

Assessment of Effects of Post Laryngeal Cancer Treatment on Voice Function and Communication of Laryngeal Cancer Survivors at Kenyatta National Hospital, Nairobi

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Abstract: While voice production is a natural part of human existence which allows functional communication to occur in a regular basis, this is not the case among laryngeal cancer survivors. The treatment approaches for post laryngeal cancer has severe impact on the survivors' ability to communicate as they experience persisting voice problems and inability to speak normally. This study sought to establish the effects of post laryngeal cancer treatment on speech production and vocal quality of laryngeal cancer survivors at Kenyatta National Hospital. The study utilized a concept based on myoelstic Aerodynamic theory by Van Den Berg theory of voice production. The study was conducted at Kenyatta National Hospital Ear Nose and Throat clinic and the study population included 28 laryngeal cancer patients who had undergone treatment, 2 oncologists and 1 speech therapist. The research adopted an experimental study design. Data was collected using questionnaires. The study findings show that post laryngeal cancer treatment had significant effects on voice function and communication of laryngeal cancer survivors. Majority of the survivors mentioned that the treatment was successful but experienced post treatment challenges such as people finding their voice unintelligible, while three-quarters indicated that they had no voice for speech production. Patients on combination of Laryngectomy, Radiotherapy and Chemotherapy had the worst effects on speech production, vocal quality and general physical functioning post treatment. Surgery, radiotherapy, and chemotherapy or a combination of the modalities was the treatment options available for patients. The study further established the available therapy option for improvement of voice and communication of the patients after laryngeal cancer treatment was vocal therapy and rehabilitation by a speech therapist. Artificial larynx speech, as well as pen and paper were the means of communication of survivors post treatment. Prohibitive costs, lack of speech therapy expertise and materials such as electro larynx machine to enhance speech production were found to be the biggest challenge faced in rehabilitation of voice and communication function post treatment. The study recommends the use of other alternative modalities such as laser therapy matched appropriately with the needs of the patients so as to preserve their voice function. The study further recommends training or employment of more skilled human resource, to train survivors on other techniques of speech such as tracheo esophageal speech to enhance survivors' communication.

Keywords: Voice Function and Communication, Laryngeal Cancer Survivors, Post Laryngeal Cancer Treatment

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INTRODUCTION

1.1 Background of the study

Cancer is a condition where abnormal malignant growth of cells divides uncontrollably and destroys body tissues. There are many types of cancers of the head and the neck, mainly the cancer of hypo pharynx, cancer of the floor of the tongue, and glossopharyngeal cancer. This study focuses on laryngeal cancer treatments and their effects on voice function and communication. Laryngeal cancer is currently among the most prevalent types of cancer that affects the upper airways. It is a disease in which malignant cancer cells form in the tissues of the larynx, but mostly onsets with the glottis. Nearly all forms of laryngeal cancer start in squamous cells, which lines the inside of the larynx.

Post laryngeal cancer strategies to manage voice and communication problems would include counselling and rehabilitation of pulmonary, voice or olfactory functions. After total laryngectomy, one of the

most critical factor is developing a new method of communication since changes in laryngeal speech options and their rates of success have remained problematic, management and improvement of certain complications, as well as differences in the recruitment of the patients¹. According to⁶, this type of cancer makes up 25% of all malignant lumps affecting the head and neck. The main concern in matters of treatment of tumors in the larynx is the survival of the patient, though speech and voice function are equally important when it comes to the choice and suitability of therapy to be employed. Part of the social life is the ability to communicate², however, during laryngeal cancer treatment, the effects of chemoradiation which can be toxic, and at times leads to scarring causing hoarseness, pain, or dysphagia, can affect patient's speech¹⁵.

World Health Organization (WHO) asserts that voice is a major component of human communication and an indicator of good health²⁰; hence the treatment for laryngeal cancer may have a major impact on ability to communicate⁸. There are three types of treatment commonly used for individuals with protracted laryngeal cancer which include exclusive chemo radiation, partial laryngectomy or total laryngectomy. Total laryngectomy as an option results in complete loss of voice function and communication and consequently personal interactions⁷. Reviewing the importance of anatomical structures and the breath support needed to produce speech assists in the understanding of how laryngectomy treatment affects a person's ability to communicate³.

