



Shaker's Exercise Rehabilitation in Head and Neck Cancer Patients – A Clinical Trial

Authors

Dr Renu Pattanshetty MPT, Ph.D¹, **Krystle Mascarenhas**², **Kennoshea Dias**³

¹Associate Professor and Head, Department of Oncology Physiotherapy, KLEU Institute of Physiotherapy, Belagavi, 590010

²Physiotherapy Intern, KLEU Institute of Physiotherapy, Belagavi, 590010
Email: mascarenhaskrystle@gmail.com, Contact No.: +91 9886334798

³Physiotherapy Intern, KLEU Institute of Physiotherapy, Belagavi, 590010
Email: kennosheadias@gmail.com, Contact No.: +91 97353180037

Corresponding Author

Dr Renu Pattanshetty MPT, Ph.D

Associate Professor and Head, Department of Oncology Physiotherapy, KLEU Institute of Physiotherapy, Belagavi, 590010

Email: renu_kori@rediffmail.com, Contact No.: +919448482564

Abstract

Context: *Dysphagia is a common complication in Head and Neck Cancer patients which is often ignored affecting the quality of life. Shaker's Exercise has shown to be beneficial in strengthening the muscles of the head and neck, opening of the throat thereby improving the swallowing function. Hence, the study was taken up.* **AIM:** *This clinical trial aimed to evaluate the swallowing efficiency using Shaker's Exercise in Head and Neck Cancer patients.*

Settings and Design: *The experimental study was undertaken in a tertiary care referral hospital over a period of three months.*

Methods and Materials: *A total of twenty (20) all adult subjects males and females with head and neck cancer were instructed to perform Shaker's Exercise for swallowing dysfunction during the hospitalisation phase. M.D. Anderson Dysphagia Inventory (MDADI), Functional Assessment for Cancer Therapy- Head and Neck (FACT H&N), and Cervical Range of Motion were assessed prior to and after one week of intervention.*

Statistical Analysis Used: *Statistical Analysis was done using SPSS Version 0.21. Students dependent and independent 't' test was used to analyse the difference in all outcome measures.*

Results: *The study demonstrated improvement in the swallowing efficiency in the post scores of MDADI, Quality of Life, and Cervical Ranges of Motion. ($p \leq 0.05$)*

Conclusions: *The present clinical trial has demonstrated improvement in swallowing efficiency in terms of MDADI, Quality of Life and Cervical Range of Motion suggesting similar trials in large sample size with longer duration.*

Keywords: *Head and Neck Cancer, Dysphagia, Shaker's Exercise, M.D. Anderson Dysphagia Inventory, Functional Assessment for Cancer Therapy- Head and Neck, Cervical Range Of Motion.*

Key Message: *Early physical therapy intervention in the form of swallowing/non-swallowing exercises in Head and Neck Cancer patients has proved beneficial in terms of swallowing efficiency. Hence, there are few clinical trials to demonstrate the same. The present study was an attempt to prove the efficiency of simple and cost effective exercises as Shaker's Exercise which would help patients in long term and improve the Quality of Life.*

INTRODUCTION

Head and neck cancer (HNC) is a complex disorder including squamous cell carcinomas developing in the upper respiratory tract. Dysphagia is common after chemotherapy and radiotherapy in HNC^{1,2}. Around 40% of patients with advanced HNC experience dysphasia post treatment³. Dysphagia complications can be severe including aspiration pneumonia, malnutrition as well as feeding tube dependence^{4,5} decreasing health-related quality of life⁶ thereby increasing the health economic burden⁷

Management of dysphagia includes exercise rehabilitation in the form of swallowing and non-swallowing exercises including tongue hold exercises, jaw opening exercises, tongue movement and resistance exercises, supraglottic swallowing manoeuvre, breath hold manoeuvre and the Shaker's Exercise or the head lifting manoeuvre.⁸ Few clinical trials have demonstrated the effects of Shaker's Exercise which aim to improve the swallowing efficiency in HNC patients. Hence, the study hypothesised that there may be improvement in the swallowing efficiency of HNC patients during the hospitalisation phase.

