



## Teaching the pharyngeal flap and sphincter pharyngoplasty: The sticky note method



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### ABSTRACT

**Objective:** To demonstrate a cost-effective, quick, and easily reproducible three-dimensional sticky note model to enhance the understanding and conceptualization of the geometry and steps of the pharyngeal flap and sphincter pharyngoplasty.

**Methods:** The method involves making specified incisions and rearrangements of readily available components, including disposable clear plastic cups, yellow and pink sticky notes, and white paper. Once assembly is complete, further incisions and remodeling are performed to simulate a pharyngeal flap or sphincter pharyngoplasty.

**Results:** The cost of the materials to make one model was \$0.94. Average construction time was less than 10 min.

**Conclusion:** This three-dimensional model is an efficient, interactive, and simple visual aid to teach surgical trainees the geometry and steps of the pharyngeal flap and sphincter pharyngoplasty.

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## 1. Introduction

Velopharyngeal dysfunction (VPD) refers to the inability to completely close the space between the velum and posterior pharyngeal wall during speech, resulting in nasal emission, hypernasality, and poorly intelligible speech. The pharyngeal flap and sphincter pharyngoplasty are two alternative surgical treatments for VPD first described in 1875 and 1950, respectively [1,2]. These surgical techniques are designed to create a functional seal between the nasopharynx and oropharynx during speech without creating nasal airway obstruction [3].

The pharyngeal flap procedure involves suturing a central myomucosal flap from the posterior pharyngeal wall to the posterior velum. This flap corrects central gaps and leaves smaller lateral ports on each side. While some advocate calibrating the size of the lateral ports, others endorse that successful occlusion of the pharyngeal port is more dependent on the dynamic medial movement of the lateral pharyngeal walls [4,5]. This procedure is thus ideal for patients with adequate lateral pharyngeal wall

motion visualized on video nasoendoscopy or multiview speech videofluoroscopy in the anteroposterior dimension [6].

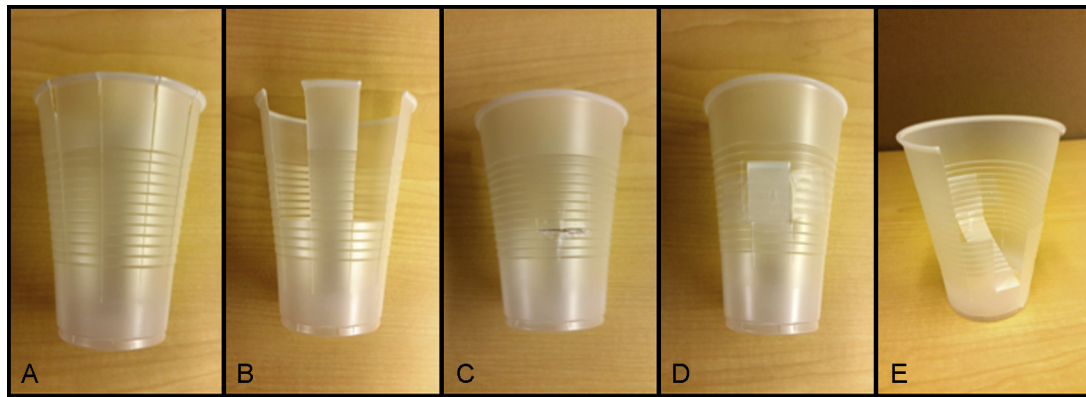
On the other hand, the sphincter pharyngoplasty procedure involves the elevation and medialization of bilateral palatopharyngeal myomucosal flaps from the posterior tonsillar pillars. The flaps are then sutured to each other end-to-end and into a transverse incision in the posterior pharyngeal wall, thereby creating a transverse mound of tissue that resolves lateral defects and creates a smaller central port [7].

A major drawback of these two procedures is the technical challenge of teaching surgical trainees. Inherent difficulties with pharyngeal flaps and sphincter pharyngoplasty include the need to work in a small cavity, poor visualization, poor depth perception, awkward angles, and limited access by both the surgeon and assistant [8]. These procedures were conventionally taught using two-dimensional (2D) drawings or photographs in textbooks. Recently, three-dimensional (3D) teaching models have been designed for better visualization and conceptualization of the Furlow double-opposing Z-plasty, the first of which utilized styrofoam, cardboard, and latex [9]. Another model utilized sticky notes for 3D visualization of the same procedure, which greatly reduced construction time [10]. 3D cleft palate simulator models have also been created to facilitate real-time surgical training; however, these either required materials that were expensive and difficult to procure or required dental laboratory facilities for assembly [8,11].

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**Fig. 1.** Steps 1–4 of the plastic cup assembly. (A and B) Anterior view. (C and D) Posterior view. (E) Completed plastic cup model, anterolateral view.