Regarding the effects of intervention for laryngeal cancer, studies have indicated that most patients may experience changes in the vocal function which varies from mild to severe, and often times presenting as complex dysphonia¹⁴. The removal of the larynx that results from Laryngeal cancer has tremendous impact on voice quality of the patient. Patients have reported hoarseness, vocal fatigue, poor vocal quality, and reduced volume post treatment¹.

Globally, high cases of laryngeal cancer have been reported in Brazil, Hong Kong, Italy and among the black populations in parts of USA¹⁰. In the USA, the estimated number of new cases of larynx cancer in 2013 was about 0.8% of all fresh cases between both sexes¹⁶. There are also areas of low incidence such as Japan, Norway and Sweden. In China, laryngeal cancer is most common in Peking and Tianjin regions⁴. In Sweden it has been approximated that 200 people are diagnosed with laryngeal cancer every year¹⁷.

In Sub-Saharan Africa, late diagnostics is evident, where the tumor presentation usually occurs in stages III and IV. Consequently, the only applicable mode of treatment is removal of the larynx which affects the ability of patients to speak⁵. For instance, most of the patients in Nigeria presented with upper airway obstruction which required emergency tracheostomy as the first line of management, with the available treatment modalities including Radiotherapy, Surgery and Chemotherapy¹⁸. In Tanzania, figures from Global cancer statistic center of 2015 give the estimated incidence of 5.3 per 100,000 in men and 0.3 per 100,000 in women cases of laryngeal cancer.

In Kenya, studies conducted on incidence and prevalence of laryngeal cancer showed that head and neck cancers contributed to 10.17 % of the total malignancies diagnosed and the most common sites of occurrence were the oral mucosa (30.23 %), naso pharynx, tongue (16.61%) and larynx (14.95%)¹¹ which contribute to 10% prevalence rate of laryngeal cancer of the total cancer cases registered at the Hospital (Kenyatta National Hospital Records).

It has been noted that there is a psychological impact on individuals due their loss of ability to communicate and swallow. According to¹¹, some of the main challenges arising from laryngeal cancer post treatment include speech problems and swallowing. Speech problems post-surgery and chemo radiation results to altered resonance affecting voice quality and ability to communicate effectively.

1.2 Statement of the problem

Production of voice and speech is a natural part of human existence allowing functional communication to occur on a regular basis. The source of sound for communication for the patient after the larynx has been removed is no longer available, since the use of voice is an integral part of communication. Post Laryngeal cancer treatment severely impacts the patient's ability to communicate. Studies suggest that up to 95% of laryngeal cancer patients experience persisting voice problems up to 10 years following radiotherapy completion⁷. Total laryngectomy involves removal of the entire larynx resulting to patients experiencing voice problems leading to inability to speak normally due to lack of vocal cords.

Treatment of advanced laryngeal cancer involves the total removal of vocal cords, also known as total laryngectomy, leading to so many cases of impaired voice function and communication because of the lack of larynx. Other treatment approaches such as partial laryngectomy leads to weakness of the vocal cords and exclusive chemo-radiation which leads to scarring of the tissues of the vocal tract and stenosis of the larynx affecting voice production. In Kenya, the most commonly used approaches for treatment of laryngeal cancer and their post treatment effects on the voice function and communication of laryngeal cancer survivors at Kenyatta National Hospital have been known to impact negatively on the voice function and communication.

A few studies conducted in Kenya majorly investigated the incidence of cancer in Nairobi Kenya ¹¹. The study by ¹² focused majorly on establishing laryngeal cancer characteristics while relating them to the patients' smoking and alcohol ingestion habits ¹² while ⁹ in her determined the characteristics and possible risk factors associated with laryngeal cancer. According to ¹¹ a study on Head and neck cancers a four year trend at the at the Nairobi cancer registry looked at the sub types which include oral pharyngeal cancer, larynx and nasopharyngeal cancers reviewed that head and neck cancers comprised of a significant problem of cancers that are characterized by high rates of oral and nasopharyngeal cancers.

