

REHABILITATION OF SMELL AND TASTE FUNCTIONS IN TOTAL LARYNGECTOMY: SYSTEMATIC REVIEW

Reabilitação das funções do olfato e do paladar em laringectomizados totais: revisão sistemática

Ada Salvetti Cavalcanti Caldas ⁽¹⁾, Vera Lúcia Dutra Facundes ⁽²⁾, Hilton Justino da Silva ⁽³⁾

ABSTRACT

Background: in total laryngectomy there occurs the transfer of the nasal airflow definitely to the tracheostoma, which could cause a decrease in the perception of smell and taste. There have been recently developed methods of intervention in order to improve performance in laryngectomized smell and taste, although few studies have investigated this issue. **Purpose:** this study aimed to systematically review the evidence of how the techniques involved in the rehabilitation of the functions of smell and taste have an effect on individuals with total laryngectomy. **Conclusion:** in this review all the selected studies demonstrated effective use of rehabilitation techniques for the role of olfaction in laryngectomized. As for taste, there were no proposals in order to intervene directly in this function.

KEYWORDS: Laryngectomy; Smell; Taste; Olfaction Disorders; Taste Disorders; Rehabilitation

■ INTRODUCTION

Total laryngectomy is a surgical procedure in which there is removal of structures that produce the laryngeal sound and neighbors muscles, with the transfer of the nasal airflow definitely to the tracheostoma¹, compromising the arrival of odor molecules to the olfactory epithelium by nasal inhalation, causing decreasing in smell perception and therefore taste function^{2,3}.

It has been recently developed methods of intervention to improve smell and taste performance in laryngectomized, especially rehabilitation techniques that provide an increase in nasal airflow with

the improvement of the odor molecules arrival in the olfactory neuroepithelium^{4,5}.

Given the few studies that address this issue, this article aims to systematically review the evidence of how the techniques involved in the rehabilitation of the smell and taste functions has effect on total laryngectomy individuals.

■ METHOD

A systematic literature review was performed from the PUBMED, MEDLINE (1997 – 2010), OLD MEDLINE (1966 – 1996), LILACS and SciELO data base, being the search of data held in 2010 october.

To search descriptors were used (DESCs) – keywords for retrieving subjects from scientific literature – and free terms (TL) – terms not found in DESC and MESH, but with relevance to the research –, being done through: “laryngectomy” (DESCs) AND “smell” (DESCs); “laryngectomy” (DESCs) AND “taste” (DESCs); “laryngectomy” (DESCs) AND “olfaction disorders” (DESCs); “laryngectomy” (DESCs) AND “taste disorders” (DESCs); “laryngectomized” (TL) AND “smell” (DESCs); “laryngectomized” (TL) AND “taste” (DESCs) and its equivalent in Portuguese and Spanish.

⁽¹⁾ Occupational Therapist; Mastering in Pathology at Federal University of Pernambuco, UFPE, Recife, PE – Brazil; Specialist in Public Health from University of Pernambuco – UPE.

⁽²⁾ Occupational Therapist; Assistant Professor of Occupational Therapy course at the Federal University of Pernambuco, UFPE, Recife, PE – Brazil; Doctor in Neuropsychiatry from Federal University of Pernambuco – UFPE.

⁽³⁾ Speech Therapist; Assistant Professor II at the Federal University of Pernambuco – UFPE, Recife, PE – Brazil; Doctor in Nutrition from the Federal University of Pernambuco – UFPE.

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The research was conducted by three researchers independently, following inclusion and exclusion criteria.

The inclusion criteria were original articles (excluding editorials and case study) that approached the total laryngectomy and the smell and/or taste functions rehabilitation in this population with the use of specific techniques, and the manuscripts were published in Portuguese, English and Spanish.

The literature review articles were excluded, as well as those who not specifically proposed interfere in the smell and/or taste functions and those who did not address the total laryngectomy population, such as animal studies.

