



The effect of partial and total laryngectomy on couples' sexual functions in men with larynx cancer

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Abstract

Purpose To investigate effect of total or partial laryngectomies with or without adjuvant treatments on couples' sexual functions.

Methods The study included 39 male patients with laryngeal cancer and their female partners who were sexually active. Twenty-six patients underwent total laryngectomy, and 13 had partial laryngectomy. Sexual functions were assessed with the International Index of Erectile Function (IIEF-5) questionnaire for erectile functions, the Male Sexual Health Questionnaire (MSHQ-4) for ejaculatory functions and the Female Sexual Function Index (FSFI) for female partners' sexual functions.

Results The mean IIEF score significantly decreased from 21.51 ± 8.78 to 16.13 ± 9.6 after the surgery ($p=0.000$). The mean MSHQ score significantly decreased from 12.95 ± 3.14 to 10.32 ± 4.59 after the surgery ($p=0.000$). To investigate risk factors that might predict decreasing in post-operative erectile and ejaculatory function of the male patients, presence of pre-operative erectile dysfunction ($p=0.04$) and additional treatment with chemo-radiation therapy were the predictors for decreases in erectile ($p=0.006$) and ejaculatory functions ($p=0.036$). The mean FSFI total score significantly decreased from 25.83 ± 7.42 to 13.45 ± 10.09 after the surgery ($p=0.000$).

Conclusion Laryngectomies have negative impact on male erectile and ejaculatory functions, and also have negative effect on female partners' sexual functions. Presence of pre-operative erectile dysfunction and additional chemo-radiation therapy were the predictors to decrease in erectile and ejaculatory functions after surgery. Therefore, male patients and their female partners should be informed in light of these findings before laryngeal surgery and adjuvant therapy.

Keywords Larynx cancer · Laryngectomy · Sexuality · Quality of life

Introduction

Laryngeal cancer is associated with smoking and alcohol consumption. It is one of the most common head and neck malignancies [1]. The most common histological type of these cancers is squamous cell cancer. The treatment options can be chosen according to tumor size and the involvement parts of larynx. These options include surgery (partial or total laryngectomy), irradiation and chemotherapy or combination therapy [2, 3]. All treatment modalities have many

effects over patients' quality of life such as the compromising of speaking and swallow, decrease in taste and smell, sputum, xerostomia, social isolation, decreased self-confidence and sexual dysfunction [3, 4].

Male erectile dysfunction is defined as the inability to attain and/or maintain penile erection sufficient for satisfactory sexual intercourse. It is a common disorder associated with aging that significantly impacts quality of life of men and their partners [5]. Erectile dysfunction (ED) is mainly associated with lower urinary tract symptoms and ejaculatory dysfunction, and it is called as male pelvic dysfunction. Its prevalence is 20% over 40 ages in men [6]. Sexual dysfunction is also commonly seen in women, and the prevalence of female sexual dysfunction in the literature has been reported from 5.8 to 46.2% [7, 8].

Sexual dysfunction eliciting after the laryngectomy for laryngeal cancer has been demonstrated as the second

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most common issue after cough [9]. In addition, the effects of male systemic diseases such as cancer on a female partner's sexual function have not been extensively assessed. Therefore, the aim of the study was to investigate effect of total or partial laryngectomy and/or adjuvant therapy on couples' sexual functions in men with larynx cancer. We also compared results of partial and total laryngectomy on couples' sexual functions in the same population.

Materials and methods

This study was approved by Local Ethical Committee. An informed consent was obtained from all patients and their female partners, included in the study.

During a 10-year period, between 2009 and 2019, a total of 123 male patients who had partial and total laryngectomy were retrospectively reviewed. The patients who died or were not sexually active or did not want to participate to this study were excluded from the study. The patients and their partners who could not recall their sexual activity before and after surgical procedures were excluded as well. Therefore, the study included 39 male patients with laryngeal cancer and their female partners who were sexually active. Twenty-six patients underwent total laryngectomy for advanced stage cancers (T3 and T4), and 13 had partial laryngectomy for early stage (T1 and T2) cancers. Laryngofissure cordectomy, vertical hemilaryngectomy and supraglottic laryngectomy was included to partial laryngectomy group. An open and trans-cervical approach was used for all partial laryngectomies. A horizontal or apron skin incision was performed at the beginning of surgery. Laryngofissure cordectomy for patients with T1 stage glottic cancer and vertical hemilaryngectomy for patients with T2 stage glottic cancer were performed. Supraglottic laryngectomy for patients with T1 and T2 stage supraglottic cancer was performed as partial laryngectomy procedure. A tracheotomy routinely was performed patients undergoing partial laryngectomy. After resolving laryngeal edema and swallowing without aspiration, tracheotomy was closed in postoperative first to third weeks.

