

## **Arytenoid Adduction as a Surgical Treatment for Hoarseness with Unilateral Vocal Cord Fixation**

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### **Introduction**

In order to improve hoarseness due to unilateral vocal fold fixation, several methods for moving and fixing the affected vocal fold at the medial position (mediofixation) have been proposed. These methods utilize Teflon or silicone injections, medial compression of the thyroid ala<sup>1)</sup>, submucosal insertion of a piece of the cartilage<sup>2)</sup>, etc. However, if the glottal chink is wide, or if the levels of the two vocal folds are different, these methods will fail to achieve complete closure for phonation because of a bulging of the operated vocal fold caused by the large amount of injection material or because of a level difference in the vertical dimension.

The arytenoid adduction method proposed by Isshiki<sup>3)</sup> seems to overcome these problems. In Isshiki's method, the adduction of the vocal fold is achieved by a traction of the muscular process of the arytenoid cartilage in the direction of the integrated forces of the adductor muscles. This causes a movement of the cricothyroid joint, which results in the natural adduction of the vocal fold. (Fig. 1)

However, Isshiki's method is not capable of correcting a pathological condition caused by vocal fold atrophy. In the case of atrophic vocal folds, we have to add silicone injection.

At the voice and speech clinic of Tokyo University Hospital, 60 patients have been treated by the arytenoid adduction method during last 8 years and 5 months with satisfactory results. In this report, pre- and post-operative phonatory function will be discussed and some technical improvements will be presented.

### **Subjects**

The patients for this study were 60 cases of unilateral vocal fold paralysis operated on in our clinic from January 1982 to May 1991. These patients consisted of 31 males and 29 females, and their ages at the time of operation ranged from 15 to 74 (average 47.2). (Table 1) The affected sides were 39 left and 21 right. The interval from onset of the paralysis to the operation ranged from 3 months to 19 years (average 32.5 months). The various diseases causing the paralysis are listed in Table 2.

## **Surgical Procedure**

Basically, our technique was the same as Isshiki's original with the exception of the type of anaesthesia. Surgery was done under general anaesthesia with an orotracheal intubation. The size of the orotracheal tube used in the surgery ranged from #28 Fr. to #32 Fr. depending on the patient's physical constitution, smaller tubes being preferable.

We used a specially designed needle to ensure an adequate route for the strings which were attached to the muscular process of the arytenoid cartilage to apply the traction force to rotate the arytenoid cartilage. First, two pin-holes were made on the surface of the thyroid at the lower third and anterior third of the cartilage, as suggested by Isshiki. Through this hole, a needle was inserted to reach the arytenoid region and to pull out the strings. Figure 2 shows an X-ray image of an excised larynx with needle.

In cases, where glottal edema was anticipated, a steroid was administered intravenously.

Voice rest was required for one week post-operatively.

## **Results**

As an measure of phonatory function, the maximum phonation time (MPT) was examined in 45 out of our 60 cases pre- and post-operatively. The average pre-operative MPT was 6.0sec. In 38 cases, the MPT was less than 10 sec. Post operatively, the average MPT was 13.6 sec. However, in 10 cases, MPTs were still less than 10 sec. The average gain in the MPT (the percentage of the post-operative MPTs against the pre-operative MPTs) was 278%. In three cases, the post-operative MPT was shorter than the pre-operative MPT. Individual trends for phonation time are shown in Figure 3 and Table 3.

## **Discussion**

Incomplete glottal closure causes uncomfortable conditions such as hoarseness, misdeglutition, hyperventilation and so forth. These conditions can be corrected when glottal closure is improved. Since this incomplete closure is mostly caused by fixation of the unilateral vocal fold at the lateral or intermediate position, medialization of the paralyzed vocal fold is the only therapeutic maneuver. We routinely ask patients to phonate with force or to do the pushing exercise for at least 6 months with some expectation of a compensatory movement of the intact vocal fold or a spontaneous recovery of the paralyzed vocal fold. In our patients, 8 cases were operated on before 6 months after the onset of their symptoms. The main complaints of these patients were mainly misde-

glutition rather than hoarseness. Since misdeglutition is a risk factors, surgery should not be postponed in these cases.

On the other hand, among our patients, 15 cases were operated on more than 2 years after onset. Although there might be several reasons for this, we are afraid that one of the reasons might be a lack of knowledge about the possibility of improvement in laryngeal function through surgery.