LITERATURE REVIEW

We found 457 articles from the research of descriptors and free terms, being 183 from the PUBMED, 153 from MEDLINE, 109 from MEDLINE OLD, seven from LILACS, three from SCIELO Brazil and two from SCIELO Colombia. Considering the inclusion and exclusion criteria, there were selected 11 articles for this review, as claimed in Figure 1.

The great diversity observed in the found studies did not allow statistical analysis (methanalysis). The heterogeneity is reflected in the absence of criteria for randomization, sampling and variables diversification considered in the population of each article. So for better presentation of results we chose to

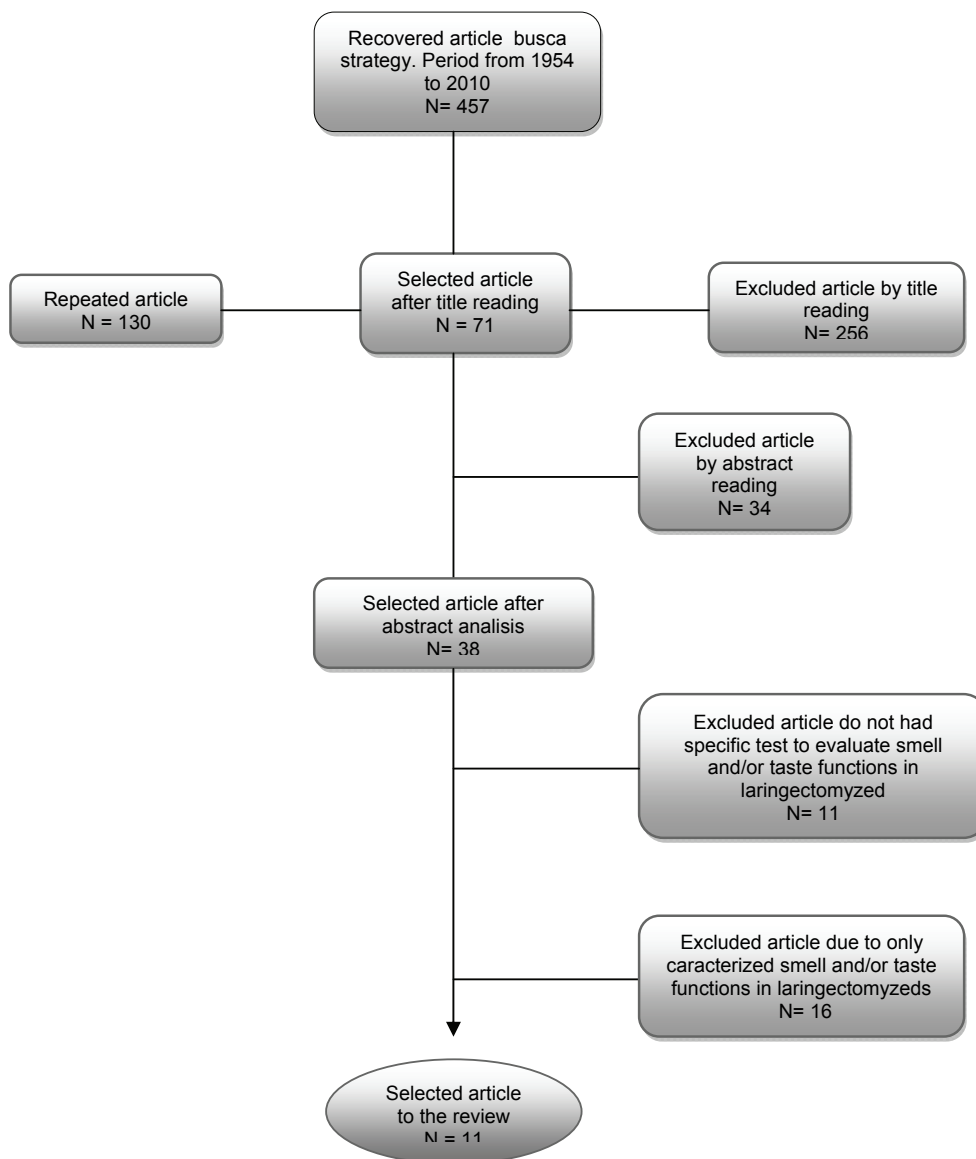


Figure 1 – Flowchart of the number of found articles and selected articles after applying inclusion and exclusion criteria according descriptors and data bases

consider the following variables of selected articles: author, year, country, sample, average age, time after laryngectomy, test used to assess the smell and/or palate function, intervention technique and results, as can be seen in Table 1.