All male patients and their female partners included in the study were called to assess sexual functions, and the interviews were performed face to face. All patients were assessed for smoking, alcohol consumption, comorbid disease, drugs taken. The patients who had additional pre- or post-operative radiotherapy or chemotherapy due to residual and recurrent disease were recorded.

Evaluation of sexual functions

To assess various aspects of erectile dysfunction, the entire study participants completed nationally validated standardized International Index of Erectile Function (IIEF) questionnaire. The IIEF questionnaire was originally a 15-item scale of male sexual function that assessed separate domains of erectile function, orgasmic function, intercourse satisfaction, and overall satisfaction. However, an abridged form of the IIEF scale, the IIEF-5, was used to assess erectile function for the survey [5]. The validated IIEF-5 scale consists of five questions scored from 0 to 5 points assessing erectile function domain and one additional item for overall satisfaction scored from 1 to 5, amounting to a total score of 30. Erectile dysfunction (ED) was classified as absent (26–30), mild (18–25), moderate (11–17), or severe (0–10).

Male Sexual Health Questionnaire (MSHQ-4) was used to assess ejaculatory dysfunction. MSHQ-4 has 4 questions scored from 0 to 5 points. MSHQ-4 consists of three questions assessing ejaculatory behavior, including force, volume and frequency of ejaculation, and one item for bother from ejaculatory dysfunction with a high degree of reliability and validity. Ejaculatory dysfunction was classified as absent (12–15), mild (8–11), moderate (5–7), or severe (0–4) [6].

Female sexual functions were evaluated with the Female Sexual Function Index (FSFI) [8, 10, 11]. The FSFI consists of 19 questions (rated from 0 to 5) and 6 domains including sexual desire, arousal, lubrication, orgasm, satisfaction, and pain. To calculate the individual domain score, the scores of individual questions comprising the domain are summed and multiplied by the factor specific to the relevant domain. The total score is calculated by adding the scores of the six domains. The total score of the scale is ranged from 2.0 to 36.0, with higher scores indicating a lesser degree of sexual dysfunction.

Statistical analysis

Data were analyzed using the Predictive Analytics Software (PASW) Statistics version 22.0 for Windows (SPSS Inc., Chicago, IL, USA). We used the paired *t* test to compare male and female sexual function scores before and after the surgery. Demographic characteristics such as male and female ages and the male and female sexual functions parameters were compared using the independent *t* test between the two surgical groups. The Chi square test was used to compare rate of co-morbid diseases between the two surgical groups. In addition, multi-variate analyses were used to predict male erectile dysfunction and ejaculatory dysfunction and female sexual dysfunction. Probability values of <0.05 were considered as significant. The values are given as the mean \pm standard deviation (SD).

Table 1 Demographic characteristics and co-morbid diseases of the patients

Demographic characteristics	Total laryngectomy Mean \pm SD (range) ($n=26$)	Partial laryngectomy Mean \pm SD (range) ($n=13$)	p value
Patient age	61.58 \pm 8.55 (37–83)	63.69 \pm 6.26 (48–69)	NS
Female partner age	58.46 \pm 7.35 (44–73)	61.57 \pm 4.46 (55–69)	NS
Patients with co-morbid disease (%)	$n=11$ (42.3%)	$n=5$ (38.4%)	NS
	Hepatitis B (2)	COPD (1)	
	COPD (2)	Cirrhosis (1)	
	Cirrhosis (1)	DM + Hypertension (1)	
	Hypertension (2)	BPH (1)	
	CD + Hypertension (1)	CAD (1)	
	CD + CAD (1)		
	Stomach cancer (1)		
	GOR (1)		

NS no statistically significance, COPD chronic obstructive pulmonary disease, DM diabetes mellitus, BPH benign prostate hyperplasia, CD cerebrovascular disease, CAD coroner artery disease, GOR gastroesophageal reflux

Table 2 Evaluation of erectile function and ejaculatory function before and after surgery

	Pre-operative	Post-operative	p value
IIEF score	21.51 \pm 8.78	16.13 \pm 9.6	0.000*
MSHQ score	12.95 \pm 3.14	10.32 \pm 4.59	0.000*

IIEF International Index of Erectile Function, MSHQ Male Sexual Health Questionnaire

