



Head and Neck Surgeons' Perspective on Chondrolaryngoplasty: A Case Series

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Abstract

Objective: Stigma associated with a conspicuous laryngeal prominence affects the self-image of women and transgender individuals (male-to-female). Chondrolaryngoplasty refers to a surgical procedure performed to reduce a prominent Adam's apple. However, no Brazilian study has reported this type of surgery. In this study, we discuss in detail a head and neck surgery team's experience with chondrolaryngoplasty, focused on the technical aspects and role of computed tomography in surgical planning.

Methods: This retrospective case series includes three cases of chondrolaryngoplasty performed by a team of head and neck surgeons. Clinical and epidemiological data were obtained from the hospital's electronic medical records. Additionally, a questionnaire was administered to evaluate patient satisfaction and surgical complications. Computed tomography and Three-Dimensional (3D) reconstructions were performed. We performed a literature review using the MEDLINE (PubMed) database to search for articles that described aesthetic chondrolaryngoplasty and compared with the technique used.

Results: All patients were discharged the day following surgery, and patient satisfaction was consistently high. The procedure was safe, without complications. No patient developed dysphonia or dysphagia. Computed tomography and 3D reconstruction used for operative planning facilitated surgeries with favorable aesthetic outcomes, without complications.

Conclusion: Despite the limited sample size of this study, we observed that careful planning and anatomical knowledge can facilitate safe and effective surgery. Head and neck surgeons have extensive knowledge of and good familiarity with the laryngeal anatomy and are technically proficient in chondrolaryngoplasty. Thin-cut laryngeal computed tomography and 3D reconstruction are valuable tools for preoperative planning.

Keywords: Tracheal shave; Adam's apple; Thyroid notch; Chondrolaryngoplasty; Transgender; Facial feminization surgery

Introduction

The thyroid cartilage located in the anterior compartment of the neck is the largest laryngeal cartilage; the laryngeal prominence, also referred to as the "Adam's apple" is present in its upper portion [1]. This name originates from the Christian doctrine of the original sin; the apple (pomum in Latin, meaning fruit) supposedly eaten by Adam was stuck in his larynx and produced the bulge [2]. Male and female larynges are identical until adolescence. During pubertal development, testosterone acts on the larynx, which results in a larger and more prominent structure in males [3,4]. In adults, the angle of fusion between the two laryngeal plates is wider in females (120°) but sharper in males (90°) [1]. Additionally, the mean laryngeal size in both the transverse (43 and 41 mm) and anteroposterior (36 and 26 mm) dimensions is larger in men than in women [4].

The association between the appearance of the laryngeal prominence and masculinization creates social challenges for transgender individuals (from male to female) or for women with a prominent cartilage, which may negatively affect their image perception [1,4]. Chondrolaryngoplasty, chondroplasty, or tracheal shaving is a surgical procedure performed to reduce the laryngeal prominence. The procedure was introduced by Wolford in 1975, with various subsequent modifications in the technique, including the use of drills, endoscopic guidance for resection, and transvestibular approaches to avoid skin scars [3,5-7]. Several studies have reported the safety of this procedure with high postoperative satisfaction and low complication rates [8].

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Potential injury to the ligamentous laryngeal structure is a serious concern associated with this surgery. The thyroepiglottic ligament and anterior commissure are inserted on the internal surface of the thyroid cartilage; therefore, this area is considered the ‘danger zone.’ Lesions involving these structures can result in dysphagia and dysphonia, respectively [4,9]. Despite its benefits, currently, this surgery is relatively uncommon in our country and is usually performed only in specialized centers that focus on facial feminization procedures. In this study, we investigated the applicability of chondrolaryngoplasty and present a discussion regarding the procedures performed by our specialized head and neck surgery team. Furthermore, we share our experience with this aesthetic procedure from the perspective of the head and neck specialty.