The rehabilitation of the smell and taste functions seems to have been evidenced by research from the 2000s. Although the knowledge that the total laryngectomy can cause a decrease in smell and taste acuity have been reported in studies since 1954⁶, only in 1987⁷ the first publication describing a intervention technique with the attempt to reverse these sensory losses were published.

It is believed that this may be related to traditionally be more emphasis on voice rehabilitation⁴, since such changes are more evident in this population, with little perceived changes in the smell functions and taste consequently.

The discovery of the decrease in olfactory and gustatory function in total laryngectomized as well as the possible mechanisms and structures involved in these changes seems to have encouraged research groups to investigate intervention strategies to improve these functions, mainly in the Netherlands, Sweden and Germany^{5,8-13}.

It is assumed that the growth of larynx cancers and the number of total laryngectomy surgeries in Europe, has driven more and more researchers to investigate this population⁸. Associated with this fact, research has used questionnaires and specific tests to assess the smell and taste functions in order to verify the effectiveness of intervention techniques, verifying in these publications more concern about the quality of life of them.

Another relevant point is the absence of studies in Latin America, suggesting little emphasis on researching this topic. In Brazil, studies on the quality of life and oral communication are preferred by researchers in this region^{14,15}, although it has been found an article by Brazilian researchers outside of research strategies including the inclusion and exclusion criteria adopted in this review¹⁶.

The diversity of publications in this review may be evidenced by the number of sampling, and studies revealed the occurrence of between 12 and 44 individuals, although it has identified a prevalent variation between 18 and 24 individuals. It is assumed that the small number of individuals surveyed may undermine the inference of these findings for the general population.

In the selected articles, the average age of the subjects assessed was approximately 60 years, which is consistent with studies that indicate the age group 40 to 70 years as the most prevalent age for laryngeal cancer¹⁷.

Another point that should be taken into account in analyzing the results presented in this review is the surgery time, and this time varied from 0 till 20 years, thereby increasing the heterogeneity of the selected studies.

The tests used to evaluate olfactory function in the majority were concerned to make a quantitative analysis using standardized instruments, which suggests a concern with the results presented, as is intended to demonstrate the effectiveness of an intervention technique.

A study with a sample about 44 individuals, was used as a method to evaluate the smell function, the *Odor Detection Test* (ODT) with presentation of 16 trials with bottles containing 250 mL of solvent odorless dipropylene glycol and the others containing dipropylene glycol phenylethanol¹³. Later, in another publication of the same author, also used this evaluate method in association to the evaluation *Smell Disk Test* (SDT) which is the submission of eight different odors on floppy disks, and the study confirmed that the SDT represents a test to be faster and simple application and reproducibility¹².

The *Sniffin Sticks test battery* is another standardized test used in recent publications^{3,5,9}, having an evaluation as a method to use odors contained in 12 "pens", with an objective test, showing a greater confidence in the presented results.

Subjective tests with questionnaires use, has been widely used to evaluate the smell and taste functions, particularly with respect to self-evaluation and satisfaction with the current situation experienced by the individual. The Olfaction questionnaire, Taste and Appetite (QOTA) represents a subjective test with a study proposed evaluation through multiple-choice questions of the current and previous total laryngectomy surgery situation^{8,10,11,13}. It is understood that although the questionnaire has well-defined scores, it requires that their use is accompanied by objective tests for better results.

In the evaluation of taste function was noted that the studies used questionnaires and semi-structured interview with subjective approach and proposal self-assessment^{4,8,10,11,13}. It is understood that changes in taste function can be considered as a consequence of the decline in olfactory function, which may explain the lack of analysis with standardized tests for the taste function.

