Localization of the Muscular Process for Arytenoid Adduction Surgery

Joshua R. Mitchell, BA; Bryan R. McRae, MD; Stacey L. Halum, MD;
Department of Otolaryngology-Head and Neck Surgery, Indiana University School of Medicine,
Indianapolis, Indiana, U.S.A

ABSTRACT

Objective: Arytenoid adduction (AA) surgery can be technically challenging, potentially limiting its utilization in general practice. Since AA often serves as an adjunct to Thyroplasty Type I (TTI) in the management of unilateral vocal fold paralysis (UVFP), this study sought to define the anatomic position of the muscular process (MP) of the arytenoid cartilage in relation to the TTI window and other key thyroid cartilage landmarks, thereby facilitating a more efficient surgical approach.

Study Design: Cadaveric anatomic dissections.

Methods: Arytenoid MP and other key thyroid cartilage landmarks were identified bilaterally in eight cadavers for a total of 16 hemilarynges. The location of the MP was measured relative to the anteroinferior corner of the traditional TTI window and parallel to the inferior border of the thyroid cartilage. In males, the mean distance to the MP was 26.9 mm from the anteroinferior corner of the window, while in females the mean distance was 18.9 mm. In all cases, the MP was inferior to the midpoint between the roots of the superior and inferior cornua (mean inferior offset = 2.7 mm).

Conclusion: The TTI window can be used intraoperatively to help locate the arytenoid muscular process during arytenoid adduction surgery.

INTRODUCTION

In the management of unilateral vocal fold paralysis (UVFP), arytenoid adduction (AA) dissections can be quite technically challenging. AA typically serves as an adjunct to Thyroplasty Type I (TTI) if TTI fails to adequately correct the posterior glottic gap during phonation. Despite AA often being used as an adjunct to TTI, no previous studies describe the position of the MP relative to the TTI window. Previous methods for locating the arytenoid MP often lack specificity or direct clinical applicability. One method, for example, by Armin et al.1 proposes locating the MP at the posterior border of the thyroid cartilage, half-way between the root of the superior cornu and the root of the inferior cornu. While this approach permits a more limited dissection, its authors note considerable variability in the underlying relationship; in addition, the field of dissection during AA does not always fully reveal the two cornual roots.

The goal of this study was to identify pertinent intraoperative landmarks that can be reliably used to identify the arytenoid MP and to facilitate a safer, more directed and more limited posterior laryngeal dissection during AA procedures.

Specific Aims

To use cadaver laryngeal dissections to anatomically define the position of the MP of the arytenoid cartilage:

- In relation to the anteroinferior corner of the TTI window
- Relative to the roots of the superior and inferior cornua, for comparison with previously described findings

METHODS AND MATERIALS

Sixteen hemilarynges from 8 human cadavers were dissected in a manner typical for a medialization laryngoplasty and AA. After resecting the strap and inferior constrictor muscles to fully expose the thyroid cartilage, a linear strip of cartilage along the posterior thyroid lamina was resected to aid in visualizing the MP. Representative digital photographs were obtained.

The distance to the MP was measured relative to the anteroinferior corner of the typical medialization laryngoplasty window, with the anteroinferior corner defined based on guidelines from multiple authors.2-4 After marking the anteroinferior corner of the TTI window, the axial distance to the arytenoid MP (distance “B”) was measured with a rule (Figure 1). To prevent notching of the thyroid cartilage from distorting the inferior border of the thyroid cartilage, this border was defined from the mid to posterior hemilarynx. In all cases, the MP was offset 1 mm or less in the axial/transverse line (which was within the error of measurement), so superior offsets or angles were not recorded. In order to compare findings to those of Armin et al., the position of the arytenoid MP in relation to the roots of the superior and inferior cornua on the thyroid cartilage was also measured.

Measurements were taken bilaterally on 4 female and 4 male cadavers for a total of 16 hemilaryngeal measurements.

