Role of CT Scan in Decision Making Prior to Approximation Laryngoplasty

Nupur Kapoor Nerurkar · Ruchira Marwah ·
Samir Mahajan

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Abstract To evaluate the role of CT scan prior to approximation laryngoplasty (AL). Occasionally, postoperative results in AL are unsatisfactory. The reasons for failure may be an incomplete closure of the phonatory gap or improper size of the implant or implant migration. The role of CT scan in planning the steps of surgery in cases of AL especially in revision cases is discussed in three cases of unilateral vocal fold paralysis. Preoperative CT larynx, especially in revision AL cases, helps plan steps of surgery by deciphering implant material, size, shape and position used in previous surgery.

Keywords Approximation laryngoplasty ·
Type 1 thyroplasty · CT scan larynx ·
Unilateral vocal fold · Paralysis

Aim

The aim of our study was to evaluate the role of CT scan prior to AL. The various aspects to be studied in the CT scan are discussed in three case studies, two of which were revision AL surgeries. A review of literature in this regard is discussed.

Introduction

Unilateral vocal fold paralysis (UVFP) occurs after iatrogenic injury or a disease process and is associated with dysphonia and occasionally aspiration. Most of these patients have an improvement of the symptoms with time, aided with speech and swallowing therapy.

However, in a small group of patients, the breathy voice persists. An approximation laryngoplasty (AL) is treatment of choice for this group of patients. Type 1 thyroplasty with or without arytenoid adduction (AA) encompasses AL.

Despite good results in most cases of AL, occasionally, postoperative results are unsatisfactory. The reasons attributed to failure are an incomplete closure of the phonatory gap or insufficient soft tissue component of the thyroarytenoid muscle in some cases. Injury to the nerve results in diminished vocal fold tone, bulk, and mobility [1].

A residual phonatory gap may be due to a level difference between the two vocal folds or a large posterior phonatory gap. An open posterior commissure is indicative of the need of AA to supplement the implant [2]. Occasionally the residual phonatory gap is due to improper placement or size of the implant.

A good postoperative voice followed by voice deterioration over time suggests implant migration. Use of Gore-Tex as an implant material has been associated with problems of migration. It is not as stable and loops of it can migrate around in the pocket [2].

The acquisition time for a CT image is extremely short (within a matter of seconds), which is quite useful for the laryngeal examination, as patients are generally required to hold their breath to reduce movement.

The role of CT scan in planning the steps of surgery in cases of AL is evaluated and discussed in three representative cases of UVFP.

N. K. Nerurkar (✉)
Department of ENT, Bombay Hospital, D-603 Simla House,
Napean Sea Road, Mumbai 400 026, Maharashtra, India
e-mail: nupurkapoor@yahoo.com

R. Marwah
Department of CT and MRI, Bombay Hospital, Mumbai, India

S. Mahajan
Department of ENT, Bombay Hospital, Mumbai, India

Materials and Methods

Case 1

A 48 year old male patient presented to us with a history of bilateral type 1 thyroplasty surgery done 6 months back for bilateral sulcus vocalis. Following this surgery he complained of a worsening of voice quality with a strained voice with effortful speech. Detailed notes of the prior surgery were unavailable. A CT scan of the larynx (3 mm cuts) confirmed the bilateral thyroplasty. A bosselated radio-opaque shadow along with a uniform triangular radio-opacity in the left ala and a uniform triangular radio-opacity in the right ala was suggestive of both Gore-Tex and silastic medialization done on the left and only silastic medialization on the right side (Fig. 1).

Videostroboscopy was done for this patient which revealed a bulge in the anterior and mid membranous part of the vocal fold on the left side. Due to this over medialization, a triangular phonatory gap was present both posteriorly and anteriorly. The anterior phonatory gap was very small. The amplitude of the mucosal wave was diminished on the left side.

A revision thyroplasty under local anaesthesia was performed for this patient, with the intention of operating on the left side and decreasing the amount of medialization in the anterior and mid membranous vocal fold. The left thyroplasty window was explored and the silastic implant was removed, following which a 2.5 cm piece of Gore-Tex was removed. It is very important to remove all the previous implant and start over after removal of the fibrous

capsule [2]. The size of the silastic implant was 9 mm anteriorly and 8 mm posteriorly. These findings correlated with our preoperative CT scan report. On removal of the silastic and Gore-Tex implant the patient felt that the strain in his voice immediately subsided, though the voice got softer. A silastic implant was carved with no anterior medialization and a 3 mm posterior medialization. The patient's voice was strain free and stronger than before. On further medialization the voice, immediately became strained. The patient expressed a satisfaction in his voice quality. Postoperatively the patient received 1 month of voice therapy following which a stroboscopy was performed, which revealed increased amplitude of the mucosal wave as compared to the previous strobe study.

Case 2

A 65 year male patient, smoker, was referred to us by an oncosurgeon for stroboscopic evaluation and opinion. He was a case of Carcinoma right lung, who had undergone a pneumectomy with postoperative radiation therapy. 3 months later, the patient developed metastasis in the opposite lung and underwent lobectomy for the same. Following this surgery the patient developed left vocal fold palsy with a breathy voice. A Gore-Tex medialization was performed by the treating oncosurgeon. However, despite an apparently good closure and good voice on table, the voice deteriorated within a day and he complained of vocal fatigue.

Our stroboscopic evaluation revealed a good anterior closure with a small posterior phonatory gap. The patient received post operative speech therapy for 4 months with no improvement in the voice. A decision to perform CT scan (2 mm cuts) was taken to ascertain the position of Gore-Tex which was seen placed at the inferior edge of the vocal fold at the mid membranous level as seen in the axial cut (Fig. 2). On the coronal images, the left true vocal fold was seen to lie at a higher level than its counterpart during phonation with the Gore-Tex appearing to push the free medial edge cranially (Fig. 3).

