Operative Techniques in Otolaryngology (2016) 27, 60–66

ELSEVIER

Operative Techniques in Otolaryngology

Surgical anatomy and physiology of swallowing

Max Hennessy, BS, David Goldenberg, MD, FACS

From the Division of Otolaryngology—Head & Neck Surgery, Department of Surgery, College of Medicine, The Pennsylvania State University, Hershey, Pennsylvania

KEYWORDS
swallowing;
Deglutition;
oral phase;
tongue base;
pharynx;
esophageal phase

Deglutition, the act of swallowing, is an extremely complex process involving approximately 50 pairs of muscles and nerves that are responsible for preparing and transferring food and liquids from the mouth to the stomach. A problem with any of these structures can lead to dysphagia and a decrease in the quality of life in patients suffering from it. To successfully diagnose and treat dysphagia, a thorough understanding of deglutition is essential. The anatomy and physiology of the swallowing process is reviewed as it pertains to operative approach and technique.

Introduction

Deglutition is a complex process, which transports ingested food and liquid from the mouth to the stomach. Swallowing requires the coordination of 3 anatomically and functionally separate upper aerodigestive tract structures, which comprise the following swallowing apparatus: the oral cavity, the pharynx, and the larynx.[1-4] These structures act as a hydrodynamic pump with valves that allows food and liquid to be transferred into the stomach without entering the respiratory tract.[1,3] The act of swallowing is divided into the following 3 phases: the oral phase, pharyngeal phase, and esophageal phase, each of which corresponds to the location of the food bolus in the swallowing apparatus. The initial stage of deglutition, the oral phase, is voluntary and triggers the subsequent involuntary pharyngeal and esophageal phases.[1-3] Dysphagia is a symptom caused by a multitude of diverse diseases that can affect each phase of deglutition, and cause a serious deterioration in the quality of life of affected patients.[3] To surgically treat dysphagia, a thorough understanding of the anatomy and physiology of deglutition is required to both identify the affected stage(s) of swallowing and the appropriate intervention needed to treat them.

Address reprint requests and correspondence: David Goldenberg, MD, FACS, Division of Otolaryngology—Head and Neck Surgery, The Milton S. Hershey Medical Center, The Pennsylvania State University, 500 University Dr, PO Box 850, H091 Hershey, PA.
E-mail address: dgoldenberg@hmc.psu.edu

http://dx.doi.org/10.1016/j.otot.2016.04.002
1043-1810/

Anatomy of the oral cavity

The oral phase of swallowing occurs in the oral region that consists of the lips, cheeks, teeth, gums, oral cavity, hard and soft palate, and the palatine tonsils. Food processing and bolus formation occurs in the oral cavity proper that is the space between the upper and lower dental arches. It is limited laterally and anteriorly by the dental arches, superiorly by the palate and inferiorly by the tongue.[5] Posteriorly, the oral cavity proper transitions into the oropharynx that is the superior portion of the pharynx (Figures 1 and 2). The lips surround the mouth and form a sphincter using the orbicularis oris muscle that controls entrance and exit from the oral cavity.[5] They are covered externally by specialized skin, internally by a mucous membrane, and contain the superior and inferior labial muscles, vessels, and nerves.[5] The cheeks form the lateral walls of the oral cavity and are continuous with the lips with the same skin and internal mucous membrane. Internally, the cheeks contain the buccinator muscles and the buccal fat pads, which lie superficial to the buccinators.[5] The hard palate composes the anterior two-third of the palate and

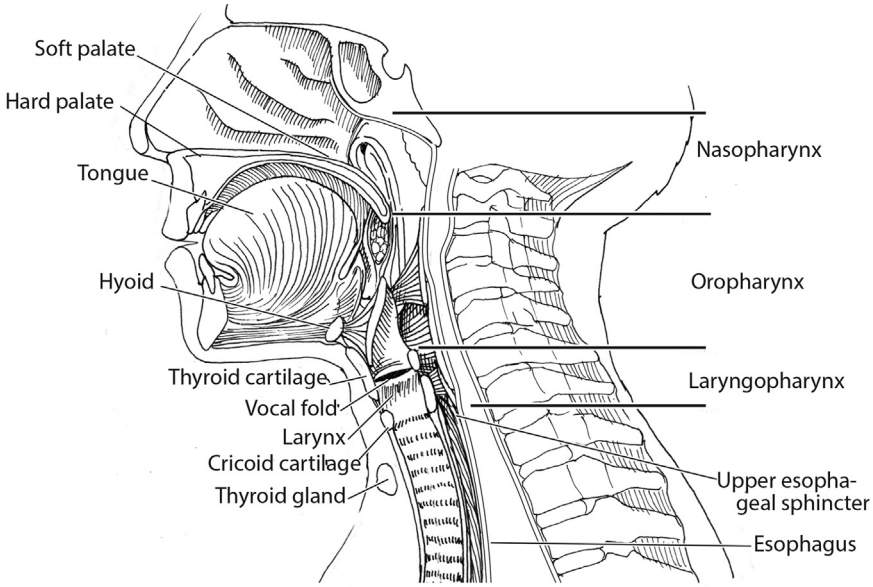

Figure 1 Sagittal view of the head and neck showing the structures of the oral cavity, pharynx, and larynx.

