interpret them adequately. Common pitfalls in the image interpretation of this region are indicated.

Key words: pharynx, anatomy - pharynx, CT - pharynx, MR

Introduction

Tumoural pathology is the most frequent reason for performing cross-sectional imaging of the oropharynx and oral cavity. The majority of these tumours are malignant and arise from the mucosal lining. Mucosal abnormalities can be far better evaluated by the clinician than with sophisticated imaging methods such as CT or MR. These tumours, however, have the tendency to spread submucosally; extension into the deep tissue planes is difficult to detect by clinical examination. A good knowledge of the normal anatomy is necessary to be able to describe and make an interpretation of the sometimes subtle, but important, alterations seen on CT or MR imaging studies of this region.

Normal anatomy

Oropharynx

The pharynx is divided into three sections: The nasopharynx lies behind the nasal cavity, the oropharynx lies behind the oral cavity and the hypopharynx lies behind the larynx, merging with the proximal oesophagus at the level of the cricoid bone (Fig. 1). The oropharynx can be defined as that part of the pharynx visible through the opened mouth. It should be distinguished from the oral cavity lying in front of the oropharynx: The oral cavity has its own anatomical peculiarities and can harbour a number of pathological processes not seen in the oropharynx.

The posterior and lateral wall of the pharynx is composed of interweaving muscular structures known as the pharyngeal constrictor muscles. Several parts are distinguished in these muscles depending on the point of origin of the muscle fibres. They all insert on a midline localised fibrous raphe. A number of other muscles contribute to the formation of this pharyngeal wall, such as the stylopharyngeal muscle, arising from the styloid process, and the palatopharyngeal and salpingopharyngeal muscles. This posterolateral wall of the pharynx is a continuous structure without markings allowing separation in a naso-, oro- or hypopharyngeal level.

The anterior wall of the pharynx displays a far more complex anatomy. The soft palate separates the nasopharynx from the oropharynx; often one uses a line drawn through the hard and soft palate as a demarcation line on the lateral and posterior wall. The oropharynx is separated from the hypopharynx by the pharyngo-epiglottic folds (Fig. 2); the hypopharynx starts posterior and inferior to these folds.

The border between the oropharynx and oral cavity is more complex, being ring-like and composed of several structures. The upper part of this ring is formed by the junction between the hard and soft palate: The hard palate is therefore a structure belonging to the oral cavity, whereas the soft palate is an oropharyngeal structure (actually, only its undersurface; the upper surface belongs to the nasopharynx). The lateral part of the ring is formed on both sides by a mucosal fold known as the anterior tonsillar or anterior faucial pillar. This mucosal fold marks the anterior border of the tonsillar fossa. The lower part of the ring is formed by a row of small structures on the back of the tongue, the circumvallate papillae, one of the several types of papillae on the tongue surface containing the taste buds. These papillae

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are on a V-shaped line with the tip of the V pointing posteriorly. This line demarcates the posterior third or base of the tongue, which is by definition part of the oropharynx.

The soft palate appears as a simple structure, a tissue flap hanging against the back of the tongue (Fig. 1). Actually, it is a complex structure made up of muscles, some fat and lymphoid tissue. There is one small intrinsic muscle in the soft palate; several extrinsic muscles extend beyond the confines of the soft palate, with their origin or insertion on the skull base, lateral pharyngeal wall or tongue base. Two muscles arising from the skull base take part in the formation of the soft palate. The more medial one is known as the levator veli palatini, whereas the more lateral one is known as the tensor veli palatini (Fig. 3). This levator muscle joins its partner from the opposite side to form a sling which suspends the soft palate. When the levator muscles contract, they pull the soft palate posteriorly and superiorly. The fibres of the tensor muscle form a tendon running underneath a bony hook of the pterygoid process of the sphenoid bone, known as the hamulus, and then join the tendon of the heterolateral tensor muscle.

