Improving Safety in Chondrolaryngoplasty

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INTRODUCTION

For many transfeminine patients, thyroid cartilage reduction, otherwise known as chondrolaryngoplasty and colloquially “tracheal shave,” is an important gender-affirming procedure within the family of operations that can be performed during facial feminization. The first chondrolaryngoplasty technique for gender affirmation was described by Wolford et al1,2 in 1990 as a reconstructive solution to laryngeal prominence discordant to femininity. Conventionally, the site of reduction was accessed by way of a transcervical approach and the raising of perichondrial flaps to excise portions of the outer thyroid cartilage, particularly the superior thyroid laminae and notch.1 Later, modifications were made to the surgery to implement greater finesse by use of a bur for aesthetic contouring.2 Additional alternatives to mitigate complications were deemed somewhat effective, either by means of retracting posterior to the thyroid cartilage to protect the vocal cords or using shear cutting forceps.3,4

Although this procedure is many times a small portion of a larger operation, possible complications include contour irregularities, unfavorable scarring, and most importantly, vocal cord damage, which causes lowering of the voice. Avoidance of these complications requires careful presurgical planning and intraoperative technique. In the past decade, significant advancements have been made either by a more aesthetically pleasing surgical approach, such as a concealing submental incision,5 or by guidance with computed tomography (CT) and endoscopy to visualize the position of the vocal cords relative to the superior thyroid notch and laminae.6 Khafif et al7 reported the inclusion of CT in preoperative evaluation to measure the distance between the vocal cords and external thyroid cartilage. However, Spiegel6 asserts that CT alone cannot provide an adequate assessment of the distance to protect from vocal cord injury and that video guidance is obligatory to a safe and effective chondrolaryngoplasty. He additionally describes his adjunctive use of fiberoptic endoscopy through a laryngeal mask airway with an anesthesiologist for direct visualization of the cords, after which he passes a needle through the midline to measure cartilage reduction.8 This allows for confirmation of the anatomic position of the vocal cord attachment relative to the anterior superior thyroid notch, thus providing further leeway for more robust reduction without inadvertent vocal cord damage and a resultant lower pitch.9

To date, the literature on application of CT and endoscopy to confirm the distance between vocal cord attachment and the anterior superior thyroid notch and guide reduction chondrolaryngoplasty is scarce. The purpose of this study is to provide a single-institution, single-surgeon (R.H.G.) technique of CT and endoscopically assisted chondrolaryngoplasty, as well as the outcomes of R. H. Gilman and partner plastic and reconstructive surgeons W. M. Kuzon and P. S. Cederna in 27 patients. The surgical technique will be described, and patient demographics and clinical outcomes, including both measure of patient satisfaction and adverse events, will be reported.

SURGICAL TECHNIQUE

Preoperative Planning and Airway Management

All patients presenting for chondrolaryngoplasty consultation receive a CT of the head and neck with contrast to determine the distance from the level of the true vocal cords to the level of the superior thyroid (Fig. 1). Radiology is specifically instructed to describe this distance in their report. This can be calculated manually by knowing the distance between image cuts and determining the number of cuts between the true vocal cords and the thyroid cartilage in the axial view. Understanding this distance is critical to ensuring that reduction is not carried inferiorly to the point of the cord attachment where damage or disinsertion can occur. Vocal cord attachment may be closer to the upper one-fourth of the cartilage in some patients, and preoperative identification of this

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Precise location by CT can confer safety and reliability compared with identification of perceived increased resistance to perichondrial elevation at the level of the thyroepiglottic ligament. (See Video 1 [online], which displays the chondrolaryngoplasty procedure and results.)

Given the use of direct laryngoscopy, the authors prefer general anesthesia for this procedure. The surgeon should discuss the use of direct laryngoscopy with the anesthesia team and the use of laryngoscopy by the surgeon or the anesthetist as an assistant should be based on the surgeon’s comfort level with airway management.

Incision Design and Dissection

There are various incisions that can be utilized for chondrolaryngoplasty including a submental or cervico-mental approach as well as hiding the incision in a natural skin crease in the neck. The senior author prefers a 3-cm incision at the cervicomental angle. Incising the deepest aspect of the hyoid angle transversely affords minimal necessary exposure without specialized instruments and is beneficial for postoperative healing. The platysma is split, and palpation of the thyroid cartilage is used to guide dissection with Bovie electrocautery. A vertical incision is made to split the strap muscles. Blunt dissection with a Q-tip is then used to further dissect soft tissue off of the thyroid cartilage.