*Statistically significant

Table 3 Relationship between erectile function and risk factors in the male patients

Risk factors	p value
Age	0.179
Surgery type	0.213
Post-operative follow-up period	0.204
Alcohol consumption	0.833
Comorbid diseases	0.482
Pre-operative erectile dysfunction	0.04*
Chemo-radiation therapy	0.006*

*Statistically significant

Results

The mean age of the patients was 62.28 \pm 7.84 years (range 37–83), and the mean age of the female partners was 59.55 \pm 6.54 (range 44–73). All patients had smoking, and 22 patients had alcohol consumption in their medical history. Of the patients, 5 underwent preoperative radiotherapy, and 11 patients had postoperative chemoradiotherapy. As shown in Table 1, no significant differences in the patients and female partners' age and co-morbid diseases between the patients who had partial and total laryngectomy.

Table 2 shows evaluation of erectile function and ejaculatory function before and after surgery. The mean IIEF score in the male patients significantly decreased from 21.51 \pm 8.78 to 16.13 \pm 9.6 after the surgery ($p=0.000$). Of the total of 39 male patients, 16 had preoperative normal erection (the IIEF score of ≥ 26) and, 23 had preoperative erectile dysfunction (the IIEF score of < 26). There was no significant difference in terms of decrease in the IIEF score after surgery according to preoperative erection score ($p=0.197$). The mean MSHQ score in the male patients significantly decreased from 12.95 \pm 3.14 to 10.32 \pm 4.59

after the surgery ($p=0.000$). When the percentage of decrease in the mean IIEF score was compared according to surgical types, it was 33.07 \pm 26.43% in the total laryngectomy group and 13.04 \pm 32.51% in the partial laryngectomy group, revealing no significant difference ($p=0.078$). The mean MSHQ score decreased 22.68 \pm 24.83% in the total laryngectomy group and 17.06 \pm 30.68% in the partial laryngectomy group, revealing no significant difference ($p=0.549$). When the percentages of differences in the scores were compared according to additional treatment with chemo-radiotherapy from preoperatively to post-operatively, no significant differences were observed ($p=0.067$ for the IIEF score and $p=0.520$ for the MSHQ score).

To investigate risk factors that might predict decreasing in post-operative erectile functions, as shown in Table 3, using multi-variate analysis, no relationship was observed in the patient age ($p=0.179$), surgery type ($p=0.213$), post-operative follow-up period ($p=0.204$), alcohol consumption ($p=0.833$) and presence of comorbid diseases

Table 4 Relationship between ejaculatory functions and risk factors in the male patients

Risk factors	<i>p</i> value
Age	0.825
Surgery type	0.205
Post-operative follow-up period	0.123
Alcohol consumption	0.054
Comorbid diseases	0.537
Pre-operative ejaculatory function	0.513
Chemo-radiation therapy	0.036*

*Statistically significant

Table 5 Sexual function sub-domains of the female partners from pre-operatively to post-operatively

Female sexual functions (total and sub-domains scores)	Pre-operative (mean \pm SD)	Post-operative (mean \pm SD)	<i>p</i> value
Total score	25.83 \pm 7.42	13.45 \pm 10.09	0.000*
Desire	3.6 \pm 1.34	2.7 \pm 1.23	0.002*
Arousal	4.09 \pm 1.3	1.87 \pm 1.62	0.000*
Lubrication	4.51 \pm 1.57	2.53 \pm 2.31	0.001*
Orgasm	4.54 \pm 1.47	2 \pm 2.06	0.000*
Satisfaction	4.34 \pm 1.7	2.04 \pm 1.98	0.001*
Pain	5.04 \pm 1.58	2.8 \pm 2.47	0.001*

*Statistically significant

($p=0.482$). However, presence of pre-operative erectile dysfunction ($p=0.04$) and additional treatment with chemo-radiation therapy ($p=0.006$) were the predictors for decrease in erectile functions after surgery.

To investigate risk factors that might predict decreasing in post-operative ejaculatory functions, as shown in Table 4, using multi-variate analysis, no relationship was observed in the patient age ($p=0.825$), surgery type ($p=0.205$), pre-operative ejaculatory function ($p=0.513$), post-operative follow-up period ($p=0.123$), alcohol consumption ($p=0.054$) and presence of comorbid diseases ($p=0.537$). However, presence of additional treatment with chemo-radiation therapy was the only predictor for decrease in ejaculatory functions after surgery ($p=0.036$).