The levator and tensor muscle of the soft palate have an important role during deglutition, because they close the nasopharynx from the oropharynx during the passage of liquids and food. Also, during phonation the nasopharynx is sealed, avoiding nasalisation of sound, except for the nasal phonemes. These muscles form a functional unit with the Eustachian tube. At rest, tissue turgor and elastic recoil of the tube cartilage close the Eustachian tube fissure. The tube needs to be opened regularly to equilibrate air pressure between the internal and external aspect of the tympanic membrane and to drain the secretions from the middle ear. The fissure is opened when contraction of the tensor muscle occurs simultaneously with contraction of the levator muscle. This simultaneous contraction occurs only during swallowing and yawning. During phonation only the levator contracts, which does not open the tube’s fissure and avoids interference in hearing one’s own voice [1].

In cases where the function of the soft palate is insufficient, sometimes a greater convergence of the posterior pharyngeal wall can be seen during phonation or swallowing. This is known as Passavant’s cushion or bar. It is due to a localised muscular contraction trying to compensate for the insufficiency of the soft palate. It is not a normal finding, although the patient can be asymptomatic [2].

The lateral oropharyngeal wall consists of the palatine tonsil and tonsillar pillars. Both the anterior and posterior tonsillar pillar are mucosal folds produced by underlying muscular structures. These two muscles are both extrinsic palatal muscles. The anterior one is the palatoglossal muscle, connecting the soft palate with the tongue base. This muscle is actually also an extrinsic tongue muscle, and together with the overlying mucosa, it is a very important structure to understand the extension pattern of oropharyngeal tumours. A lot of these tumours arise on the anterior tonsillar pillar, using this muscle as a pathway to spread into the soft palate and tongue base. The posterior muscle is the palatopharyngeal muscle, which takes part in the formation of the muscular pharyngeal wall. The muscles of the tonsillar pillars have an important function during deglutition because, together with other muscles, they close the pharyngeal inlet, preventing regurgitation from the oropharynx to the oral cavity during the early pharyngeal phase of swallowing.

Between the tonsillar pillars lies the tonsillar fossa, containing the palatine tonsil, which is made up of encapsulated lymphoid tissue. It is one of the major tonsils in the lymphoid ring of Waldeyer, together with the lingual tonsil and the pharyngeal tonsil in the roof of the nasopharynx.

These different structures, building up the lateral oropharyngeal wall, can be well seen clinically. On CT scans they usually cannot be distinguished, all displaying the same density. Sometimes, the lymphoid tissue of the palatine tonsil can be recognized on MR images, due to a higher T2 signal intensity than the surrounding muscular structures, especially in cases of inflammation or lymphoma.

The lateral oropharyngeal walls sometimes appear somewhat asymmetrical. This can be due to asymmetrical chronic inflammation of the palatine tonsils, a condition regularly seen in the patient population at risk for tumour pathology of this region, often smokers and drinkers (Fig. 4). Slight asymmetry in the thickness of the lateral oropharyngeal walls should therefore not be considered as evidence of a tumour, although it should be regarded with suspicion, making sure no other signs of tumour involvement are present.

Small calcifications are sometimes seen in the tonsilar tissue. They are probably due to calcium precipitation in areas of previous or chronic inflammation. They have no further importance. Small retention cysts can also be seen in this region.

Between the tongue base and the free edge of the epiglottis a pit is formed, divided by a median mucosal fold running from the base of the tongue to the epiglottis, known as the glosso-epiglottic fold. These pits are called the valleculae (Fig. 2). The anterior border of the free edge of the epiglottis is also considered to belong to the oropharynx. Underneath the bottom of the valleculae a laryngeal fat plane is present, known as the pre-epiglottic fat plane. This fat tissue sometimes serves oropharyngeal tumours to dive into the larynx, an extension that is often occult to the examining clinician.

Within the mucosal space of the tongue base lymphatic tissue is found, forming the lingual tonsil. This tonsil can appear prominent in younger subjects, prolapsing into the valleculae. The volume of the lingual tonsil (as that of the other tonsils) decreases with age. Patients older than 40 years are not expected to have a significant amount of residual lymphatic tissue, but small tags of tissue may persist. The volume of this lingual tonsil may increase due to an upper respiratory tract infection, but also due to an extranodal lymphoma localisation [3]. Differentiation between a persistent or asymmetrical appearing lingual tonsil and a malignant