REVIEW ARTICLE

Procedures for Integrating a Voice Unit in an ENT Area/Service and its Results

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Received 16 June 2010; accepted 30 July 2010

KEYWORDS
Voice unit; Laboratory voice; Dysphonia

Abstract
Objectives: (I) To serve as a model for ENT services in the process of creating a Voice Unit and (II) to show the results obtained in our Voice Unit over the past 12 months. Methods: Sections on Voice Unit Functions, Organisation, and Procedures are presented, as well as the study of 122 patients: an assessment of patient self-perception using the Voice Handicap Index, diagnostic category, Voice Unit diagnosis, previous treatments, and treatments proposed by the Unit. Results: The results highlight that Voice Handicap Index scores tend towards mild and moderate evaluations; that the most frequent pathological group are exudative lesions affecting Reinke’s space; that there are diagnostic discrepancies of more than 50% between the general ENT consultations and the Voice Unit; and that the most common treatment is speech and language therapy (45%), followed by phonosurgery (28%). Conclusions: The main aim of the Voice Unit is to achieve maximum effectiveness and quality in its various functions. Correct diagnosis and treatment increase effectiveness and allow better use of resources; achieving this requires a minimal, essential setup: laryngostroboscope, a multidimensional protocol and interdisciplinary work.

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PALABRAS CLAVE
Unidad de Voz; Laboratorio de Voz; Disfonía

Procedimientos para la integración de una Unidad de Voz en el funcionamiento de un Servicio/Área de ORL y sus resultados

Resumen
Objetivos: (I) Servir de modelo para aquellos Servicios de ORL que se encuentren en proceso de creación de una Unidad de Voz. (II) Exponer los resultados que hemos obtenido en nuestra Unidad de Voz a lo largo de los últimos 12 meses.


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Introduction

In the past 2 decades, there has been a growing interest in voice and its disorders. In fact, an array of tests to assess impairment of vocal function has appeared. These tests are currently used not just in the case of voice professionals or elite singers, but for any patient who perceives vocal impairment as a disability and as a difficulty in adapting to the environment (social or work).

Until relatively recently, an objective and accurate voice assessment was nonexistent. Voice was measured subjectively; judgement was based entirely on the perception of the physician, through so-called psychoacoustic assessment. However, this type of analysis, despite its frequent use even today, has the disadvantage of the subjectivity with which the listener judges the voice, leading to intra- and inter-judgement discrepancies. At present, the emergence of new technical possibilities (some of them not so new) in the anatomical-functional analysis of the vocal folds (laryngostroboscopy, vocal acoustic analysis, and aerodynamic analysis) has provided physicians with useful tools to aid their "clinical ears".

Consequently, today we can say that the voice can be altered (just like any other human function) and that this alteration must be studied and analysed in an objective, comprehensive manner. This can be achieved at a Voice Unit, which is a super-specialised sector belonging to an interdisciplinary perspective. Within the operation of an ENT Service as a whole.

The reality of our hospitals is far from this conception. A recent study (2006) concluded that only 38% of ENT Services had a Voice Unit; that just over half used laryngeal stroboscopy in daily clinical practice; that one-third of otolaryngologists knew very little about the work of speech therapists; that fewer than half of the services used some form of written protocol in the evaluation of dysphonic patients; and that a systematised protocol for the evaluation and treatment of the voice was unanimously considered necessary.

In any case, as we have observed, the existence of a Voice Unit does not entail a consistent performance with evident results. Rather, with a few exceptions, it usually involves a transient, uneven, and sometimes anecdotal activity within the operation of an ENT Service.

The purpose of this article is to explain how we proceeded to strengthen and give greater weight to our Voice Unit in our hospital environment. We briefly describe the following topics: functions, organisation, procedures, and results of a Voice Unit.

This article could be useful, in some cases, for ENT services in the process of creating a similar Voice Unit or in the process of remodelling an existing one.