Duplicate measurements were recorded by a second researcher (blinded with respect to the initial data) and the 2 data sets were averaged. If a discrepancy between two measurements was noted, a third researcher repeated the measurements and all values were used to calculate the mean.

RESULTS

The mean distances from the anteroinferior corner of the window to the MP (distance B) are indicated in Table I. The mean distance B was 8.0 mm greater in male larynges than female larynges (Table I). In all cases, the MP was inferior to the midpoint between the roots of the superior and inferior cornua (mean inferior offset = 2.7 mm) (Figure 2 and Table II).

DISCUSSION / CONCLUSION

TTI Window as Surgical Landmark

- Arytenoid MP sits roughly at the axial level of the TTI window’s anteroinferior corner
- Mean transverse distance to arytenoid MP (Distance “B”) was found to be 18.9 mm in women and 26.9 in men, with little variation (3.1 mm or less in all specimens)
- This relationship may be useful intraoperatively to help limit posterolateral thyroid cartilage dissection during TTI with AA

MP Location Relative to Cornua Roots

- Armin et al. study1 suggested the arytenoid MP to be near the midpoint between the two cornual roots
- On average, our study found the MP to be 2.7 mm inferior to the midpoint between the roots of the superior and inferior cornua
- Inferior offset (below the midpoint) was noted among all 16 hemilarynges in our study

REFERENCES


Table I. Measurement Between Muscular Process and Anterior-Inferior Corner of TTI Window (mm)

<table>
<thead>
<tr>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadaver</td>
<td>Thyroid Cartilage</td>
</tr>
<tr>
<td>Right Lamina</td>
<td>Left Lamina</td>
</tr>
<tr>
<td>A-sup</td>
<td>24.5</td>
</tr>
<tr>
<td>A-inf</td>
<td>26.5</td>
</tr>
<tr>
<td>A-sup</td>
<td>23.5</td>
</tr>
<tr>
<td>A-inf</td>
<td>24.5</td>
</tr>
<tr>
<td>Mean per pair</td>
<td>25.1</td>
</tr>
<tr>
<td>Mean Overall Distance (mm)</td>
<td>26.9</td>
</tr>
</tbody>
</table>

Table II. Muscular Process Level Relative to Roots of the Superior and Inferior Cornua

<table>
<thead>
<tr>
<th>A-mm</th>
<th>MALES</th>
<th>FEMALES</th>
<th>MALES</th>
<th>FEMALES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean = 24.0 (range 23.0 - 28.0)</td>
<td></td>
<td>17.9 (16.0 - 20.0)</td>
<td>26.0 (23.5 - 28.0)</td>
<td>28.0 (17.0 - 21.5)</td>
</tr>
<tr>
<td>A-sup (mm)</td>
<td>12.5</td>
<td>9.6</td>
<td>6.7</td>
<td>1.7</td>
</tr>
<tr>
<td>A-inf (mm)</td>
<td>11.9</td>
<td>8.3</td>
<td>3.4</td>
<td>2.3</td>
</tr>
<tr>
<td>Offset from midpoint (mm)</td>
<td>-0.85 (+1.5 to -3.5)</td>
<td>-0.7 (0.0 to -2.0)</td>
<td>-3.7 (-1.5 to -8.0)</td>
<td>-1.7 (-0.5 to -3.5)</td>
</tr>
</tbody>
</table>

A: distance at the posterior thyroid lamina between roots of the superior and inferior cornua
A-sup: distance from arytenoid MP to root of superior cornua
A-inf: distance from arytenoid MP to root of inferior cornua

Figure 1. (1A) Anterior view. (1B) Lateral view. Schematic view for measurements of the arytenoid muscular process relative to the anteroinferior corner of the thyroplasty type I window, with the anteroinferior corner defined as 5 mm lateral from midline and 3 mm above the inferior border of the thyroid cartilage for the purposes of the current study. Note that the inferior border was defined by a dotted line (×××××) at the middle and posterior aspects (1B), thereby remaining unaffected by any anterior notching.