SUBJECTS AND METHODS

The study was undertaken in a tertiary care referral hospital over a period of three months. A total of twenty (20) adult subjects both males and females post-operative/chemo-radiotherapy HNC patients in the age group of 18-75 years and subjects willing to participate in the study were recruited into the study. Subjects below eighteen (18) years with neurological or neuromuscular disease, pregnant females, tracheostomy subjects and mentally ill subjects were excluded from the study.

Subjects were administered M.D Anderson Dysphasia Inventory (MDADI) and Functional assessment for cancer therapy - Head and neck Questionnaire (FACT-H&N) prior to intervention. The cervical ranges of motion of flexion, extension, lateral rotation and lateral flexion were

measured prior to Shaker's Exercise. Shaker's Exercise was administered to all the subjects. Effect of swallowing efficiency and quality of life and the cervical range of motion were noted after one week of intervention.

PROCEDURE FOR SHAKER'S EXERCISE⁹

Step 1: Measure the subject's cervical range of motion using Goniometer

Step 2: The subject is instructed to lift his/her and to look at the toes without raising the shoulders, in supine lying.

Step 3: The subject is then asked to hold position for 60 seconds.

Step 4: Subject is asked to repeat the exercise 3 times with arrest of one minute between each repetition.

Step 5: Subject is then asked to repeat 3 times with arrest of one minute between each repetition.

Step 6: Subject is asked to repeat 3 times with arrest of one minute between each repetition.

Step 7: This is followed by 30 consecutive lifts with no rest in between.

Step 8: This exercise will be repeated 3 times a day.

Step 9: Follow the above exercise protocol for a period of one week.

Step 10: Assessment of outcome measure at the end of one week

Outcome measures viz. MDADI, FACT H&N and the Cervical Range of Motion¹⁰ were assessed prior to intervention and after one week of intervention during the hospitalization phase.

RESULTS

This study was conducted to find out the efficiency of swallowing and the quality of life using Shaker's Exercise in HNC patients. A total of twenty patients were recruited in this study and administered Shaker's Exercises for a period of one week. Statistical analysis using SPSS software version 0.21 was done to compare pre and post-treatment scores using Students Dependent and Independent 't' test. 'p' values ≤ 0.05 were considered statistically significant.

Out of twenty subjects in the study, twelve (12) were males and eight (8) females. The overall age group of twenty subjects ranged between 30-75 years of which mean age of males was 56.00 ± 11.61 and females was 51.25 ± 9.93 . The MDADI scores improved from $47.15 \pm$ to 61.1 ± 12.94 which was statistically significant ($p \leq 0.05$). FACT H&N which was used to

evaluate the health related quality of life also demonstrated improvement in post treatment scores from 78.10 ± 19.66 to 90.55 ± 20.00 which was statistically significant ($p \leq 0.05$). All ranges of cervical motion (flexion, extension, lateral flexion and rotation) showed significant post scores. ($p \leq 0.05$)

Table 1: Demographic data of all subjects in the study (n=20)

Gender	'n'	Age	Mean age& SD	Percentage	Surgery/Chemotherapy/Radiotherapy
Males	12	62	56±11.61	60%	Chemotherapy
		72			Oesophagectomy
		72			Oesophagectomy
		51			Hemi-mandibulectomy
		43			Hemi-mandibulectomy
		55			Chemotherapy
		60			Total Thyroidectomy
		42			Chemotherapy
		54			Neck dissection
		74			Chemotherapy
		40			Hemiglossectomy
		47			Thyroidectomy
Females	08	37	51.56±9.93	40%	Thyroidectomy
		55			Neck dissection
		67			Radiotherapy
		48			Gastroesophagectomy
		51			Hemi-mandibulectomy
		42			Radiotherapy
		65			Radiotherapy
		45			Neck dissection