Material and Method

A Voice Unit must complete a minimum number of stages: implementation, development, stability, and performance. Achieving all these stages relies on certain work criteria (functions, structural organisational, and procedures), which are part of our material and method and which are detailed below.

Functions of a Voice Unit

The Voice Unit must have the following functions and features:

- Specific support within the ENT Service/Area, in particular from the Larynx and Neck Unit and from the rest of the Service as a whole.
- Ability to organise healthcare work, as well as other management aspects.
- Availability of a multidisciplinary team.
- Availability of a Voice Laboratory to conduct extensive explorations and multidimensional diagnosis.
- Ability to perform comprehensive voice therapy: medical–pharmacological, surgical, rehabilitative, and preventative.
- Ability to organise and carry out patient follow-up.
- Ability to assess the effectiveness of treatments.
- Willingness towards research and teaching (resident training, etc.).

**Structural Organisation of a Voice Unit**

- Voice Unit in the ENT Service/Area: in our organisation, the Larynx and Neck Unit involves 3 related, complementary subunits: Voice Unit, Oncological Neck/Larynx Unit, and Non-Oncological Neck/Larynx Unit (Fig. 1).
- Provision of resources: human resources, material resources, and dedication.
  - Human resources: the Voice Unit consists of 2 ENT physicians and 1 speech therapist, all specialising in the field of voice and the larynx.
  - Material resources: the Voice Unit requires a specific space. In our particular case, this is a large room of approximately 14 m².
    The technical means available include: computer access to patient medical histories, laryngoscope, stroboscope, unidirectional microphone, sound analysis software, and computerised assessment protocol, in our case based on the Teatinos Protocol and the recommendations of the European Laryngology Society.
  - Commitment to the Voice Unit: healthcare activity counts with 1 specific consultation per week. The time allotted to each patient is approximately 30 min, with another 30 min/day for planning improvements, organisation, analysis of indicators, and research.
- Portfolio of services: the Unit serves known pathological groups in our specialty (functional, organic-functional, organic-congenital, and organic-acquired dysphonias, among others).

**Procedures in a Voice Unit**

- Admission of patients: patients come to the Voice Unit after attending the ENT general consultation (Fig. 2), where the physicians themselves filter these referrals. They issue a report and a provisional diagnosis along with the referral to the Voice Unit. This referral is to the Voice Unit in cases of benign pathology or to the Oncological Neck/Larynx Unit in cases with suspected neoplastic or preneoplastic pathology. The waiting time for the Voice Unit will not exceed 30 days.
- Health assistance work (study, diagnosis, and treatment): the study of patients takes place in a space intended for that purpose known as the Voice Laboratory, according to American terminology. A semi-structured clinical history is carried out which includes:
  - Anamnesis.
  - Study of the voice through a self-perception questionnaire (Voice Handicap Index [VHI]).
  - Image recording and study using laryngostroboscopy.
  - Perceptual voice evaluation (GRBAS system).

![Figure 1](http://www.elsevier.es)

*Figure 1* Organisation and integration of the Voice Unit in the ENT Service.

![Figure 2](http://www.elsevier.es)

*Figure 2* Procedure diagram for Voice Unit healthcare.
• Acoustic voice study (acoustic analysis + spectrogram).
• Aerodynamic study (MPT, S/Z ratio, etc.).
• Functional study (speaking rate, muscle tension, psychological aspects, etc.) and evaluation of the use of voice.

A diagnosis and referral for treatment are issued after studying the patient. Treatments are not mutually exclusive. On the contrary, in many cases they are complementary:

• **Phonosurgery** treatment. The patient will join a waiting list and subsequently a general surgical plan specific to the Voice Unit will be organised.
• **Medical-pharmacological** treatment. This is usually accompanied by a subsequent review to check on the progress and is often simultaneous with other treatments.
• **Extensive speech therapy** treatment: this is carried out at our partner services. The centres are sectored by zones. The service is provided by specialised speech therapists. The Unit holds regular meetings to obtain and provide information on the quality of treatments, the most effective techniques and the needs of speech therapy centres. Referral to speech therapy treatment is handled through a sufficiently detailed report. If additional information is required, it will be provided by telephone or personal contact.
• **Limited speech therapy** treatment: this speech therapy treatment is provided directly at the Voice Unit. It is preventive treatment consisting of 1 or 2 sessions with guidance and ‘vocal hygiene’ standards.