These studies did not relate post laryngeal cancer treatment effects to the patients' ability to communicate. Therefore, despite the high number of laryngeal cancer patients (14.9%) who have undergone treatment or currently undergoing treatment at Kenyatta National Hospital, there has been no documentation thus there is paucity of information on effect of post laryngeal cancer treatment approaches on patients' voice function and communication. It was, thus, worth conducting this study to establish the effects of laryngeal cancer treatment on voice function and communication of laryngeal cancer survivors in Kenya.

1.3 Objectives of the study

The objective of the study was to assess the effects of post laryngeal cancer treatment on speech production and vocal quality of laryngeal cancer survivors at Kenyatta National Hospital.

1.4 Significance of the study

The study is beneficial in highlighting the plight of laryngeal cancer patients who have undergone total laryngectomy and lost voice at Kenyatta National Hospital, so that they can be advised by Speech and language therapists and laryngeal cancer specialist on the relevant methods to adopt in order to regain their lost voice. The study findings may also be useful to various stakeholders in the Ministry of Health by providing a framework to deal with effects of post laryngeal cancer and to adopt better coping strategies for patients who have undergone total laryngectomy and chemo radiation and had their voice impaired. The study may be beneficial to Speech and Language Therapists (SLTs) when advising their patients regarding effects of intervention measures for post laryngeal cancer on voice function and communication. The study findings may also be useful to other scholars who may want to pursue further research on the topic or provoke other areas of study by serving as a reference point especially in the discussion of post laryngeal cancer treatment effects on voice function and communication. The study may be beneficial to other multidisciplinary team members in planning treatment options for patients with laryngeal cancer.

1.5 Theoretical framework

This study was guided by the Myoelastic Aerodynamic (MEAD) Theory of sound production proposed by ¹⁹. The theory has been quantified and tested with mathematical models which have suggested that oscillations inherent to vocal folds is produced by the asymmetric function resulting from the opening and closing portions of the glottal cycle.

The theory states that vocal cords will remain closed when they come together as a result of breath pressure applied to them until sufficient subglottic pressure underneath pushes them apart which allows passage of air leading to a drop in pressure sufficient to ease the muscle tension to wince which repeats the whole process again as pressure once again builds up and the cords being pushed apart. The pitch of phonation relies on the frequency of opening and closing of the cords.

A derivative of Bernoulli's principle in fluids is the aerodynamic theory, which states that pressure differences lead to a self-sustained oscillation when a stream of breathe flows through the glottis as a result of the arytenoid muscles holding the arytenoid cartilage. When the glottis is convergent, the push takes place as a result of glottal opening, and when it is divergent, the pull takes place as a result of glottal closure which causes the flow of air to be cut until the pressure from breathing pushes the cords apart causing a repeat of the cycle, illustrating the aerodynamic theory. This theory was supported in the study by Brunton and Cash (1883), who found that a cadaver larynx is capable to produce sound when air was blown through it.

The theory is applicable to this study as it describes the structure of the vocal cords and voice production which are significant in voice function and communication. When the vocal cords are impaired during laryngeal cancer treatment, speech and language therapists, laryngologists and oncologists can be informed by this theory in making clinical decisions for rehabilitation of voice to facilitate communication post laryngeal cancer treatment. The theory is thus very important in informing the study on effects of laryngeal cancer treatment on voice function and communication at Kenyatta National Hospital.

METHODOLOGY

2.1 Area of study

This study was conducted in the Ear Nose Throat out-patient clinic at the Kenyatta National Hospital (KNH). KNH was established in 1901 and is situated in Nairobi City County. It is a public, national, referral and teaching hospital receiving patients from all over the country. It is also the largest public hospital in the country with comprehensive cancer treatment facilities. The hospital has a well-equipped ENT clinic in addition to the Cancer Center hence boasts of efficiency in diagnosis and treatment of laryngeal cancer.

2.2 Research design

The study adopted an experimental design to establish the existence of the cause and effect relationship between the two variables, so to allow the researcher to be able to assess the effects of post laryngeal cancer treatment. The participants were selected based on the inclusion and exclusion criteria set for the study.

2.3 Population and Sampling design

The current study was carried out in Kenyatta National Hospital Nairobi County, where a total of 283 laryngeal cancer patients who had undergone laryngeal cancer treatment at the hospital and were still undergoing therapies and follow up care. Two oncologists and one speech and language therapist practicing at the hospital were selected making a total of 286.