Materials and Methods

This retrospective study performed at a reference hospital in southern Brazil included a team of specialized head and neck surgeons and patients who underwent chondrolaryngoplasty. Patients who underwent prior cervical surgeries or those who declined to participate in the study were excluded. All patients provided voluntary informed consent *via* an electronically signed consent form, and all necessary clarifications were provided. This study was approved by the Institutional Ethics Committee (no. 6.335.515) and was performed in accordance with the Declaration of Helsinki. All images used in this study were authorized for publication and were anonymized to ensure patient confidentiality.

Clinical and epidemiological data were obtained from electronic medical records. A satisfaction questionnaire was administered using the following options: 1= dissatisfied, 2= not very satisfied, 3= satisfied, and 4= very satisfied. Information was also obtained regarding postoperative dysphonia or dysphagia and any procedure-induced complaints. The InVesalius software (version 3.1) was used to create a virtual Three-Dimensional (3D) surface and to measure the safe resection area from preoperative Computed Tomography (CT). Additionally, the Meshmixer software (version 3.5) was used to assemble the 3D model and simulate the resection area. We performed a literature review using the MEDLINE (PubMed) database to search for articles that discuss aesthetic chondrolaryngoplasty; we used “chondrolaryngoplasty” and “aesthetic chondrolaryngoplasty” as search terms. Articles were selected based on their year of publication and historical relevance.

Results

Participants

This study included three patients who underwent uncomplicated chondrolaryngoplasty (two women and one transgender individual, patients’ mean age 30 ± 5.29 years) between January and December

Table 1: Epidemiological data and status postoperative.

Characteristic	Patient 01	Patient 02	Patient 03
Gender	Transsexual (male to female)	Female	Female
Age (years)	28	36	26
Pos operative satisfaction	Very Satisfied	Very Satisfied	Satisfied
Dysphonia	No	No	No
Dysphagia	No	No	No
Complains	No	No	No

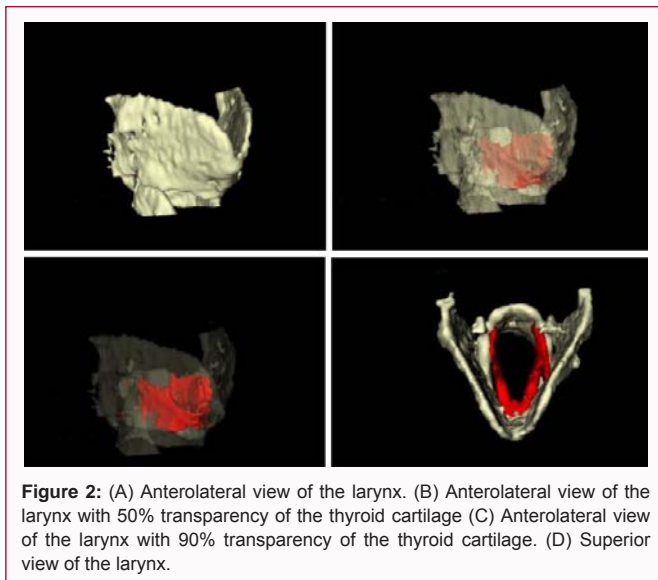


Figure 2: (A) Anterolateral view of the larynx. (B) Anterolateral view of the larynx with 50% transparency of the thyroid cartilage (C) Anterolateral view of the larynx with 90% transparency of the thyroid cartilage. (D) Superior view of the larynx.

Surgical technique

The preoperative planning phase included non-contrast CT to obtain thin sections of the larynx, followed by 3D reconstructions. The rendered virtual 3D model was used to accurately measure the craniocaudal distance of the laryngeal prominence, determine the optimal location for Broyles’ ligament implantation and to select an appropriate margin of resection for each patient (Figure 2). Figure 3 and 4 shows the 3D model used to estimate the resection area and to predict possible outcomes. The created model could be printed using a 3D printer if required (Figure 3, 4).