Table 5 shows sexual function total score and sub-domains of the female partners from pre-operatively to post-operatively. The mean FSFI score in all female partners significantly decreased from 25.83 \pm 7.42 to 13.45 \pm 10.09 after the surgery ($p=0.000$). Highly significant decreases were observed after the surgery in sexual desire ($p=0.002$), arousal ($p=0.000$), lubrication ($p=0.001$), orgasm ($p=0.000$), satisfaction ($p=0.001$) and pain ($p=0.001$). To investigate risk factors that might predict female sexual dysfunction, no relationship was

observed in the patient age ($p=0.752$) and female partners' age ($p=0.769$), surgery type ($p=0.710$) and post-operative follow-up period ($p=0.931$).

Discussion

Cancers in head and neck and their treatments might affect quality of life based on treatment modalities. Some factors such as diagnosis of cancer itself, treatment of cancer in older ages can lead to depression, decreasing self-confidence, decrease in future expectation and sexual dysfunction. In addition, total or partial laryngectomy related voice problems compromising communication between partners exaggerate sexual dysfunctions. To our best knowledge, this is the first study to investigate effect of laryngectomies with or without adjuvant treatment on male erectile and ejaculatory functions and also female partners' sexual functions.

Few studies have reviewed impact of surgical procedures for laryngeal cancer on sexual functions [3, 9]. Tracheostomy, sputum, lower olfaction, loud breath and appearance of the neck in patients who underwent total laryngectomy and alteration of voice of the patients undergoing partial laryngectomy could cause difficulty in sexual approach between the patients and their sexual partners. Head and neck cancers, surgery and reconstructive applications for these cancers have a variety of effects on body image of patients [12]. The alteration of patients' neck image such as tracheostomy and thin neck and change in voice might have negative impacts on desire in their spouse. Additionally, patients may avoid from sexual intimacy because of shaming from their loudly breath and sputum through the tracheostomy. Offerman et al. found that one-fourth of patients with total laryngectomy felt less attractive [13]. In the present study, the mean IIEF score in the male patients significantly decreased from 21.51 \pm 8.78 to 16.13 \pm 9.6 after the surgery. The mean MSHQ score, which shows ejaculatory functions in the male patients, significantly decreased from 12.95 \pm 3.14 to 10.32 \pm 4.59 after the surgery.

Total laryngectomy and neck dissection are more extensive surgical procedure than partial laryngectomy. Once considered the involved difference between these procedures, effects on sexual life each can be different. Karaaltın et al. have reported that according to the Arizona Sexual Experiences Scale (ASEX) there was no significant difference about sexual function between total and partial laryngectomy, but it was significant difference according to European Organization for Research and Treatment of Cancer, Head and Neck Cancer Module (EORTC QLQ-H&N35) [14]. Singer et al. have shown that advanced tumor stages and distress instead of surgery type had negative impact on sexual problems [9]. Herranz et al. determined that 5% of patients undergoing radical or functional

surgery for laryngeal cancer showed a substantial alteration on sexual life of partners [15]. Akıl et al. had found that there was no significant difference in ASEX and significant difference in QLQ- H&N35 (HNSX, sexuality subunit) [16]. In addition, they stated that HNSX does not show directly sexual functions. In our study, both total and partial laryngectomy had negative effects on male and also female partners' sexual functions. But, type of surgery did not significantly affect sexual functions. When the percentage of decrease in the mean IIEF score was compared according to surgical types, it was $33.07 \pm 26.43\%$ in the total laryngectomy group and $13.04 \pm 32.51\%$ in the partial laryngectomy group, revealing no significant difference. The mean MSHQ score decreased $22.68 \pm 24.83\%$ in the total laryngectomy group and $17.06 \pm 30.68\%$ in the partial laryngectomy group, revealing no significant difference.

Preoperative radiotherapy did not provide negative effects on the sexual functions in our study. However, patients with total laryngectomy have less sexual intimacy than ones administered radiotherapy alone [17]. Karaaltın et al. reported that there was significant difference between those administered chemo-radiotherapy after surgery and those applied radiotherapy alone after surgery [14]. Moreno et al. demonstrated that patients undergoing radiotherapy had better sexual satisfaction than those not having surgery [4]. Alcohol consumption and smoking did not have significantly impact on sexual satisfaction as well. In our study, chemoradiotherapy after surgery negatively influenced sexual functions ($p = 0,006$). However, when the percentages of differences in the scores were compared according to additional treatment with chemo-radiotherapy from preoperatively to post-operatively, no significant differences were observed ($p = 0.067$ for the IIEF score and $p = 0.520$ for the MSHQ score).