Among the several existing techniques for the medialization of the vocal fold, Isshiki's method is the most physiological because the adduction of the vocal fold is achieved by the traction of the muscular process in the direction of the integrated forces of the adductor muscles, causing a natural rotation of the arytenoid cartilage at the cricoarytenoid joint. From this point of view, we have widened the indication for the arytenoid adduction. Our statistics show that the number of the patients has been increasing in the last two years.

Isshiki emphasizes the merits of the topical anaesthesia. One of his points is the advantage in monitoring the patient's voice during surgery. This gives us an indication of the proper traction force to the arytenoid cartilage. First, we did our surgery under topical anaesthesia asking the patients to phonate. However, we found that the procedure under topical anaesthesia has some disadvantages. First, when we manipulate the pyriform sinus, a swallowing action takes place and makes a fine manipulation difficult. Second, patients complain of discomfort when the larynx is turned around to manipulate the arytenoid region. Finally, in the university hospital, in general, we have to instruct young doctors. Patients may feel uneasiness when we talk around the operating table with young doctors.

We were afraid that the orotracheal tube might interfere with the adduction of the arytenoid cartilage. In order to study the interaction between the orotracheal tube and the repositioning of the vocal process of the arytenoid cartilage, a fiberscopic observation was performed during the surgery under general anaesthesia. It revealed that the orotracheal tube was positioned at the posterior end of the glottis and would not interfere with the adduction of the vocal process. After this preliminary study, we decided to use general anaesthesia with orotracheal intubation.

Our next question was how to find the proper force which should be applied to the arytenoid cartilage by pulling the thread attached to it. Isshiki suggests that the appropriate pulling force is about 50gr. However, it is difficult to control this force during surgery. From our experience, the thread should be pulled as forcefully as possible. Since we have an orotracheal tube at the inter-arytenoid region in the posterior glottis, the arytenoid cartilage should not approximate too tightly even when pulled strongly. We experienced two cases where the arytenoid cartilage adducted beyond the midline. In these two cases, a small granuloma appeared at the tip of the vocal process probably

because of the collision of the corrected processes for phonation. However, these disappeared within a month. We assume that a compensatory adjustment for phonation takes place shortly after surgery.

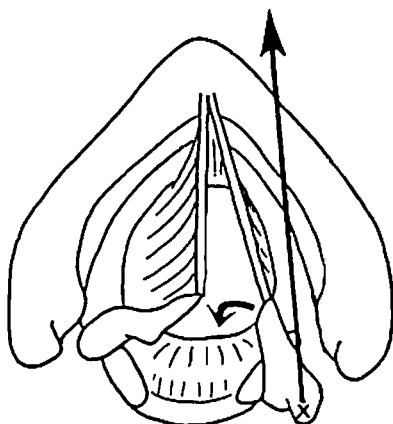
It has been said that for ordinary life, the MPT should be more than ten seconds, otherwise one would have to inspire frequently for speech, resulting in hyperventilation. In our statistics, 9 patients showed less than 9 sec. MPT post-operatively. Among these, 2 cases showed 46% and 55% gain in the phonation time. This means that their MPT had become as short as half of pre-operative MPT after operation. One of these patients had a malignant mediastinum tumor. The shortening of the MPT in this case might have been due to a general deterioration of the patient's physical condition. The other patient was the post-operative case of the vagus neurinoma. Her vocal fold showed a marked atrophy probably caused by the total denervation of the affected side. Since atrophy of the vocal fold is one of the causative factors in the incomplete closure of the glottis, the lack of improvement of MPT in this particular case might be attributed to the defective vocal fold. But this does not explain shortening of her MPT. We have to look at other similar cases.

## Conclusion

For the last 9 years, we have operated on 60 patients with dysphonia caused by unilateral vocal fold paralysis. Our technique was basically the same as Isshiki's except for the type of anaesthesia. We use general anaesthesia instead of topical anaesthesia. We have found that the orotracheal tube does not interfere with the adductory movement of the arytenoid cartilage. The average gain of the maximum phonation time has been 278%.