All surgical procedures were performed under general anesthesia

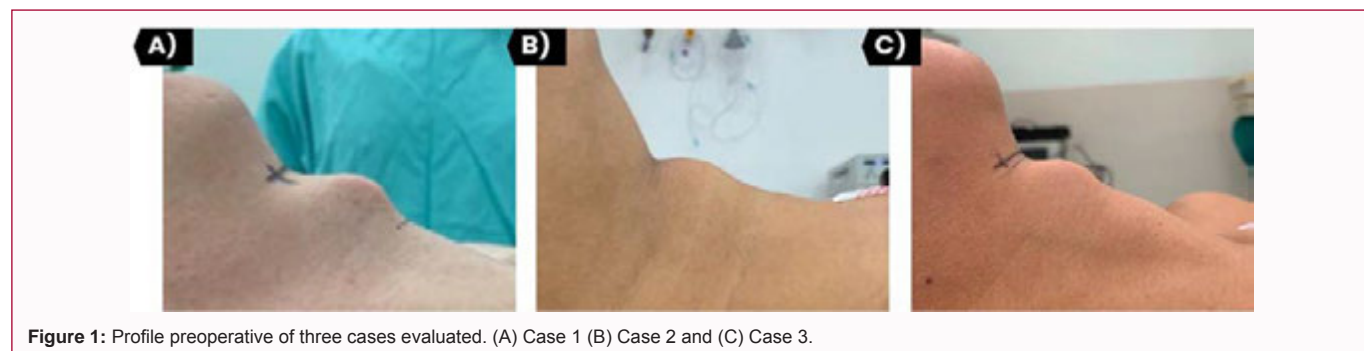


Figure 1: Profile preoperative of three cases evaluated. (A) Case 1 (B) Case 2 and (C) Case 3.

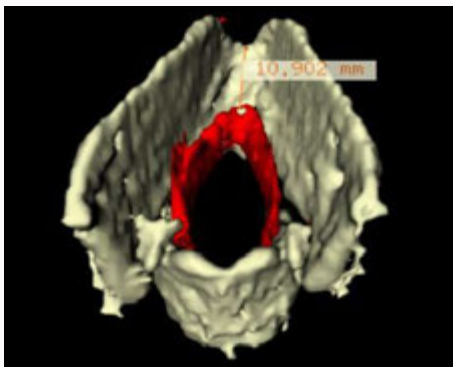


Figure 3: Posterosuperior view for measurement between anterior commissure and laryngeal notch.

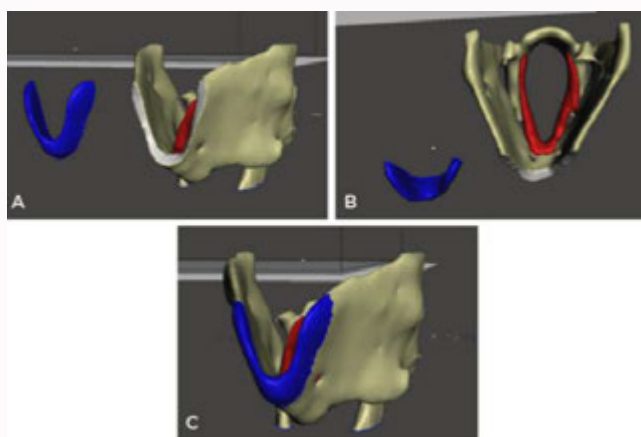


Figure 4: (A) Anterolateral view of the 3D model rendered by Meshmixer software with cartilage to be removed. (B) Superior view of 3D model (C) Anterolateral view demonstrating resection planning.

and orotracheal intubation, with the patient in the dorsal decubitus position, using a scapular cushion for cervical hyperextension. A transverse incision (3 cm) was carefully delineated over the most cranial skin crease (cervicomenal angle) to ensure discreet scarring.