It is observed that even in articles that offer only the assessment of gustatory function, subjective tests are used, especially aqueous solutions, with non-standard instruments¹⁸, which demonstrates the lack of more objective studies to analyse this function.

The found intervention techniques in the articles selected for this review primarily describes the use

Table 1 – Studies that tested the evidence of rehabilitation techniques for smell and taste functions in total laryngectomy

Author/Year	Country	Sample	Average age in years	Time of laryngectomy	Test used to evaluate the smell and/or taste functions	Intervention technique	Results
MORALES-PUEBLA <i>et al</i> , 2010 ⁴	Spain	41 (02 women and 39 men)	65,04	4 years (average)	Acuity olfactory test; semi-structured interview; LB use;	NAIM	Before learning the technique: 21.95% (n = 9) able to detect odors; In self-assessment identified the loss of 53% in taste function capacity and 97.5% in smell function capacity after surgery. After rehabilitation classified 69% and 44% loss of taste and smell functions respectively. In tests, after using the technique, 90.24% (n = 37) were able to identify odors, 88% of those who had anosmya had positive result with the technique;
WARD <i>et al</i> , 2010 ³	Austrália	43 (06 women and 37 men)	63,6	At least 6 months	SStb;	NAIM: Exercise at home group; Clinical assistance group;	Before training → At home: 65% anosmya, 35% hyposmya; In the clinic: 85% anosmya, 15% hyposmya; After training with NAIM → At home: 35% anosmya, 30% hyposmya, 10% normal; assistance in the clinic: 20% anosmya, 55% hyposmya, 20% normal; After 3 months of training → At home: 20% anosmya, 35% hyposmya, 20% normal; assistance in the clinic: 25% anosmya, 50% hyposmya, 20% normal; Clinical training cause more improvement in olfactory acuity;
RISBERG-BERLIN <i>et al</i> , 2009 ⁸	Sweden	18 included (03 women and 15 men) 18 control	71	10 years (average)	SOIT; Semi-structured interview; QOTA;	NAIM	SOIT score → After rehabilitation: 61% anosmya; 39% feel odors; After 6 months: 70% anosmya pass to hyposmya; After 36 months: 22% anosmya e 78% normosmya e hyposmya; 12 of 18 volunteers used NAIM everyday; 6 volunteers did not used (2 normosmya/hyposmya; 4 anosmya);
GOEKTAS <i>et al</i> , 2008 ⁹	Germany	16 (03 women and 13 men)	63	-	SStb; Subjective scala 10 points;	LB; SV;	Greater improvement on smell function after the use of SV (75%) compared to LB; SV easier to use;
GOKTAS <i>et al</i> , 2008 ⁵	Germany	16 (02 women and 14 men)	62	Between 1995 to 2003	SStb; Subjective scala 10 points;	LB	Before the technique all had anosmya (3 points in test average); After the LB went to an average of 7 points: 5 patients with 8 points (upper limit of anosmya) and 2 with higher scores passing on anosmya to hyposmya;
RISBERG-BERLIN; MOLLER; FINIZIA, 2007 ¹⁰	Sweden	24 (03 women and 21 men)	68	7 yeras (average)	Semi-structured interview; SOIT; QOTA;	NAIM	Before treatment → 10 of 24 (42%) are able to perceive odors; 14 (58%) have anosmya; After 6 months of treatment → 87% (n=20) were able to perceive odors; After 12 months of treatment → 88% (n=21) perceived odors; With the rehabilitation 63% (n=15) were classified as normosmya at the end of the study.