## References:

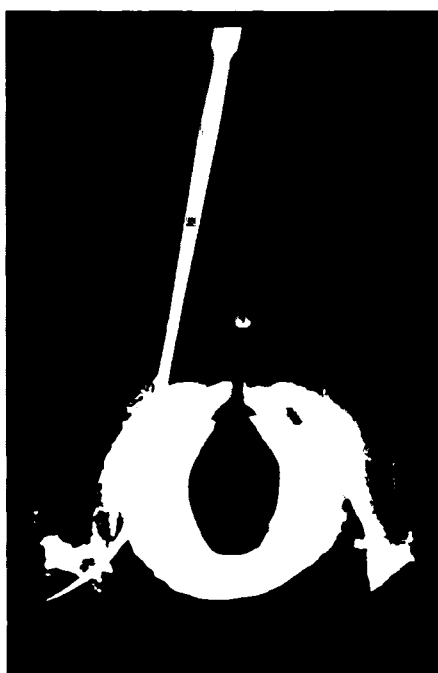
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- 2)M.Sawashima, G.Totuka, T.Kobayashi and H.Hirose:"Surgery for hoarseness due to unilateral vocal cord paralysis.", Arch. Otolaryng., 87,289-294,1968
- 3)N.Isshiki, M.Tanabe and M.Sawada:Arch Otolaryngol, 104,555-558,1978



**Figure 1**

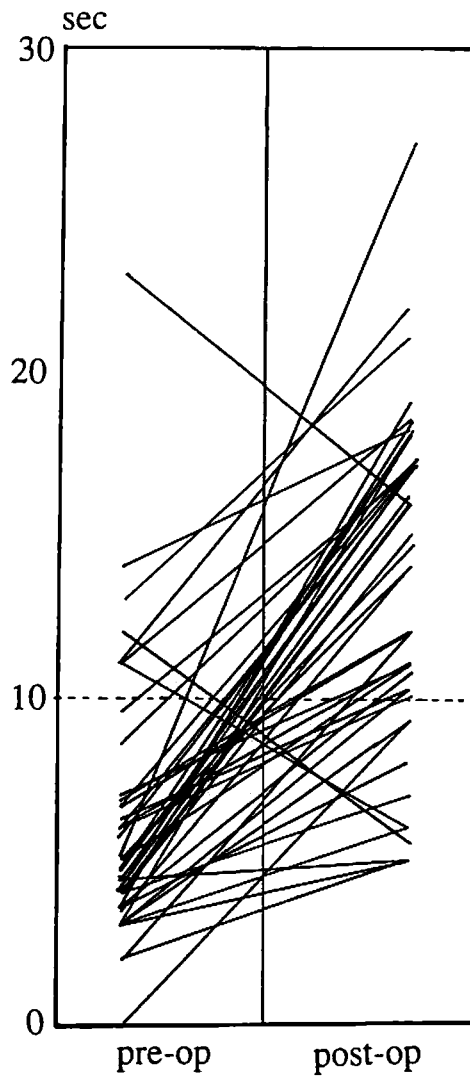
Schema of the arytenoid adduction technique.

The arrow indicates the direction of the traction force applied to the arytenoid cartilage. (from Isshiki, 1975)



**Figure 2**

X-ray photo of the excised larynx with a specially designed needle. The needle was inserted through the anterior surface of the thyroid cartilage passing under the intralaryngeal mucosa to reach the arytenoid region. The needle has a tiny hook at its tip to retrieve the thread out from the needle hole.



**Figure 3**

Individual MPT trends for 45 operated patients.

The average pre-operative MPT was 6.1sec. and the post-operative MPT was 13.7sec.

Table 1

## Age and Sex of the Patients

Age	Male	Female	Total
-10	0	0	0
-20	2	3	5
-30	0	2	2
-40	7	8	15
-50	4	9	13
-60	9	3	12
-70	7	3	10
-80	2	1	3
81-	0	0	0
Total	31	29	60

Table 2

## Causes of the Paralysis

Thyroid surgery	8
Thyroid Ca	4
Parathyroid surgery	1
Neurinoma surgery	7
Paraganglioma surgery	4
Mediastinum surgery	6
Esophageal Ca	1
Esophagus surgery	1
Aorta surgery	6
Lung Ca	1
Lung surgery	2
Pyothorax surgery	1
Trauma	3
Submaxillary gland surgery	2
Wallenberg	2
Meningeoma surgery	1
Janetta surgery	1
Congenital	1
Breast Ca surgery	1
Idiopathic	7
Total	60

**Acknowledgements**

This work was supported in part by a Grant-in-Aid for Scientific Research (No.01440071) from the Japanese Ministry of Education, Science and Culture.