Flaps were elevated in the subplatysmal plane, and the midline was opened longitudinally with application of lateral traction on the pre-thyroid musculature. The laryngeal prominence was identified after exposure of the entire anterior portion of the thyroid cartilage. Craniocaudal measurement of the laryngeal prominence was performed using a ruler (calibrated in mm), and the point of vocal fold implantation in the middle third was marked, and the area to be resected was demarcated using a sterile pen or methylene blue.

An incision was created, and the external perichondrium in the cranial portion was dissected, followed by V-shaped resection of the thyroid cartilage using a delicate reciprocating saw. Cartilage contours were refined using a drill.

Subsequent irrigation was performed using saline solution, hemostasis was confirmed, and the external perichondrium was re-approximated using Vicryl 4-0. The strap muscles were re-approximated, and the subcutaneous/platysmal plane was closed using Vicryl 4-0. Intradermal skin sutures were placed using Monocryl 4-0, and a sterile dressing was applied using micropore tape (Figure 5).



Figure 5: Case 1 (a) Preoperative patient profile (b) The transverse incision (c) Surgical specimen in detail. (d) Final aesthetic aspect.

Discussion

Chondrolaryngoplasty safely and effectively addresses body image disturbances associated with a conspicuous laryngeal prominence. This issue has currently gained much attention in the society owing to an increase in the transgender population [10]. Gender dysphoria is defined as the distress and discomfort that result from the incongruence between an individual's biological sex at birth and their gender identity [11]. The Diagnostic and Statistical Manual of Mental Disorders, fifth edition classifies this condition as a “cultural syndrome” in the American population [12]. Approximately 2.0% of the Brazilian adult population identifies as transgender and non-binary based on a survey published in 2021 [13]. In the United States, 4.0% of respondents had undergone this procedure, 29.0% were inclined to undergo the surgery in the future, and 29.0% were unsure based on a survey performed in 2015 [1,14]. No data regarding this surgery are publicly available in Brazil, and currently, no publication has reported this procedure.

Chondrolaryngoplasty may also be performed for cosmetic indications in women with a prominent larynx [1,8]; however, population-level information on women who undergo the procedure for this purpose is unavailable. In our sample, two of three patients were women in this scenario. A meta-analysis of four studies that included 69 patients reported that 84.1% were transgender individuals and the remainder were women [8].

Several surgical techniques have evolved over the years. Following the initial description by Wolfort and Parry in 1975, the procedure was further modified by Wolfort in 1990 with the addition of burr-aided contouring [3,5]. In 2003, Conrad described endoscopic visualization of the vocal folds within the larynx and marking the lower limit of resection with a needle perforating the thyroid cartilage, for improved safety and to enable more aggressive resection [15]. In 2008, Spiegel developed a technique using general anesthesia and a laryngeal mask with transoperative nasofibrolaryngoscopy performed through the laryngeal mask to locate the anterior commissure [6].

Another technical variation is the transvestibular approach, which is similar to scarless access performed during the Transoral Endoscopic Thyroidectomy Vestibular Approach (TOETVA), which uses endoscopic scissors, curved burrs, or cartilage shavers. In 2020, Chung et al. and Verhasselt et al. published their findings in five and

six fresh cadavers, respectively and reported the feasibility of this approach to perform the procedure [16,17]. Khafif et al. described the first case series of four patients who successfully underwent the procedure without major complications [7]. In our opinion, scarless surgery being an aesthetic procedure, should be considered in such cases. The association of Phonosurgery with vocal pitch feminization through cricothyroid approximation is a viable option; however, this approach remains controversial, and few studies in the literature have described this strategy [18-20].

In this study, we used 3D planning using multi-slice CT with thin cuts focused on the laryngeal region. Khafif et al. have discussed the role of CT-based preoperative planning [7,9]; however, some authors are of the view that CT alone may not ensure safe chondrolaryngoplasty and endoscopic assistance is necessary [21]. No report in the available literature describes 3D reconstruction for this surgery [22,23]. In recent years, 3D models (printed or virtual) have been used across several specialties for preoperative surgical planning. This novel technology provides accurate anatomical details that can be easily understood by surgeons and patients [24]. With regard to patient satisfaction and complications, our findings were similar to those reported in the literature. Despite the small sample size of our study, we recommend multi-slice CT for preoperative planning, particularly aligned with 3D technology.