RISBERG-BERLIN; YLITALO; FINIZIA, 2006 ¹¹	Sweden	24 (03 Women and 21 men)	68	At least 5 months	Semi-structured interview; SOIT; QOTA;	NAIM	Before treatment → 42% (normosmya [n=6]; hyposmia [n=4]) are able to perceive odors; 58% (n=14) has anosmya; 13(72%) of 18 patients with abnormal smell that used NAIM showed improvement; 7 of the 14 with anosmya started to perceived odors after a session of intervention;
HILGERS <i>et al.</i> , 2002 ¹²	Netherlands	41 (10 women and 31 men)	63	6,5 years	ODT [POPS]; SDT;	NAIM	46% (n =19) were considered with normosmya; It had statically significant with correct use of NAIM ;
HILGERS <i>et al.</i> , 2000 ¹³	Netherlands	44 (10 women and 34 men)	64	6 years	ODT; QOTA [POPS];	NAIM	Before treatment: 33 anosmya and 11 hyposmia/normosmya; After the treatment: 19 anosmya e 25 hyposmia/normosmya (success rate 46%)
ARMENGOT <i>et al.</i> , 1990 ¹⁹	Spain	20 men	Between 43 till 75 years	9 months to 20 years	Elsberg method	Phonatory prosthesis	Without prosthesis: better perception limiar to the pure olfactory stimuli; With prosthesis: pure limiar olfatory remain in normal values;
SCHWARTZ <i>et al.</i> , 1987 ⁷	USA	i 12 (2 women and 10 men); ii 30 (6 women and 24 men) 25 control	61,6 i 63 ii	2 months to 20 years	Limiar detection odors test i; Odors identification test with "odorant confusion matrix" ii;	LB ii	Reversal of hyposmia by trigeminal nerve stimulation; Reversal of hyposmia is not complete without olfative nerve stimulation; The identification test with the matrix was dependent on the inspiratory airflow with and without LB.

SStb = Sniffin Sticks test battery; SOIT =The Scandinavian Odor Identification Test ; QOTA = Questions on Odor, Taste and Appetite; POPS =Present Odor Perception Scale; ODT= Odor Detection Test; SDT = Smell Disk Test; LB = Larynx bypass; SV = Scent-diffusing ventilator; NAIM: Nasal Airflow-Inducing Maneuver; i = (group 1) initial study; ii= (group 2) 30 subjects (10 of group 1)

of devices to restore nasal airflow, reconnecting the upper to the inferior airway, as well as techniques whom works the orofacial muscles in order to recover this airflow. But in only one analyzed study observed the possibility of using the speech prosthesis as a intervention technique, and certified low efficiency of this method¹⁹.

Some studies have shown efficacy in the use of "Larynx Bypass" (LB), a flexible tube in order to connect the patient's mouth and tracheostoma to restore the airflow, resulting from the smell improves air circulation in the nasal passage, requiring the patient to relax the palate does not obstruct the nasopharynx^{5,7,9}.

Research conducted in Germany discusses the practicality of this method and proposes the technique of Scent-Diffusing ventilator (SV), in which a small fan is attached to a mask, carrying the air directly to the nose, allowing the entry of odor molecules passively into nasal cavity⁹.

In both techniques there is evidence of improvement in olfaction, but we see a great improvement through the use of the SV technique compared with the use of the LB technique, as well as being easier to use. In contrast, the cost of this technique is discussed, there is need greater technology, as

in LB technique uses only one flexible tube, which suggests less financial support.

The *Nasal Airflow-Inducing Maneuver* (NAIM) is the most commonly used technique in studies that propose smell and taste functions rehabilitation^{3,4,8,10-13}. This device has a proposal to create a negative pressure in the oral and oropharynx cavity to induce nasal airflow, allowing the arrival of odor molecules back to the olfactory neuroepithelium. This technique known as *polite yawning*, is a "yawn" extended with the simultaneous movement of retraction of the mandible, the mouth floor, the tongue, the base tongue base and soft palate, keeping lips tightly closed¹³.

It was observed that this technique has proven effective in restoring olfactory function, converting individuals with anosmya to resume the ability to perceive odors, both short term and extended periods of use, besides being easy to learn by users.

In research conducted in Sweden with 24 individuals, it was used the NAIM rehabilitation method, noting that half of patients who had anosmya started to perceive odors after being administered a single session of this technique¹¹.