Once the prescribed treatment has been carried out, follow-up will take place along with corresponding evaluations and plan to be followed.

## Results

Below are the results achieved by our Voice Unit in a year. Statistical analysis has been performed with No. = 122 patients. We conducted a descriptive analysis, with measurements of central tendency, dispersion in continuous variables, and frequency distribution for qualitative variables.

The results obtained through the VHI self-perception test are shown in Fig. 3.

The diagnostic categories considered and their percentage distributions are shown in Fig. 4. As can be observed, among the group of the most common diseases, those recently classified as *exudative lesions of Reinke’s space* (*nodular lesions, vocal polyp, Reinke’s oedema*) stand out. Furthermore, epidermal cyst predominates within the group of organic-congenital dysphonias, with a volume greater than 12%.

Fig. 5 shows discrepancies between the final Voice Unit diagnoses and those obtained at the ENT general practice.
In fact, partial overlap is shown in 5.7% of diagnoses, while full discrepancy is shown in 54.1%.

Fig. 6 shows how different patients are distributed with respect to the treatment of their problem once they have been diagnosed at the Voice Unit. Phonosurgery and speech therapy are prominent among the most frequent possible treatments.

Discussion

Voice pathology is an important, growing demand at any ENT Service. This represents an increase in the need for specialised professionals. This specialisation deals with effectively diagnosing and treating the problem.

As indicated by Sataloff,4 Voice Units involve much more than laryngostroboscopic exploration or a Voice Laboratory. For such units to be created and maintain a stable and efficient operation, they must have greater accessibility, functionality and usability. Voice Units must assume a greater importance in relation to: coordination with the rest of the ENT Service, organisation, operation, healthcare function, teaching, etc. With respect to these functions, the Voice Unit should be able to answer many questions. Among the most notable are:

a. Related to management:
   - How does the Voice Unit work and relate with other ENT sections or units?
   - What volume of patients is it possible to attend at the Voice Unit?
   - How often are speech pathology patients being attended?
   - What are the resources consumed by patients attending the Voice Unit?
   - What are the most common pathologies?

b. Related to speech pathology:
   - Can the voice measurement be considered normal or pathological?
   - If the vocal function is considered pathological, what degree of pathology does it present?
   - What is the pathophysiological mechanism involved in the production of this voice?

c. Related to treatments:
   - What solutions or treatments are the most effective?
   - What objective and subjective changes occur after treatment?

- What degree of stability is provided by the treatments and how do voice quality and quality of life improve for patients?

Answering all these questions is not only important in clinical practice; it is also essential for research purposes and, where necessary, to support medical decisions in legal proceedings. The overall impression of physicians and patients is that a Voice Unit provides a comprehensive and objective assessment of vocal disorders.8

To achieve this goal, Voice Units require material resources and a human team composed of different professionals. This interdisciplinary assessment offers the best chance of identifying those aspects of the pathogenesis involved in vocal disorders. The otolaryngologist and speech therapist,10 who are generally responsible for intervening in these pathologies, must collaborate in a joint action that will benefit both the patient and the social health system. The otolaryngologist should be especially devoted to phoniatric problems, including phonosurgery; the speech therapist should be an integral part of the ENT Service structure and have as broad a commitment as possible to this work. In our particular case, Voice Unit consultations are carried out jointly by the otolaryngologist and speech therapist. Although the ENT specialist is in charge of the Voice Unit, decisions about assessment, diagnosis, and treatment options are taken jointly. This is a horizontal and interdisciplinary style of work.11