Stratified Proportionate sampling technique was used to select the laryngeal cancer patients who had undergone laryngeal cancer treatment to be the representative sample because it ensures that laryngeal cancer population will be adequately represented within the whole sample population. Two Oncologists at the Oncology clinic of Kenyatta National Hospital and one speech and language therapists at the ENT clinic Kenyatta National Hospital were purposively selected using census technique and included in the study.

2.4 Data collection

The study adopted the use of semi-structured questionnaires in collecting data from laryngeal cancer patients who had undergone laryngeal cancer treatment to capture the characteristics of voice and communication difficulties and to assess voice function and communication.

Semi structured interview guide was used in order to obtain in-depth information through probing the oncologists and SLT based on treatment approaches and remediation and rehabilitation strategies used to treat laryngeal cancer patients.

Primary data was collected using a well-structured questionnaires and interview guide. Following a successful application for pilot-testing, and data collection, the researcher explained the nature and purpose of the study to establish rapport with the patients who were used for the pilot test.

During the actual data collection on a separate day, the researcher distributed questionnaires to patients with the help of two research assistants, and then the researcher conducted interviews with the two oncologists and one speech therapist face to face that lasted not more than 30 minutes. The researcher was present to clarify any possible ambiguities during the filling of the questionnaire. Collection of questionnaires was done the same day. Out of 31 questionnaires (96.7%), 30 were returned.

2.5 Data analysis

The researcher edited the data collected from the field to ensure they were free from any error. In case of quantitative data the researcher numbered the questionnaires appropriately, followed by the coding process to mark and categorize information such as gender, age and level of education. Data was then entered into the computer program Statistical Package for Social Sciences (SPSS) for data analysis. Demographic characteristics of the patients were analyzed and summarized with the use of frequencies and percentages as well as with the use of graphs.

The effects of laryngeal cancer treatment approaches on voice structure (larynx), and the effects of post laryngeal cancer treatment on speech production and vocal quality of laryngeal cancer survivors at Kenyatta National Hospital were analyzed and summarized with the use of frequencies and percentages as well as use of graphs.

The effects on speech production and vocal quality, physical functioning and speech production, and the functional and vocal quality were assessed with the use of Kruskal-Wallis test. A p-value < 0.05 was considered statistically significant if there were differences in the mean ranks of the responses.

DATA ANALYSIS AND DISCUSSIONS

3.1 Response Rate

Response rate refers to the extent to which the final data sets includes all sample members, and is calculated as the number of respondents with whom questionnaires are completed and divided by the total number of respondents in the entire sample including non-respondents.

The researcher targeted 31 respondents which included 28 laryngeal cancer patients, 1 speech and language therapist and 2 oncologists. The results are as shown.

Table 3.1: Response Rate

Category	Frequency	Percent
Response	30	96.7%
Non response	1	3.3%
Total	31	100.0

Out of the targeted 31 respondents, 30 were returned while one was not. This response rate was an excellent representative of the respondents since according to ¹³ stipulations that a response rate of 50% is adequate for analysis and reporting; a rate of 60% is good and a response rate of 70% and over is excellent.

From the results in Table 3.1 it is clear majority of the respondents filled the questionnaires, and only 1 respondent was reluctant to participate due to sensitivity of the of the topic under investigation. Never the less the researcher managed to get a good number of respondents to fill the questionnaires.

3.2 Respondents by Gender

The respondents were asked to specify their gender and the findings indicate there were more male (89%) than female (11%) respondents.

3.3 Age of the Respondents

The respondents were asked to specify their age and the results indicate that the over 45 years (89%) were the majority as compared to those at 45 years and below (11%) who were the least. From the results, it is observed that the most observations for laryngeal cancer were in the age group of the over 45 years old.