Our patient was posted for silastic medialization with arytenoid adduction (SMAA) with the view of closing the posterior phonatory gap and at the same time, lowering the left vocal fold to bring it in alignment with the right vocal fold. Surgery was performed under local anaesthesia, with mild sedation as the patient had a poor respiratory reserve. We counseled the patient regarding the possibility of a respiratory compromise on performing AA due to an already decreased respiratory reserve. However, the patient tolerated the SMAA procedure well. Flexible laryngoscopy done on table, confirmed a complete closure of the phonatory gap with a satisfactory voice outcome subjectively.

Fig. 1 A bosselated radio-opaque shadow along with a uniform triangular radio-opacity in the left ala and a uniform triangular radio-opacity in the right ala suggestive of both Gore-Tex and silastic medialization done on the left and only silastic medialization on the right side

Fig. 2 Axial CT scan of the larynx showing Gore-Tex situated at the mid membranous level of left vocal fold

Fig. 3 Coronal image of CT larynx showing the left true vocal fold at a higher level than its counterpart during phonation with the Gore-Tex appearing to push the free medial edge cranially

Case 3

A 35 year male patient, smoker was referred by a chest physician to us for his complains of a very breathy voice and dysphagia. The patient was a case of adenocarcinoma of the left lung with a metastatic mediastinal mass on the left side. Videostroboscopy revealed a 3–4 mm phonatory gap but on phonation, the arytenoids were symmetrical in appearance. The patient had received chemotherapy for the primary tumor, which had not responded. Opinion of a senior oncosurgeon was sought, who felt that the tumor was unresectable. The patient and his wife were keen on a

good voice to improve his quality of life. Since the Ct scan revealed a large mediastinal mass causing compression of the trachea with a lumen of 2.5 mm (Fig. 4), a decision was taken to perform thyroplasty, without any sedation and without flexion of the neck Fig. 3. Since arytenoid symmetry was noted on stroboscopy, a need for AA was unlikely, and may have also caused respiratory compromise in this particular patient.

Surgery was done using glycopyrrolate $\frac{1}{2}$ hour before surgery, with 2 percent xylocaine and 1:10,000 adrenaline local injection in supine position with no neck extension. A 2 mm anterior and 8 mm posterior silastic implant was carved according to medialization specifications (Fig. 5) Our patient tolerated the procedure well and his voice improved.

Discussion

In revision AL cases, a CT scan can give us information regarding the size of the larynx, window size and window location, implant size, placement and material used. The level of both the vocal folds and an idea of the muscle mass of the vocal fold can be appreciated. All these factors play a huge role in deciding the steps of the surgery prior to the revision thyroplasty. A CT Scan from base skull to mediastinum is imperative in all cases of UVFP to diagnose the etiology.

Silastic implants are recognized by their hyper attenuated triangular configuration whereas Gore-Tex implants have a unique heterogeneous attenuation with irregular medial margins. Fat injection has a low-attenuation ovoid mass while Teflon injections are hyper attenuated and mass like and should not be mistaken for tumor. Finally,

Fig. 4 Ct scan revealing a large mediastinal mass causing compression of the left side of the trachea with a lumen of 2.5 mms

Fig. 5 A 2 mm anterior and 8 mm posterior silastic implant in the left vocal fold

high-resolution CT of the larynx is useful for localization of extruded implants before revision thyroplasty [3].

In case 1, since details of previous surgery were unavailable, the CT indicated the material used for approximation (both silastic and gore Tex) for the left vocal fold. This helped us plan the revision surgery by knowing what to look for.

In case 2, a level difference of the vocal folds on CT scan confirmed need for AA. Woo et al. [4] found that the most common cause of failed medialization thyroplasty was arytenoid malrotation, resulting in a persistent posterior glottic gap. They found high-resolution CT of the larynx useful in determining the degree of arytenoid rotation and the position of the arytenoid cartilage on the cricoid facet. This situation was amenable to AA and revision medialization thyroplasty.

A CT Scan of the base skull to mediastinum is essential to rule out submucosal malignancy of the larynx or any pathology along the course of the recurrent laryngeal nerve in all cases of unilateral immobile vocal fold. Laryngeal mucosa does not typically enhance on contrast-enhanced CT imaging. On CT imaging, thyroid cartilage can appear

isodense to soft tissue or demonstrate a hyper attenuated outer and inner core with a hypo attenuated marrow space, depending on the degree of ossification. Thyroid cartilage (ossified or not) does not typically enhance with administration of contrast [3].

In the 3rd case, the importance of avoiding anaesthesia was based on the CT scan of the mediastinum revealing a large mediastinal mass causing compression on the trachea. Sedation would have caused a relaxation of the muscles with further airway lumen compromise.

A discussion of the CT findings with the radiologist is highly recommended prior to surgery and this is the protocol followed in all of our cases.

Conclusion

Vocal fold palsy can be labeled as idiopathic only after exclusion of any pathology from base skull to mediastinum. CT scan larynx plays an important role in excluding sub mucosal laryngeal tumour and cervical or mediastinal pathology effecting the RLN.

Preoperative high resolution CT of the larynx in revision AL cases helps plan steps of surgery by deciphering implant material, size, shape and position used in previous surgery. However, the implant size and position during surgery should always be decided by voice quality during medialization and intra-operative flexible laryngoscopy.

Conflict of interest None

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