Following the directions of the European Laryngological Society (ELS)6 the 5 key aspects in a full assessment of a voice disorder are: perceptual, laryngostroboscopic, aerodynamic, acoustic, and self-perception analysis. This last aspect represents the way in which the physician can learn how patients **“live”** with their voice disorders. One of the most useful self-perception questionnaires for the assessment of dysphonic patients is known as VHI and was developed by Jacobson et al.12 in 1997. The questionnaire is versatile, easy to complete, and contributes abundant information.13 It makes it possible to quantify the impact suffered by a dysphonic subject in vocal function, the physical capacity associated with it and the emotions caused by dysphonia.14 The VHI guides professionals in the treatment of patients when taking a particular therapeutic approach. Despite its widespread use in clinical practice, we must consider that there are studies that have not found sufficient connection between the VHI and the parameters usually analysed in the study of dysphonia. In other words, according to these studies,15 the feelings of patients about their voice problems cannot be evaluated by objective measurements. Not even the harmonic-to-noise ratio, which has been correlated in the literature with the degree of overall perception of dysphonia, has shown a strong association with the VHI.

In our study, the most frequent assessments were found in the mild to moderate range; most notably, the pathological group of submucosal retention cyst presented the highest VHI value. It would be interesting in further studies to relate the VHI response with the level of vocal use, since vocal dysfunction will surely be manifested in different ways depending on the vocal demands of each subject.
With regard to diagnoses obtained by the Voice Unit, exudative lesions of Reinke’s space can be highlighted as the most frequent pathological group. Within this group, vocal nodules are predominant with 19.6%, followed by vocal polyps and Reinke’s oedema. The high percentage of epidermal cysts, with 12%, is worth noting.

From the physiopathological point of view, exudative lesions of Reinke’s space are included within organic-functional dysphonias and account for approximately 50% of diagnoses. This coincides with the literature, where this group is also the most common. However, we should highlight the low percentage of vocal nodules compared with other studies. The explanation is that vocal nodules diagnosed in the ENT general consultation are referred directly to the Speech Therapy Section. Only cases that do not improve with speech therapy treatment, with a functional impact on the patient and/or susceptible of phonosurgery due to their fibrous component are referred to the Voice Unit.

It is remarkable that 7.4% of larynges were healthy, considering as such a normal laryngoscopy examination or absence of symptoms. Referral of these cases to the Voice Unit took place because of acute disease processes resolved in the time delay.

We emphasise the limited number of laryngitis cases due to gastroesophageal reflux (only 0.8% of the total) despite the important role of laryngopharyngeal reflux, usually as a secondary factor, in the pathogenesis of dysphonias. Correct diagnosis and treatment performed at the ENT general consultation may explain this low percentage.

In relation to the diagnoses issued by the Voice Unit, the high rate of diagnostic discrepancy between them and those from the ENT general consultation is striking.

Specifically, the laryngeal pathologies showing the largest diagnostic discrepancies are those in the group of congenital organic dysphonia (epidermal cyst, sulcus, and stria). These are considered as lesions with a difficult diagnosis because of their intrafold location. This may be due to several factors:

1. Use of the laryngostroboscope. As mentioned earlier, out of the 5 points needed to carry out a voice exploration, laryngostroboscopy is undoubtedly the main tool for diagnosing the source of voice disorders. As we know, stroboscopy is an examination method producing an optical illusion, through which an object that moves quickly and regularly appears to move slowly or remain stationary. In turn, this perception of the vocal cords will enable an accurate assessment of the mucosal wave amplitude, the degree of periodicity and symmetry of the vocal cycle and of the morphology of glottic closure. It also enables precise, detailed assessment of the mucosal wave and the status of the free edge of the vocal fold. All these lead to a visualisation of laryngeal lesions that would be difficult to diagnose under halogen light.