This factor reinforces the importance of investment in rehabilitation proposals, since it is possible to detect changes in a short period of time, resulting

in improvement in olfactory function and quality of life of these subjects. These results may provide incentives for researchers to invest in this area and propose new forms of intervention in clinical practice.

In this selected studies it is clear that the intention of researching proposals for rehabilitation is not always reflected in investments in clinical practice, and although there is a concern to encourage this practice⁴ only one study presents the analysis of interventions in clinical and home care³. Given this, we suggest new studies who reported the applicability of these techniques in everyday of professionals who provide care to this population.

We also observe that the various techniques available for the reactivation of smell function do not propose to intervene directly in the taste function. The absence of specific methods to rehabilitate the taste function, such as the lack of standardized tests to assess this function, reiterates the hypothesis that the olfactory changes in total laryngectomizeds can reflect disorders in taste function and the reactivation of the olfactory function can also improve the taste function in this population.

■ CONCLUSION

In this review the tests used to evaluate olfactory function in the majority were concerned to make a quantitative analysis using standardized instruments, which suggests a concern with the results presented, as is intended to demonstrate the effectiveness of an intervention technique, but there are no tests to evaluate the taste function tests and specific methods of rehabilitation.

All analyzed studies demonstrated effectiveness in use of rehabilitation techniques for the smell function in total laryngectomized. Of the several techniques available, that who has been most commonly used is *Nasal Airflow-Inducing Maneuver* (NAIM), being a fast learning method, with obvious results in the reactivation of smell function and may have immediate effects after administration.

There is greater concern in the rehabilitation of olfactory function due to the taste function, considering that the taste function changes in total laryngectomized are a consequence of smell function changes, suggesting that the reactivation of smell function also resonate in taste function improvements.

RESUMO

Tema: na laringectomia total ocorre a transferência do fluxo aéreo nasal definitivamente ao traqueostoma, podendo provocar diminuição na percepção do olfato e do paladar. Recentemente tem sido desenvolvidos métodos de intervenção a fim de melhorar a performance olfativa e gustativa em laringectomizados, embora sejam escassos os estudos que abordam esse tema. **Objetivo:** rever de forma sistemática as evidências de como as técnicas envolvidas na reabilitação das funções do olfato e do paladar tem efeito em indivíduos laringectomizados totais. **Conclusão:** nesta revisão todos os estudos selecionados demonstraram eficácia na utilização de técnicas de reabilitação para a função do olfato em laringectomizados totais. Para o paladar não houve propostas para intervir diretamente nesta função.

DESCRITORES: Laringectomia; Olfato; Paladar; Transtornos do Olfato; Distúrbios do Paladar; Reabilitação

■ REFERENCE

1. Hannickel S, Zago MMF, Barbeira CBS, Sawada NO. O comportamento dos laringectomizados frente à imagem corporal. *Revista Brasileira de Cancerologia*. 2002 jul-ago-set; 48(3): 333-9.
2. Welge-luessen A, Kobal G, Wolfensberger M. Assessing olfactory function in laryngectomees using the Sniffin.sticks test battery and chemosensory evoked potentials. *Laryngoscope*. 2000; 110: 303-7.
3. Ward E, Coleman A, van As-Brooks C, Kerle S. Rehabilitation of olfaction post-laryngectomy: a randomized control trial comparing clinician assisted versus a home practice approach. *Clin Otolaryngol*. 2010 fev; 35(1):39-45.
4. Morales-puebla JM, Morales-Puebla AF, Jiménez-Antolín JA, Muñoz-Platón E, Padilla-Parrado M,