Table 2: Comparison of Pre and Post M.D. Anderson Dysphagia Inventory (MDADI) Scores of all the Subjects (n=20)

	Mean and SD.	Paired 't' Test	p value
PRE - TEST	47.15±14.96	-9.95	.000*
POST - TEST	61.10±12.94		

*Level of significance $p \leq 0.05$

Table 3: Comparison of Pre and Post Functional Assessment of Cancer Therapy for Head and Neck (FACT H&N) Scores of all the Subjects (n=20)

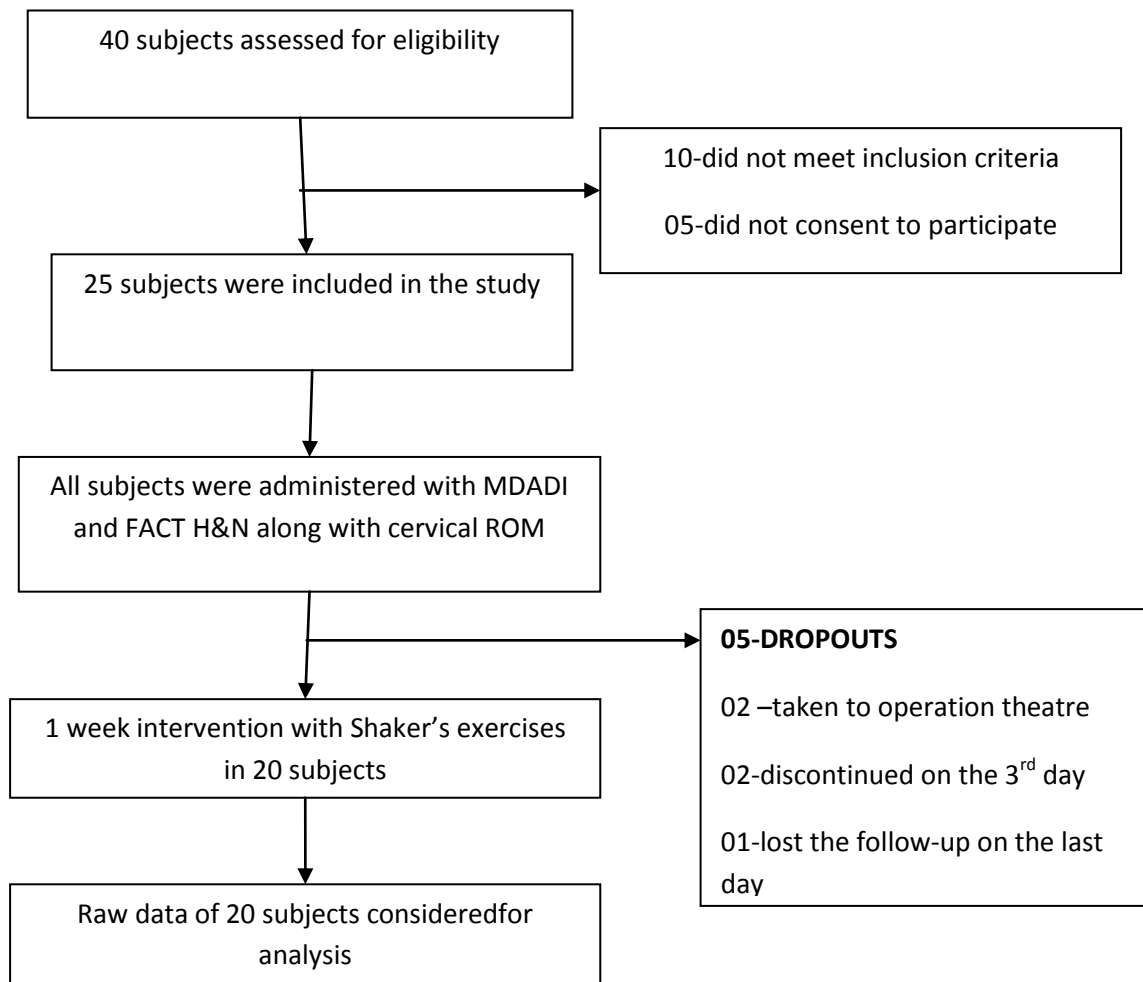
	Mean and SD	Paired 't' Test	p value
PRE - TEST	78.10±19.66	-5.053	.000*
POST - TEST	90±20.00		