A recently published study has shown a 90% diagnostic correlation between stroboscopy and direct microlaryngoscopy, which helps us understand the great power that diagnostic laryngostroboscopy offers for the clinical examination of voice. Consequently, we believe that one of the reasons that would justify the high diagnostic discrepancies (54%) found at our Voice Unit is the routine use of the stroboscope.

2. Voice Unit staff expertise: professionals involved in the Voice Unit must have specific training in this area. The learning curve is common to other disciplines. Practical and direct training with groups with extensive experience is of great interest. This specialisation leads to more accurate differential diagnoses.

3. Multidimensional and multidisciplinary assessment: the integration of different analysis systems (multidimensional study) and professionals (mainly otolaryngologists and speech therapists) within the voice assessment process is of great interest and importance for diagnostic accuracy.

4. More time devoted to the study of patients. The time available for each patient at the Voice Unit (30 minutes) can improve the accuracy of the diagnosis by not exerting the usual healthcare pressure.

As previously indicated, the Voice Unit is superior to the ENT consultation in reaching a correct diagnosis. This also has implications for treatment decisions. For example, in our study, we identified that 46.6% of the group of diagnosed polyps and cysts had already undergone speech therapy treatment as monotherapy. Clearly, this had not resolved the pathology and the patients had to be examined at the Voice Unit, where the treatment considered was phonosurgery. Referral to speech therapy treatment for these patients would be justified primarily in the context of a sandwich technique (preoperative and postoperative speech therapy) or in patients refusing surgical treatment.

Functional treatments are the most frequent at our Voice Unit, considering as such extensive speech therapy treatments and limited speech therapy treatments or vocal hygiene guidelines. This presents 2 possible causes:

1. A regular presence of the functional component in voice pathology, even when the diagnosis is organic; and organic diagnoses with specific need for speech therapy treatment, as is the case in recurrent paralysis.

2. Patients who access the Voice Unit with a provisional diagnosis of organic-congenital pathology, in whom an organic-functional pathology is finally confirmed. The recommended treatment in this situation is usually functional or, in any case, the mixed type: speech therapy-surgery-speech therapy.

The second most common treatment option is phonosurgery. The high percentage of phonosurgery procedures is justified by the type of population attending the Voice Unit. As previously mentioned, the number of vocal nodules is limited, since only vocal nodules with very defined and delimited characteristics are treated. In fact, it is noteworthy that only 5.9% of them reach surgical treatment. Moreover, as indicated in the diagnosis table, a significant number of organic-functional and organic-congenital lesions that can only be improved through surgery are identified.

We also observed a remarkable rate of discharges. This is a result of receiving some patients with acute processes at the Voice Unit, who therefore do not present stable vocal pathologies. This is also justified by postoperative reviews.
that usually lead to discharges once the pathological situation has been corrected and the vocal situation has become normal. The forecast is that the discharge rate will increase, considering the percentage of patients who are referred to phonosurgical treatment.

Conclusions

The Voice Unit should be part of the normal operation of an ENT Service/Area and be involved in organisational, healthcare, teaching and research activities.

A Voice Unit requires qualified and interdisciplinary staff, a minimum set of equipment (with stroboscopy being essential) and a clearly defined mode of action and referral criteria.

Voice Units are more efficient than ENT general consultations. This superiority is achieved through the following values:

1. Interdisciplinary work.
2. Material resources.
3. Sufficient time devoted to each patient.
4. Broad functionality (management, research, teaching, etc.).

Nodular lesions were the most common pathological group at our Voice Unit; the VHI test results showed a mild-moderate self-perception; there were a high percentage of discrepancies between the diagnoses of the ENT general consultation and those of the Voice Unit, and the preferred treatment was speech therapy.

We conclude that it is definitely necessary for the Voice Unit to contribute to the generation of correct diagnoses and treatments. This would eliminate:

- Patient discomfort.
- Inefficient treatments.
- Repeated consultations.

In turn, this would lead to:

- Increased patient satisfaction.
- Greater/better rationalisation of resources.

Conflict of Interests

The authors have no conflicts of interest to declare.

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