3.4 Effects of post laryngeal cancer treatment on speech production and vocal quality

This objective sought to establish the effects of post laryngeal cancer treatment on speech production and vocal quality. The respondents were asked to rate the effects of their treatment on a likert scale. The ratings were on a scale of 0 to 3, where ‘Never’ was represented by 0, ‘Sometimes’ by 1, ‘Often’ by 2, and ‘Always’ by 3. The scores were added, and the mean ranks were calculated for each of the cancer treatment types. The mean rank for each treatment type was used to compare the effect of the different treatment group. A higher mean rank means a poor effect of treatment. The difference in rating scores of cancer treatment types was assessed using Kruskal-Wallis test. A p-value < 0.05 was considered statistically significant if there are differences in the mean ranks. The analysis of the responses on the ratings of their speech and vocal quality post treatment is as summarized on Table 3.2.

Table 3.2: Speech and Vocal Quality in Social Settings

	Exclusive Chemoradiatio n	Laryngectomy	Radiotherapy	Laryngectomy Radiotherapy Chemotherapy	p-value
Trouble speaking to friends	17.3	14.0	11.5	15.3	0.778
Feel that people interrupt because of speech	12.0	15.4	9.2	16.7	0.490
Relaxed and comfortable around other people in speaking situation	12.1	15.1	12.3	15.7	0.845
Admit to the person you are talking to that	11.3	16.0	13.5	13.3	0.651

you had a laryngectomy					
Think speech improves with the amount of time using it	18.3	14.2	14.7	12.6	0.703
Frequent clubs, meetings, or lodges less often because of speech	16.8	13.7	12.0	16.3	0.786
Difficulty having getting people's attention to speak	16.6	14.4	10.8	15.2	0.798
Find that people are unable to understand me	14.1	14.8	8.2	17.3	0.407
Have to repeat things a number of times during conversation to be understood	11.0	14.6	12.2	17.8	0.524
Overall	12.1	15.8	7.8	16.1	0.399

As shown in table 3.2, respondents who were treated with a combination of Laryngectomy, Radiotherapy and Chemotherapy had the highest mean rank of 16.1 signifying they experienced worst effects on their speech and vocal quality. This was followed by patients treated with Laryngectomy with a mean rank of 15.8, Exclusive Chemo radiation with mean rank of 12.1, and lastly by Radiotherapy with a mean rank of 7.8. A Kruskal-Wallis H test showed that there was not a statistically significant difference in the mean ranks between the different types of laryngeal cancer treatments, $\chi^2(3) = 2.955$, $p = 0.399$. speech production in terms of volume (low or no voice) and unintelligibility of In terms of speech production, statistically there was no significance whereas clinically very insignificance change affects the survivors 'speech voice

The respondents were asked to rate effects on their physical functioning and speech production post treatment when in a social setting. The analysis of the responses on their ratings of their physical functioning and speech production post treatment is summarized on Table 3.3.

Table 3.3: Physical Functioning and Speech Production

	Exclusive Chemoradiation	Laryngectomy	Radiotherapy	Laryngectomy Radiotherapy Chemotherapy	p-value
Trouble speaking in a large room or a big group of people	12.5	14.4	9.5	18.5	0.360
Run out of air when I talk	16.4	13.9	16.5	13.4	0.895
Trouble using the telephone because of voice	15.9	13.8	14.0	15.6	0.945
Sound of my voice vary throughout the day	16.6	15.0	18.2	9.9	0.335
Trouble doing my job or practicing my profession because of my voice	11.1	13.0	13.7	20.9	0.149
Voice sound creaky and dry	16.4	12.4	18.8	16.4	0.447
Overall	13.8	13.3	16.7	16.9	0.792

The findings show that respondents who were treated with a combination of Laryngectomy, Radiotherapy and Chemotherapy had the highest mean rank of 16.9 signifying they experienced worst effects on their physical functioning and speech production, this was followed by patients treated with Radiotherapy with a mean rank of 16.7, Exclusive Chemo radiation with mean rank of 13.8, and lastly by Laryngectomy with a mean rank of 13.3. A Kruskal-Wallis H test showed that there was not a statistically significant difference in the mean ranks between the different types of laryngeal cancer treatments, $\chi^2(3) = 1.039, p = 0.792$. This means the respondents' physical function statistically was insignificant, however clinically their functional status and vocal quality was affected as the survivors experienced challenges (not audible) when speaking in a big group of people or in a large room, others with trouble practising their profession because of voice and running out of air when they speak. The respondents were further asked to rate the effects of their functional status and vocal quality post treatment. The analysis of the responses on their ratings for functional and vocal quality post treatment is summarized on Table 3.4.