*Level of significance $p \leq 0.05$

Table 4: Comparison of Pre and Post Cervical Ranges of Motion (in degrees) of all the subjects(n=20) in the study.

CERVICAL RANGE OF MOTION (in degrees)	Mean and SD (Pre Test)	Mean and SD (Post Test)	Paired 't' Test	p value
Flexion	28.75±8.09	32.50±7.90	-4.3	.000*
Extension	29.65±4.88	33.70±5.98	-3.31	.004*
Right lateral flexion	33.70±6.81	38.40±5.47	-6.45	.000*
Left lateral flexion	34.30±5.17	39.75±4.31	-6.84	.000*
Right rotation	36.40±8.15	40.40±6.60	-6.45	.000*
Left rotation	36.75±8.03	41.10±7.00	-5.60	.000*

*Level of significance $p \leq 0.05$

Figure 1: Consort Flow Chart

DISCUSSION

The present study aimed to evaluate the efficiency of Shaker's Exercise Rehabilitation on swallowing ability in Head and Neck Cancer Patients. The following clinical trial was conducted on a total of twenty (20) treated with Shaker's Exercise post operatively during the hospitalization phase. Among the twenty (20) subjects, twelve (12) were males and the eight (08) were females. Males are usually prone to developing head and neck cancer due to cigarette smoking and smokeless tobacco in its various forms. In the overall epidemiology of HNC, highest number of

HNC in males was seen in Hong Kong. India ranked number one among females with HNC.¹¹ In the present clinical trial males (n=12) were more affected than females (n=8) with HNC suggesting that smoking and tobacco chewing are more common in males. The risk of squamous cell carcinoma for HNC has been estimated to be approximately 10-fold over that of individuals who have never smoked. This risk has shown to increase with the duration and the extent of smoking.¹² However, the present study did not consider the duration or the extent of smoking since they were already diagnosed with HNC.

The association between smoking and HNC has shown to be the strongest for laryngeal cancer, as tobacco smoke a known environmental carcinogen is responsible for the high inducibility of aryl hydrocarbon hydroxylase which increases the lifetime risk susceptibility to HNC¹³. Aryl hydrocarbon hydroxylase is an inducible, membrane-bound enzymes involved in the metabolism of the chemical carcinogens. Carcinogens form the link between nicotine addiction and HNC. Nicotine addiction is the reason that people continue to smoke. While nicotine itself is not considered to be carcinogenic, each cigarette contains a mixture of carcinogens, including a small dose of polycyclic aromatic hydrocarbons (PAH) and 4-(methylnitrosamino)-1-(3-pyrridyl)-1-butanone (NNK) among other carcinogens tumour promoters and co-carcinogens. Carcinogens such as NNK and PAH's require metabolic activated to exert their carcinogenic effect and once metabolically activated these carcinogenic metabolites bind covalently to DNA, usually at guanine or adenine.¹⁴

Association of alcohol seems to be the highest in hypo pharyngeal cancer. This is due to the fact that alcoholic beverages contain acetaldehyde, the initial metabolite of ethanol. Acetaldehyde is a recognized mutagen and animal carcinogen, although specific evidence that is a cause of HNC in humans has not been fully established. However, given that fast alcohol metabolizers will have the greatest peak exposure to acetaldehyde, it has been hypothesized that possession of ADH1B (acetaldehyde-1-beta) genotypes encoding for the fast alcohol metabolism will confer an increased risk of HNC.¹⁶