Direct Laryngoscopy and Reduction

Direct laryngoscopy is performed to visualize the attachment of the true vocal cords, and a 25-gauge needle is inserted into the skin at the level of the notch and directly visualized by endoscopy to ensure that the planned area of reduction is not at the level of the insertion of the cords. The most prominent and projecting portion of the thyroid cartilage is often at or just below the superior thyroid notch and extends inferiorly for a variable distance and superiorly along the wings of the thyroid cartilage. The cords generally attach below the most projecting area, but they may also attach within the area of projection. Ensuring that the reduction of cartilage does not weaken the area of attachment is the reason for determining where this attachment is before the procedure. Inadvertent, excessive reduction of the area of attachment can lead to a change in pitch of the speaking voice or lax cords, which can lead to an airway problem. The planned area of reduction is then marked, and a 5-mm round power diamond bur is utilized for reduction until a smooth contour is achieved on external examination. A 5-mm round diamond bur reduces

**Table 1. Patient Demographics**

| Demographic and Outcome Variables | N = 27 |
|----------------------------------|--------|
| Race                             |        |
| African American                 | 2 (11.1)|
| White                            | 25 (85.2)|
| Hispanic                         | 1 (3.7) |
| No response                      | 1 (3.7) |
| Smoking status                   |        |
| Nonsmoker                        | 26 (96.3)|
| Smoker                           | 1 (3.7) |
| Other operations performed       |        |
| Chondrolaryngoplasty alone       | 12 (44.4)|
| Chondrolaryngoplasty and facial feminization | 9 (33.3)|
| Chondrolaryngoplasty and PIV     | 3 (11.1) |
| Chondrolaryngoplasty and breast augmentation | 5 (11.1)|
| Major complications              | 0 (0) |
| Minor complications              | 2 (0.7) |
| LOS                              | 1.22 (SD, 0.97) |
| Op length                        | 148 min (SD, 89.54) |
| Mental health conditions         |        |
| Depression                       | 5 (18.5) |
| Anxiety                          | 5 (18.5) |
| Other                            | 5 (18.5) |
| Medical comorbidities            |        |
| DM                               | 2 (7.4) |
| HTN                              | 2 (7.4) |
| Resp disease                     | 5 (11.1) |
| Other conditions                 | 8 (29.6) |

DM, diabetes mellitus; HTN, hypertension; LOS, length of stay; PIV, penile inversion vaginoplasty.
the cartilage in a fashion that optimizes smoothness of the surface. In older individuals, the thyroid cartilage is often calcified, making removal with a scalpel more difficult. A rongeur can also be used, but it can result in a rougher surface. The muscles are then reapprroximated with 4-0 Vicryl in running fashion, and the skin is closed with 4-0 Monocryl in a running subcuticular fashion.

Postoperative Management

Chondrolaryngoplasty is a well-tolerated procedure requiring minimal to no inpatient stay. The authors recommend that patients do not lift anything greater than 5 pounds and refrain from physical activity for 1 week. The authors do not have specific restrictions as it relates to diet or voice rest. Patients are educated on the warning signs of airway compromise.

Patient Demographics and Postoperative Outcomes

A retrospective review was performed from 2012 to 2020 examining patients who underwent gender-affirming laryngoplasty at the author’s institution. A total of 27 patients were identified. The average age was 32.8 (SD, 12.3) and BMI was 23.81 (SD, 4.84). The majority of patients had additional procedures at the time of chondrolaryngoplasty (Table 1). The average length of stay was 1.22 days. The average operative time was 148 minutes for all patients. This may reflect that additional gender-affirming surgeries were performed at the same time and may also reflect extra time for resident teaching. Additionally, the visualization of vocal cord attachment by anesthesiology similarly can lengthen the operation, especially with anesthesia resident involvement. However, avoiding endoscopic confirmation and relying on preoperative CT will improve efficiency and safety for this procedure in the future. When examining patients who underwent chondrolaryngoplasty alone, this time was 91.4 minutes. There were no readmissions or reoperations within the series. There were two minor complications, which included a maculopapular rash and severe perioral edema. Overall, chondrolaryngoplasty was frequently combined with other procedures with few complications.

CONCLUSIONS

For many patients, chondrolaryngoplasty is a critical procedure for surgical gender affirmation. Chondrolaryngoplasty is well tolerated with few complications. Use of both preoperative imaging and intraoperative direct visualization can aid in preventing damage to the true vocal cords, which can cause permanent vocal changes. We aim to share this technique utilizing both CT imaging and visualization with direct laryngoscopy, in addition to sharing patient outcomes over a decade at our institution.

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