Table 3.4: Functional and Vocal Quality

	Exclusive Chemoradiation	Laryngectomy	Radiotherapy	Laryngectomy Radiotherapy Chemotherapy	p-value
Speech makes it difficult for people to hear me	15.8	15.2	12.8	12.7	0.884
People have difficulties understanding me in a noisy room	13.3	14.1	8.7	19.5	0.129
Have difficulties when attending parties or social gatherings	13.8	13.3	13.2	18.8	0.517
Use the phone less often than I would like to use	14.1	14.0	12.5	16.9	0.839
Feel out when I am in a group of people because of my voice	14.1	13.0	15.7	17.8	0.615
Voice difficulties restrict my personal and social life	15.5	15.0	13.0	13.3	0.943
Overall	13.4	14.2	11.8	17.3	0.769

As presented in table 3.4, respondents who were treated with a combination of Laryngectomy, Radiotherapy and Chemotherapy had the highest mean rank of 17.3 signifying they experienced worst effects on their functional and vocal quality, this was followed by patients treated with Laryngectomy with a mean rank of 14.2, Exclusive Chemo radiation with mean rank of 13.4, and lastly by Radiotherapy with a mean rank of 11.8. A Kruskal-Wallis H test showed that there was not a statistically significant difference in the mean ranks between the different types of laryngeal cancer treatments, $\chi^2(3) = 1.133, p = 0.769$. In terms of functional and vocal quality, clinically the survivors developed challenges post treatment.

CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

The study concludes that most patients' treatment is successful but also dependent on the modalities of their treatment, and that most of them would experience problems post treatment. The treatments results to less unintelligible voice and loss of voice post treatment. Patients find it difficult to communicate with friends with no immediate improvement of speech even after period of using it. The patients often find themselves repeating things a number of times for them to be understood. Communication gets more difficult in a large room full of people or a noisy setting leaving them to feel left out, and at times they run out of air during conversations. This results in avoiding speaking to other people. Patients can be advised to buy an artificial larynx machine as means of communication post treatment. Modalities used for improvement on voice function and communication post treatment depend on the stage of the disease. Treatments modalities can be quite costly, and also there is lack of enough human resources for rehabilitation purposes. The voice function can be lost but also be preserved if early interventions are done. Finally, the study concludes that there was availability of rehabilitation and vocal therapy for these patients at the facility for their voice and communication function.

Speech therapy is the modality that is used towards improvement of voice and communication function after laryngeal cancer treatment.

4.2 Recommendations

By objectively assessing the effects of post laryngeal cancer treatment on voice function and communication on survivors, based on the findings of the study, the researcher recommends:

- i). Ministry of Health to provide a framework to deal with effects of post laryngeal cancer treatment by providing better coping strategies for patients who had their voices impaired.
- ii). Multidisciplinary approaches should be embraced by all professionals in management of laryngeal cancer and its effects
- iii). There is also need to look at other means of communication other than use of artificial larynx machine or pen and paper as a means of communication post treatment.
- iv). The issue of costing of the treatment should be objectively revised to become affordable especially electrolarynx gadgets and also train or employ more skilled human resource, to train survivors on other techniques of speech such as tracheoesophageal speech and TEP to enhance survivors' communication
- v). The need to research further on alternatives modalities such as laser therapy or currently available modalities used for treatment and match them appropriately with the needs of the patients so as to preserve their voice function that would result into successful treatment.