Dysphagia is a term that describes problems during the action of swallowing of foods and/or fluids.¹⁷The diagnosis is made by the detailed history using to a questionnaires, which allows distinguishing between oropharyngeal and oesophageal dysphagia. There are four stages of swallowing that involve in series of

coordinated events involving more than 30 pairs of muscles and six cranial nerves. The oropharyngeal swallow includes all events from the lips to the upper oesophageal sphincter (UES), also known as the cricopharyngeal inlet (CPI). The oesophagus is a relatively less complex muscular tube, for which the main therapeutic manoeuvre is dilatation. Patients can learn to bypass the voluntary oral preparatory and the oral stages of swallowing, but the completion of swallowing is an involuntary reflex that must be triggered. The trigger sets subsequent events in motion. The soft palate elevates to seal the nasopharynx to prevent regurgitation velopharyngeal insufficiency (VPI). The tongue pushes backward to meet the forward-bulging protected by the adduction of the vocal folds and cephalad laryngeal excursion, leading to epiglottic closure. The circopharynges muscle relaxes, but the larynx must also move to anteriorly to open the upper oesophageal sphincter (UES), and allow the bolus to enter the oesophagus. Anything that restricts driving pressure or limits UES opening leads to the swallowing residuals that may spill into the airway. Aspiration is thus consequence of dysphagia.¹⁸

In the present study, population was heterogeneous with varying age, suffering from different types of HNC including oesophageal (n=3), mandible (n=3), buccal mucosa (n=11), and thyroid (n=3). These subjects demonstrated varying difficulty in swallowing due to reduced posterior tongue base movements towards the posterior pharyngeal wall and reduced laryngeal elevation during the swallow. They also experienced muscular discomfort in the form of neck, shoulder and myofascial pain along with the decreased cervical range of motion post operatively.

Radiation therapy can often cause scarring and stiffening of the muscles in the mouth and throat causing them not to function at their best which in turn can lead to swallowing problems. High doses of chemo radiation may

cause xerostomia and affect the perception of swallowing ability leading to difficulty in swallowing, dry mouth, needing water while eating, food gets stuck in the mouth or throat and change in the taste. Therefore the need for physiotherapy is of the utmost importance in rehabilitation in HNC.¹⁹

Studies have shown that a structured exercise program can play an important role in improving the functional capacity and the quality of life in HNC subjects receiving chemo radiation therapy²¹. The present study shows that a physiotherapy regimen not only physical well-being of the individual but also in emotional and social wellbeing. This improvement can be seen in terms of increased cervical range of motion, increased MDADI scores on the swallowing ability, increased FACT H&N scores on the physical, emotional, social and functional well-being of the subjects post treatment with Shaker's Exercise, hence suggesting that physiotherapy should be implemented in the rehabilitation of cancer patients irrespective of the type of Head and Neck Cancer.

Exercise programs should be strictly followed and should be continuous interval. Shaker's Exercise has shown to be beneficial for a short duration, post operatively for one week. However, Shaker's Exercise has proved to show more significant results if implemented for a longer duration which includes both the pre-operative and post-operative phase. However, in the present study Shaker's Exercise was used to improve swallowing efficiency for a short duration. Shaker's exercise consisting of isometric and isokinetic head lifts from the supine position where the subjects is instructed to look at his/her without raising his/her shoulders. This manoeuvre has proven to be beneficial even in stroke subjects with dysphagia showing an improvement in the video fluoroscopic results. It has shown to strengthens the suprahyoid muscles of the neck during swallowing enhancing the upward and forward

movement of the hyoid bone and larynx resulting in the opening of the oesophageal sphincter. This may be one of the reasons for the swallowing efficiency with Shaker's exercise in the present study.²¹ Similar outcomes were also noted when Shaker's Exercise was used along with Kinesio taping which demonstrated significant improvement in the pre post frequency scales for the symptoms Gastroesophageal Reflux Disease.