Sexual dysfunction is associated with older age in men and women. Çayan et al. reported the prevalence of erectile dysfunction as 33% in men over 40 years of age. Younger patients with total laryngectomy have more sexual problems than older ones, because the younger have more sexual expectations than that in the older [13, 18]. In contrast to these findings, Moreno et al. advocated that males under 60 years had the highest sexual satisfaction after treatment. In the present study, to investigate risk factors that might predict decreasing in post-operative erectile functions, using multi-variate analysis, we did not observe significant relationship in the patient age, surgery type, post-operative follow-up period, alcohol consumption and presence of comorbid diseases. However, presence of pre-operative erectile dysfunction and additional chemo-radiation therapy were the predictors for decrease in erectile functions after surgery. In addition, to investigate risk factors that might predict decreasing in post-operative ejaculatory functions,

presence of additional chemo-radiation therapy was the only predictor for decrease in ejaculatory functions after surgery.

Very few studies have investigated female partners' sexual functions in male patients with laryngeal cancer who underwent surgical treatment. A small number of studies have shown that laryngectomy affected couples' sexual relations and that male patients' partners undergoing total laryngectomy needed professional psychological support [13, 19]. Half of the patients undergoing laryngectomy had the communication problems, tension and difficulties in life of family [17]. The issues discussed above, first of all, sexual intimacy, desire and arousal in female partners could be negatively affected at the beginning of sexual intimacy between partners and female might not show sexual intimacy against their male partners with laryngectomy. Deep and comfortable breathing compromised by the narrow airway depend on partial laryngectomy or radiotherapy can be decreased physical performance during sexual activity. This condition may lead to decrease orgasm and satisfaction in female during intercourse. Likewise, it was shown that about one-third of partners had less sexual contact than before total laryngectomy [13]. In our study, female partners' sexual functions total score significantly decreased from 25.83 ± 7.42 to 13.45 ± 10.09 after the surgery. Highly significant decreases were observed after the surgery in sexual desire, arousal, lubrication, orgasm, satisfaction and pain scores. To investigate risk factors that might predict female sexual dysfunction, we did not find any relationship with patient age and female partners' age, surgery type and post-operative follow-up period.

Our study has some limitations. Retrospectively assessment of sexual functions in the patients and their partners could affect the results, because they could not remember their sexual life also before the surgery. However, the IIEF-5 and the MSHQ-4 to assess male erectile and ejaculatory functions, respectively, and the FSFI to assess female partners' sexual functions are the validated questionnaires which have been used for these purposes in the studies to compare pre- and post-treatment sexual functions, instead of comparing data with non-parametric tests. Of course, it would be better to assess sexual functions of the patients and their partners, prospectively. However, this could take another 10 years to collect all data, and further studies could be designed in the future to support our findings.

Conclusion

Both total and partial laryngectomy have negative impact on male erectile and ejaculatory functions and also female partners' sexual functions. However, surgery type had no effect on these functions. Presence of pre-operative erectile

dysfunction and additional chemo-radiation therapy were the predictors to decrease in erectile and ejaculatory functions after surgery. This is the first study in the English literature to investigate male erectile and ejaculatory functions and also female partners' sexual functions. Therefore, male patients and their female partners should be informed in light of these findings.

Author contributions HG: design, analysis and/or interpretation, materials, writing, literature, SÇ: writing, critical review, materials, data collection and/or processing, EA: data collection and/or processing, analysis and/or interpretation, writing, EKD: data collection and/or processing, materials, design, CÖ: data collection and/or processing, writing, literature, design, KG: data collection and/or processing, writing, literature, design.

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Availability of data and material Not applicable.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics approval This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of University of Mersin (Date: 02.10.2019./No: 2019/426).

Informed consent Informed consent was obtained from all individual participants included in the study.

Code availability Not applicable.