- Chacón-Martínez J. Olfactory rehabilitation after total laryngectomy. *Acata Otorrinolaringol Esp.* 2010 mar-abr; 61(2):128-34.
5. Goktas O, Fleiner F, Paschen C, Lammert I, Schrom T. Rehabilitation of the olfactory sense after laryngectomy: long-term use of the larynx bypass. *Ear Nose Throat J.* 2008 Set;87(9): 528-30.
 6. Marco J, Gimenez JA, Morera H. Olfaction in laryngectomy. *Rev Esp Otoneurooftalmol Neurocir.* 1954 Nov-Dez; 13(76):380-94.
 7. Schwartz DN, Mozell MM, Leopold DL, Youngentob SL, Sheehe PR. Improvement of olfaction in laryngectomized patients with the larynx bypass. *Laryngoscope.* 1987 Nov; 97(11): 1280-6.
 8. Risberg-Berlin B, Rydén A, Möller RY, Finizia C. Effects of total laryngectomy on olfactory function, health-related quality of life, and communication: a 3-year follow-up study. *BMC Ear, Nose and Throat Disorders.* [periódico na internet] 2009 [acesso em 2010 out. 19]; 9 (8):[9 p.]. Disponível em: <http://www.biomedcentral.com/1472-6815/9/8>.
 9. Goektas O, Fleiner F, Frieler K, Scherer H, Paschen C. The scent-diffusing ventilator for rehabilitation of olfactory function after laryngectomy. *Am J Rhinol.* 2008 Set-Out;22(5):487-90.
 10. Risberg-Berlin B, Moller RY, Finizia C. Effectiveness of Olfactory Rehabilitation With the Nasal Airflow-Inducing Maneuver After Total Laryngectomy: One-Year Follow-up Study. *Arch otolaryngol head neck surg.* 2007 Jul.; 133 (7):650-4.
 11. Risberg-Berlin B, Ylitalo R, Finizia C. Screening and rehabilitation of olfaction after total laryngectomy in swedish patients: results from an intervention study using the nasal airflow-inducing maneuver. *Arch Otolaryngol. Head Neck Surg.* 2006 mar.; 132: 301-6.
 12. Hilgers FJM, Jansen HA, Van As CJ, Polak MF, Muller MJ, Van Dam FSAM. Long-term results of olfaction rehabilitation using the nasal airflow-inducing (“polite Yawning”) maneuver after total laryngectomy. *Arch Otolaryngol. Head Neck Surg.* 2002 jul.; 128: 648 –54.
 13. Hilgers FJM, Van Dam FSAM, Keyzers S, Koster MN, Van As CJ, Muller MJ. Rehabilitation of olfaction after laryngectomy by means of a nasal airflow-inducing maneuver: The “polite yawning” technique. *Arch Otolaryngol. Head Neck Surg.* 2000 jun.; 126: 726 –32.
 14. Oliveira IB de, Costa CC, Chagas JFS, Rochetti ECG, Oliveira LO de. Comunicação oral de laringectomizados com prótese traqueoesofágica: análise comparativa pré e pós-treino. *Pró-Fono R. Atual. Cient.* 2005 Aug.; 17(2): 165-74.
 15. Paula FC, Gama RR. Avaliação de qualidade de vida em laringectomizados totais. *Rev bras cir. cabeça pescoço.* 2009 Jul-Set; 38(3):177-82.
 16. Cleto ML, Pedalini LM, Junior JFM. Reativação do olfato em laringectomizados totais. *Arquivos internacionais de otorrinolaringologia.* 2005 Abr-Jun; 9(2):102-7.
 17. Wünsch Filho I. The epidemiology of laryngeal cancer in Brazil. *Sao Paulo Med J.* 2004;122(5):188-94.
 18. Kashima HK, Kalinowski B. Taste impairment following laryngectomy. *Ear Nose Throat J.* 1979 Fev;58(2):88-92.
 19. Armengot M, Algarra JM, Franco MR, Gimenez F. Olfaccion en los laringectomizados: influencia de la protesis fonatoria. *Anales O.R.L. iber.-Amer.* 1990; 17: 99-105.

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Mailing Address:

Ada Salvetti Cavalcanti Caldas

Rua Guedes Pereira, 180 – apto. 903 Parnamirim

Recife – Pernambuco

CEP: 52060-150

E-mail: adasc@hotmail.com