Improvements noted were explained due to the strengthening of the muscles of swallowing which lead to the better mechanism of the hyoid bone and larynx thereby resulting in the opening of the upper oesophageal sphincter, hence suggesting Shaker's Exercise proving to be an important exercise and cost effective exercise in various medical conditions where subjects present with swallowing difficulties.²²

Besides physiotherapy, there are different approaches that may be used to treat dysphagia. Studies one using surface electromyographic (sEMG) biofeedback has shown to increase in the functional oral intake of food/liquid.²³ Electrical neuromuscular stimulation in stroke and HNC subjects, positive outcomes in terms of improvement in swallowing. However both the studies are costly and can be administered only in the presence of a trained practitioner thereby not allowing to be an active participant in the rehabilitation. Shaker's Exercise once taught to the patient could be practised by the patient itself. It is seemingly easy to perform and has fewer side effects.²⁴

The M.D. Anderson Dysphagia Inventory (MDADI) was used to evaluate the impact of dysphagia on the health related quality of life in the subjects who have undergone treatment HNC in the present study. This questionnaire consisted of nineteen questions that were divided into four sub domains; global, emotional, functional and physical. The questionnaire was administered to the subjects pre-treatment as well as post treatment with Shaker's exercise. Subjects demonstrated significant improvement

in post-treatment scores in all sub domains, particularly in the swallowing ability.²⁵ Subjects could swallow with lesser effort, they weren't embarrassed about their eating habits as they were before they commenced therapy, swallowing wasn't more difficult at the end of the day for them and reported to have self esteem compared to pre-treatment. Subjects could also eat semi solid food as compared to the difficulty they had pre therapy.

The World Health Organization has defined Quality of Life as "an individual's perception of their position in life in context of culture and value systems in their life and in relation to their goals, expectations, standards and concerns."²⁶ Quality of life is particularly relevant for patients with HNC was because of the social interaction and emotional expression depends to a great extent of the structural and functional integrity of the head and neck region. In the patients with advance disease, intensive medical treatment may lead to severe physical psychosocial sequelae. Depression and other psychosocial morbidity have shown to occur frequently in these patients. Measurements of QOL of HNC patients may help to make decisions about the treatment, identify patients with severe physical and psychosocial morbidity and plan rehabilitation.²⁷

The Functional Assessment of Cancer Therapy for Head and Neck Cancer (FACTH&N) is a patient reported outcome measure that was used to assess health related quality of life in subjects undergoing cancer treatment particularly in HNC patients. This scale consisted of 27 items that assessed the physical well-being (PWB-7), social/family wellbeing (SWB-7), emotional well-being (EWB 6) and functional wellbeing (FWB 7). In addition to these items there 12 items that were primarily assessed the disease specific factor of HNC.²⁸ Subjects were asked to encircle the most appropriate option pertaining to the above domains both and before and after therapy. Statistical significant increase, demonstrating an overall

improvement in the quality of life, particularly with regard to the physical well being, the social /family well being and the functional wellbeing. Subjects did not show much improvement in their emotional well being scores suggesting that they were still depressed and worried that their condition may worsen. It is therefore, important to evaluate the Quality of Life in Cancer patients, particularly in HNC patients for longer duration.

Range of motion limitation arise as late effects of radiotherapy for HNC.²⁹ The present study aimed to increase the cervical range of motion and also strengthen the neck musculature. Routine cervical range of motion exercises include neck rotations, neck tilts, simple neck flexion and extension exercises chin tucks and levator scapular stretch were administered to all the patients show, the ranges of flexion and extension showed slight increase post therapy. Which may be due to the fact that subjects underwent surgery were unable to flex and extend their neck optimally while performing shakers exercise due to sutures. On the other hand, post therapy scores of lateral flexion and cervical rotation have shown improvement attributing to the fact the cervical rotator muscles particularly sternocleidomastoid scalene, spinalis cervicis and spinalis capitis were not weak as compared to neck flexors and extensors.