Despite the recent development of 3D models for Furlow palatoplasty, there are no 3D models for teaching pharyngeal flaps or sphincter pharyngoplasty. We propose a very affordable and swiftly reproducible 3D teaching model utilizing sticky notes, a clear plastic cup, and readily available office supplies designed to improve trainees' understanding and conceptualization of the pharyngeal flap and sphincter pharyngoplasty.

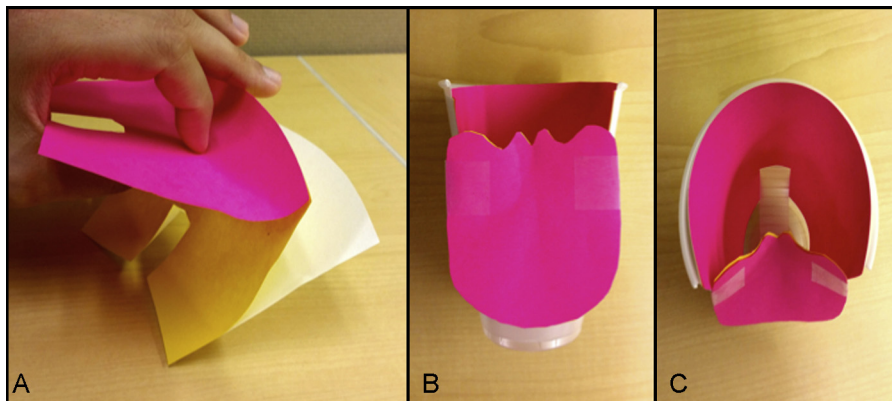
## 2. Materials and methods

Materials that were used to construct this model included a 9-fluid ounce (roughly 0.25 L) clear plastic cup, 8" × 6" yellow and pink sticky notes, 11" × 8.5" sheets of white paper, scissors, knife/scalpel, clear tape, and a metric ruler.

The first portion of assembly involved construction of the plastic cup (Fig. 1). (1) Two vertical straight 7.5-cm incisions were made from the rim of the cup with scissors to create a strip measuring 2.0-cm in width at the top and 1.25-cm in width at the bottom, which represented the nasal septum. (2) Two more identical incisions 2.0-cm lateral to the first two incisions were created to generate two new strips measuring 2.0-cm in width at the top and 1.25-cm in width at the bottom. These two new strips were then cut 5.0-cm from the rim to form shorter strips, which represented the palatal shelves. These two steps resulted in a 7.5-cm long central strip and two 3.0-cm long lateral strips. (3) A knife was then used to create a 2.0-cm transverse slit that was 5.5-cm from the rim on the posterior surface of the cup. (4) The central strip was then retracted back through the slit and pulled 2.5-cm above the slit so that there was tension on the strip in order to resemble the posterior border of the vomer.

The second portion of assembly involved construction of the posterior pharyngeal wall using 8" × 6" yellow and pink sticky notes (Fig. 2). We designed a printable PDF template of the posterior pharyngeal wall model for easy tracing that is available online (Supp. material). If printed in color, the template can also be used to visualize the palatine tonsils, which are marked as darker patches on the lateral aspects of the posterior pharyngeal wall model. (1) One 8" × 6" pink sticky note was attached to an 8" × 6" yellow sticky note, which then attached to an 11" × 8.5" sheet of white paper. The pink represented pharyngeal mucosa, yellow represented pharyngeal muscle and submucosal tissue, and white represented prevertebral fascia. We found it most useful to have the sticky portion of the yellow note attached upside-down toward the bottom of the sheet of white paper and then to have the sticky portion of the pink note attached 4.5-cm below the superior edge of the yellow note. (2) Next, the superior border of the posterior pharyngeal wall template was approximated to the superior edge of the pink sticky note and traced. (3) The sticky notes were then cut to create the posterior pharyngeal wall model.

Similarly, the third portion involved construction of the palate using 8" × 6" yellow and pink sticky notes as described previously [10]. We also designed a printable PDF template of the palate model for easy tracing (Supp. material). (1) A pink sticky note was attached to a yellow sticky note, which then attached to another pink sticky note. The superficial pink represented oral mucosa, yellow represented palatal muscle and submucosal tissue, and deep pink represented nasal mucosa. We found it most useful to stagger the pink and yellow sticky notes so that there was an overlapping middle region of 7.5-cm. (3) The sticky notes were then cut with scissors using the palate template as a guide.



**Fig. 2.** Assembly of the pharyngeal wall model and palate model. (A) Posterior pharyngeal wall model with pink sticky note, yellow sticky note, and white paper attached in an accordion fashion. Pink = pharyngeal mucosa, yellow = pharyngeal muscle and submucosal tissue, white = prevertebral fascia. (B and C) Attachment of the posterior pharyngeal wall model and palate model to the cup, anterior and superior views.

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