Chondrolaryngoplasty is known to produce favorable aesthetic results associated with high levels of postoperative patient satisfaction. In our series, patient satisfaction was assessed based on the response of two patients who indicated that they were “very satisfied” and one patient who indicated being “satisfied” with the surgery. Tang et al. reported 100.0% postoperative patient satisfaction in a case series comprising 91 patients. However, two of 91 patients (2.2%) were concerned regarding scarring, and three of 91 patients (3.3%) sought a second opinion to explore the possibility of further cartilage removal. The Glasgow Benefit Inventory, a validated scale that assesses postoperative quality of life, was used in the same study, and patients showed statistically significant improvement in all three sub-scores (general, social, and physical) [4]. Cohen et al. also investigated the quality of life in a series of 45 patients, using a scale that assesses physical, emotional, and social satisfaction. In this study, 60.0% (27/45) of patients reported being “very” or “completely” satisfied with the appearance of their neck and Adam’s apple and only 13.3% (6/45) were “not at all” satisfied. Dissatisfaction was primarily attributed to scar formation and the size of the remnant scar [25]. In a case series reported by Matai et al., the post-chondrolaryngoplasty satisfaction rate was 86.0%. In the same study, some patients underwent voice feminization surgery (cricothyroid approximation), either alone or in combination, with a postoperative satisfaction rate of 79.0% [19].

Chondrolaryngoplasty is safe and is associated with few complications, including hoarseness, dysphagia, laryngospasm, and typically those observed in cases of cervical surgery, such as infection and hematoma [8,9]. References to the latter two are unavailable in the literature, which is likely attributable to the clean surgery and easy hemostatic management performed at the operated site [8].

Hoarseness is a serious concern, particularly in patients who undergo aesthetic procedures, and is most challenging in transgender patients, in whom a deep voice postoperatively may produce catastrophic consequences [1]. Resection of the laryngeal prominence, specifically at the level of the vocal folds, particularly at the anterior commissure where they attach to the thyroid cartilage *via*

Broyles’ ligament can lead to loss of vocal fold tension and subsequent hoarseness [6,9]. In a meta-analysis reported by Theratill et al., hoarseness occurred in 39.0% of patients; however, this complication resolved within 20 days in 96.0% of patients, with a postoperative satisfaction rate of 98.0% [8]. Therefore, it is reasonable to conclude that dysphonia observed in most cases was attributable to factors other than injury to the laryngeal ligaments, such as intubation-induced injuries. Other complications reported by the same study included laryngospasm in 1 (1.5%) and odynophagia in 14 patients (20.3%) [8].

Another possible complication is dislodgment of the epiglottic petiole from the thyroepiglottic ligament, with consequent dysphagia [26]. This complication remains a theoretical concern, without any case reported in the literature. No complications were observed in our study, even after direct inquiry. Despite the limited sample size of this study, we observed that rigorous planning and accurate understanding of the laryngeal anatomy can ensure safe chondrolaryngoplasty.

Conclusion

Chondrolaryngoplasty performed in accordance with anatomical principles is a safe and effective procedure. Its effectiveness is evident from the high postoperative satisfaction levels reported by patients. However, currently, this approach is not widely known or accepted across the country and is associated with an unmet demand owing to lack of awareness regarding this operation.

The use of thin-cut laryngeal CT and 3D reconstruction warrant further investigation as safe options for procedural planning. In conclusion, head and neck surgeons are knowledgeable regarding the laryngeal anatomy and possess extensive experience with manipulation of saws and drills, which enables them to excel in this surgery.

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