The present study was conducted for a short period of time with only twenty patients suggesting similar clinical trials maybe be considered in future with longer duration follow up especially with the depression aspect of cancer subjects. The present study evaluated the swallowing efficiency using Shaker's exercises which is a non-swallowing exercise. A combination of swallowing exercises (including supraglottic and super supraglottic swallowing manoeuvre) and non swallowing exercise maybe used in patients suffering from dysphagia in HNC patients with a long term

follow up would be beneficial in swallowing efficiency.

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REFERENCES

1. Logemann J, Pauloski B, Rademaker A, Lazarus C, Gaziano J, Stachowiak L et al. Swallowing disorders in the first year after radiation and chemoradiation. *Head Neck*. 2008; 30(2):148-158.
2. Martino R, Foley N, Bhogal S, Diamant N, Speechley M, Teasell R. Dysphagia After Stroke: Incidence, Diagnosis, and Pulmonary Complications. *Stroke*. 2005; 36(12):2756-2763.
3. Caudell J, Schaner P, Meredith R, Locher J, Nabell L, Carroll W et al. Factors Associated With Long-Term Dysphagia After Definitive Radiotherapy for Locally Advanced Head-and-Neck Cancer. *International Journal of Radiation Oncology*Biophysics*. 2009; 73(2):410-415.
4. Schindler A, Ginocchio, G Ruppolo. What we don't know about dysphagia complications? *Revue de laryngologie - otologie - rhinologie*.2007
5. Nguyen N. Dysphagia following chemoradiation for locally advanced head and neck cancer. *Annals of Oncology*. 2004; 15(3):383-388.
6. Martino R, Foley N, Bhogal S, Diamant N, Speechley M, Teasell R. Dysphagia After Stroke: Incidence, Diagnosis, and Pulmonary Complications. *Stroke*. 2005; 36(12):2756-2763.
7. Nguyen N, Sallah S, Karlsson U, Antoine J. Combined chemotherapy and radiation therapy for head and neck malignancies. *Cancer*. 2002; 94(4):1131-1141.
8. I Rudberg, H Bergquist, M Anderson, H Dotevall, S Horvath, C Finizia. Shaker Exercise Rehabilitation in Head and Neck Cancer and Stroke Patients with Dysphagia - A Pilot Study. *Journal of Cancer Science and Clinical Oncology*.2015; 2(3).
9. Hashibe M, Brennan P, Benhamou S, Castellsague X, Chen C, Curado M et al. Alcohol Drinking in Never Users of Tobacco, Cigarette Smoking in Never Drinkers, and the Risk of Head and Neck Cancer: Pooled Analysis in the International Head and Neck Cancer Epidemiology Consortium. *JNCI Journal of the National Cancer Institute*. 2007; 99(10):777-789
10. Norkin CC, White DJ. Measurement of joint motion: a guide to goniometry. FA Davis; 2016
11. Sankaranarayanan R, Masuyer E, Swaminathan R, Ferlay J, Whelan S. Head and neck cancer: a global perspective on epidemiology and prognosis. *Anticancer research*. 1997 Dec;18(6B):4779-86.
12. Schlecht NF, Franco EL, Pintos J, Kowalski LP. Effect of smoking cessation and tobacco type on the risk of cancers of the upper aero-digestive tract in Brazil. *Epidemiology*. 1999 Jul 1;10(4):412-8.
13. Sturgis EM, Wei Q, Spitz MR. Descriptive epidemiology and risk factors for head and neck cancer. In *Seminars in oncology* 2004 Dec 31 (Vol. 31, No. 6, pp. 726-733). WB Saunders.
14. Rothman K, Keller A. The effect of joint exposure to alcohol and tobacco on risk of cancer of the mouth and pharynx. *Journal of chronic diseases*. 1972 Dec 1;25(12):711-6.
15. Brennan P, Lewis S, Hashibe M, Bell DA, Boffetta P, Bouchardy C, Caporaso N,