Taking the limitations and delimitations of the study, the following areas were suggested for further research

- i). Studies to explore area of laser surgery as an alternative treatment for organ preservation

REFERENCES

- [1]. Bergström, L., Ward, E.C, & Finizia, C. (2016). Voice rehabilitation for laryngeal cancer patients: Functional outcomes and patient perceptions. *The Laryngoscope*, 126(9), 2029-2035.
- [2]. Bergström, L., Ward, E.C, & Finizia, C. (2017). Voice rehabilitation after laryngeal cancer: Associated effects on psychological well-being. *Supportive Care in Cancer*, 25(9), 2683-2690.
- [3]. Gheit, T., Abedi- Ardekani, B., Carreira, C., Missad, C.G., Tommasino, M., & Torrente, M.C. (2014). Comprehensive analysis of HPV expression in laryngeal squamous cell carcinoma. *Journal of medical virology*, 86(4), 642-646.
- [4]. Han, Y., Yang, L.H., Liu, T.T., Wang, J., Li, H., Yu, G., & Wang, E.H. (2015). Liposarcoma of the larynx: report of a case and review of literature. *International journal of clinical and experimental pathology*, 8(1), 1068.
- [5]. Iseh, K. (2011). Total laryngectomy for laryngeal cancer in a Nigerian tertiary health center: Prognosis and outcome. *Journal of surgical technique and case report*, 3(1), 23.
- [6]. Karlsson, T., Johansson, M., Andréll, P., & Finizia, C. (2015). Effects of voice rehabilitation on health-related quality of life, communication and voice in laryngeal cancer patients treated with radiotherapy: A randomised controlled trial. *Acta Oncologica*, 54(7), 1017-1024.
- [7]. Karlsson, T., Tuomi, L., Andréll, P., Johansson, M., & Finizia, C. (2017). Effects of voice rehabilitation after radiotherapy for laryngeal cancer: A longitudinal study. *Logopedics Phoniatrics Vocology*, 42(4), 167-177.
- [8]. Kerkhoff, E.K. (2013). Comparing The Efficacy of Voice Restoration Speaking Options Following Laryngectomy. *Research Papers*. Paper 358
- [9]. Kirigo, D.M.C. (2009). Determination of The Characteristics and Possible Risk Factors Associated with Squamous Cell Carcinoma of the Hypopharynx at Kenyatta National Hospital (Doctoral dissertation, University of Nairobi).
- [10]. Kitcher, E. D., Yarney, J., Gyasi, R. K., & Cheyuo, C. (2006). Laryngeal Cancer at the Korle Bu Teaching Hospital Accra Ghana. *Ghana medical journal*, 40(2), 45- 54.
- [11]. Korir, A., Okerosi, N., Ronoh, V., Mutuma, G., & Parkin, M. (2015). Incidence of cancer in Nairobi, Kenya (2004–2008). *International journal of cancer*, 137(9), 2053-2059.
- [12]. Menach, O.P., Patel, A., & Oburra, H.O. (2014). Demography and histologic pattern of laryngeal squamous cell carcinoma in Kenya. *International journal of otolaryngology*.
- [13]. Mugenda, O.M. & Mugenda, A.G. (2003). *Research Methods. Quantitative and Qualitative Approaches*. Nairobi: Acts Press.
- [14]. Rathod, S., Livergant, J., Klein, J., Witterick, I., & Ringash, J. (2015). A systematic review of quality of life in head and neck cancer treated with surgery with or without adjuvant treatment. *Oral oncology*, 51(10), 888-900.

- [15]. Rossi, V.C., Fernandes, F.L., Ferreira, M.A.A., Bento, L.R., Pereira, P.S.G., & Chone, C.T. (2014). Larynx cancer: quality of life and voice after treatment. *Brazilian journal of otorhinolaryngology*, 80(5), 403-408.
- [16]. Siegel, R., Ma, J., Zou, Z., & Jemal, A. (2014). *Cancer statistics: A cancer journal for clinicians*, 64(1), 9-29.
- [17]. Tuomi, L. (2014). *Voice Rehabilitation and Functional Outcomes Following Radiotherapy for Laryngeal Cancer*.
- [18]. Umana, A., Offiong, M., Mgbe, R., Adekanye, A., Bassey, I., & Ebughe, G. (2011). Cancer of the larynx-Management challenges in Calabar, south-south Nigeria. *The internet Journal of Third World Medicine*, 9.
- [19]. Van Den Berg, J. (1958). Myoelastic-aerodynamic theory of voice production. *Journal of Speech, Language, and Hearing Research*, 1(3):227-44
- [20]. WHO (World Health Organization) 2015. Measuring quality of life. *The World Health Organization quality of life instruments*. WHO/MSA/MNH/PSF, p. 1-15.

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