References

- Peller M, Katalinic A, Wollenberg Teudt IU, Meyer JE (2016) Epidemiology of laryngeal carcinoma in Germany, 1998–2011. *Eur Arch Otorhinolaryngol* 273:1481–1487. <https://doi.org/10.1007/s00405-016-3922-8>
- Tomeh C, Holsinger FC (2014) Laryngeal cancer. *Curr Opin Otolaryngol Head Neck Surg* 22:147–153. <https://doi.org/10.1097/moo.0000000000000032>
- Yılmaz M, Yener M, Yollu U et al (2015) Depression, self-esteem and sexual function in laryngeal cancer patients. *Clin Otolaryngol* 40:349–354. <https://doi.org/10.1111/coa.12378>
- Moreno KF, Khabbaz E, Gaitonde K, Derr JM, Wilson KM, Patil YJ (2012) Sexuality after treatment of head and neck cancer: findings based on modification of sexual adjustment questionnaire. *Laryngoscope* 122:1526–1531. <https://doi.org/10.1002/lary.23347>
- Çayan S, Kendirci M, Yaman Ö et al (2017) Prevalence of erectile dysfunction in men over 40 years of age in Turkey: results from the Turkish Society of Andrology Male Sexual Health Study Group. *Turk J Urol* 43:122–129. <https://doi.org/10.5152/tud.2017.24886>
- Kendirci M, Asci R, Yaman O et al (2014) Prevalence of male pelvic dysfunction: results from the Turkish society of andrology male sexual health study group. *Andrology* 2:219–224. <https://doi.org/10.1111/j.2047-2927.2013.00176.x>
- Burri A, Spector T (2011) Recent and lifelong sexual dysfunction in a female UK population sample: prevalence and risk factors. *J Sex Med* 8:2420–2430. <https://doi.org/10.1111/j.1743-6109.2011.02341.x>
- Çayan S, Yaman Ö, Orhan İ et al (2016) Prevalence of sexual dysfunction and urinary incontinence and associated risk factors in Turkish women. *Eur J Obstet Gynecol Reprod Biol* 203:303–308. <https://doi.org/10.1016/j.ejogrb.2016.06.030>
- Singer S, Danker H, Dietz A et al (2008) Sexual problems after total or partial laryngectomy. *Laryngoscope* 118:2218–2224. <https://doi.org/10.1097/mlg.0b013e318182cdc6>
- Rosen R, Brown C, Heiman J et al (2000) The Female Sexual Function Index (FSFI): a multidimensional self-report instrument for the assessment of female sexual function. *J Sex Marital Ther* 26:191–208. <https://doi.org/10.1080/009262300278597>
- Rosen RC, Riley A, Wagner G, Osterloh IH, Kirkpatrick J, Mishra A (1997) The international index of erectile function (IIEF): a multidimensional scale for assessment of erectile dysfunction. *Urology* 49:822–830. [https://doi.org/10.1016/s0090-4295\(97\)00238-0](https://doi.org/10.1016/s0090-4295(97)00238-0)
- Curtis TA, Zlotolow IM (1979) Sexuality and head and neck cancer. *Front Radiat Ther Inc* 14:26–34. <https://doi.org/10.1159/000383860>
- Offerman MPJ, Pruyn JFA, de Boer MF, Busschbach JJV, de Jong RJB (2015) Psychosocial consequences for partners of patients after total laryngectomy and for the relationship between patients and partners. *Oncol* 51:389–398. <https://doi.org/10.1016/j.oraloncology.2014.12.008>
- Batioğlu-Karaaltın A, Binbay Z, Yiğit Ö, Dönmez Z (2016) Evaluation of life quality, self-confidence and sexual functions in patients with total and partial laryngectomy. *Auris Nasus Larynx* 44:188–194. <https://doi.org/10.1016/j.anl.2016.03.007>
- Herranz J, Gavilán J (1999) Psychosocial adjustment after laryngeal cancer surgery. *Ann Otol Rhinol Laryngol* 108:990–997. <https://doi.org/10.1177/000348949910801011>
- Akıl F, Yollu U, Toprak SF, Ayral M (2017) Laryngectomy: what is the impact of the type of surgery on life quality and sexual function? *Acta Otorhinolaryngol Ital* 37:276–280. <https://doi.org/10.14639/0392-100x-760>
- De Boer MF, Pruyn JF, van den Borne B, Knegt PP, Ryckman RM, Verwoerd CD (1995) Rehabilitation outcomes of long-term survivors treated for head and neck cancer. *Head Neck* 17:503–515. <https://doi.org/10.1002/hed.2880170608>
- Monga U, Tan G, Ostermann HJ, Monga TN (1997) Sexuality in head and neck cancer patients. *Arch Phys Med Rehabil* 78:298–304. [https://doi.org/10.1016/s0003-9993\(97\)90038-1](https://doi.org/10.1016/s0003-9993(97)90038-1)
- Meyers AD, Aarons B, Suzuki W, Pilcher L (1980) Following laryngectomy sexual behavior. *Ear Nose Throat J* 59:327–329

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