forms a bony concave roof covered with a mucous membrane. The soft palate is a mobile fibromuscular fold, which comprises the posterior one-third of the palate and separates the nasal cavity from the nasopharynx.[6] There is a subtle color change from pink of the hard palate to yellow-red of the soft palate.[2,5] The soft palate is suspended anteriorly from the posterior edge of the hard palate by the palatine aponeurosis, which is thick anteriorly and thins posteriorly as it combines with the muscular section.[5] Posterior and inferiorly, the soft palate has a curved free margin from which the uvula hangs. Laterally, the soft palate is continuous with the palatoglossal and the palatopharyngeal folds, which join it to the tongue and the pharynx respectively.[5] The space between the oral cavity and the pharynx is termed the fauces, and is bound superiorly by the soft palate, laterally by the palatoglossus and the palatopharyngeal arches, and inferiorly by the root of the tongue. The soft palate contains 5 muscles which emanate from the base of the skull and descend to the palate.[3,5] The levator palatini muscle that moves the soft palate upwards and backwards during swallowing, extends inferiorly, medially, and anteriorly from both the petrous part of the temporal bone and the cartilage pharyngotympanic tube, and inserts on the mid partition of the palatine aponeurosis.[2] The tensor veli palatini muscle, responsible for tensing the soft palate and opening the pharyngotympanic tube during swallowing, extends from the scaphoid fossa of the medial pterygoid plate, spine of sphenoid bone, and cartilage of pharyngotympanic tube.[3,5] It extends first inferiorly, and then turns at a 90° angle medially over the

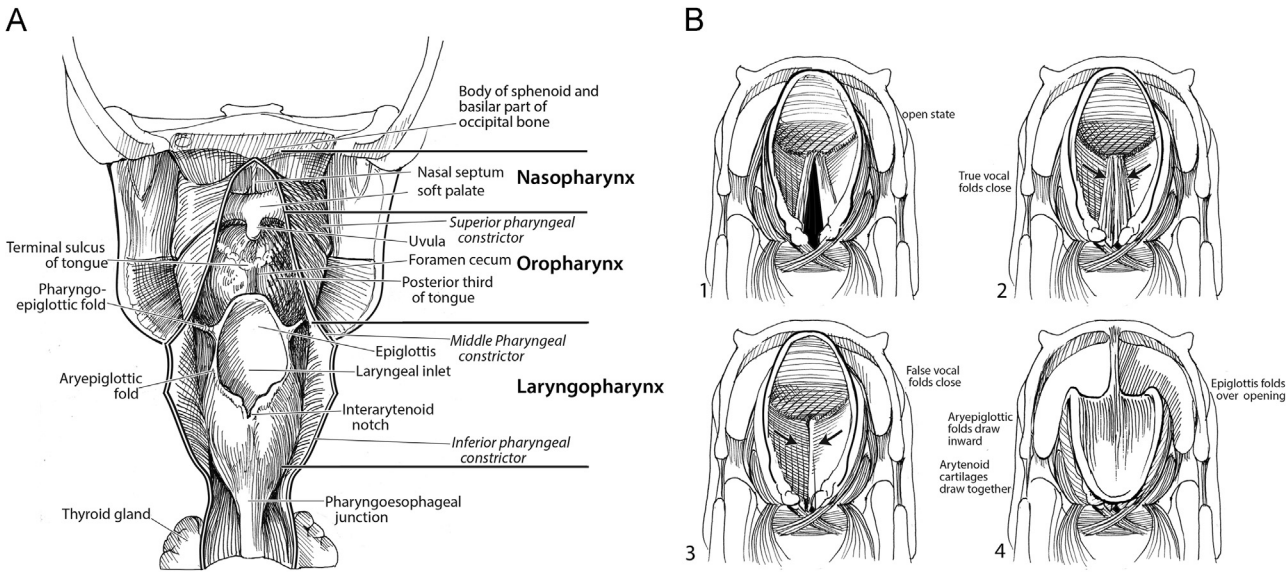

Figure 2 Anterior wall of the pharynx. The posterior wall has been excised to show the connections of the pharynx to the oral cavity and esophagus.