- Chen C, Coutelle C, Diehl SR, Hayes RB. Pooled analysis of alcohol dehydrogenase genotypes and head and neck cancer: a HuGE review. *American journal of epidemiology*. 2004 Jan 1;159(1):1-6.
16. Brennan P, Lewis S, Hashibe M, Bell DA, Boffetta P, Bouchardy C, Caporaso N, Chen C, Coutelle C, Diehl SR, Hayes RB. Pooled analysis of alcohol dehydrogenase genotypes and head and neck cancer: a HuGE review. *American journal of epidemiology*. 2004 Jan 1;159(1):1-6.
17. Arnold W, Nager F. Dysphagia: definition. *Therapeutische Umschau. Revue therapeutique*. 1991 Mar;48(3):135-8.
18. Manikantan K, Khode S, Sayed SI, Roe J, Nutting CM, Rhys-Evans P, Harrington KJ, Kazi R. Dysphagia in head and neck cancer. *Cancer treatment reviews*. 2009 Dec 31;35(8):724-32.
19. Browman GP, Wong G, Hodson I, Sathya J, Russell R, McAlpine L, Skingley P, Levine MN. Influence of cigarette smoking on the efficacy of radiation therapy in head and neck cancer. *New England Journal of Medicine*. 1993 Jan 21;328(3):159-63.
20. Epstein JB, Emerton S, Kolbinson DA, Le ND, Phillips N, Stevenson-Moore P, Osoba D. Quality of life and oral function following radiotherapy for head and neck cancer. *Head & neck*. 1999 Jan 1;21(1):1-1.
21. I Rudberg, H Bergquist, M Anderson, H Dotevall, S Horvath, C Finizia. Shaker Exercise Rehabilitation in Head and Neck Cancer and Stroke Patients with Dysphagia - A Pilot Study. *Journal of Cancer Science and Clinical Oncology*. 2015; 2(3).
22. Padwal T, Gurudut P, Hajare S. Effect of shakers exercise with kinesio taping in subjects with gastroesophageal reflux disease: A randomized controlled trial. *Health Sciences*. 2016;5(10):170-8.
23. Crary MA, Carnaby GD, Groher ME, Helseth E. Functional benefits of dysphagia therapy using adjunctive sEMG biofeedback. *Dysphagia*. 2004 Aug 1;19(3):160-4.
24. Crary MA, Carnaby-Mann GD, Faunce A. Electrical stimulation therapy for dysphagia: descriptive results of two surveys. *Dysphagia*. 2007 Jul 1;22(3):165-73.
25. Chen AY, Frankowski R, Bishop-Leone J, Hebert T, Leyk S, Lewin J, Goepfert H. The development and validation of a dysphagia-specific quality-of-life questionnaire for patients with head and neck cancer: the MD Anderson dysphagia inventory. *Archives of Otolaryngology-Head & Neck Surgery*. 2001 Jul 1;127(7):870-6.
26. Bjordal K, Hammerlid E, Ahlner-Elmqvist M, de Graeff A, Boysen M, Evensen JF, Biorklund A, de Leeuw JR, Fayers PM, Jannert M, Westin T. Quality of life in head and neck cancer patients: validation of the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-H&N35. *Journal of Clinical Oncology*. 1999 Mar;17(3):1008-.
27. Hassan SJ, Weymuller EA. Assessment of quality of life in head and neck cancer patients. *Head & neck*. 1993 Nov 1;15(6):485-96.
28. Ringash J, Bezjak A, O'sullivan B, Redelmeier DA. Interpreting differences in quality of life: the FACT-H&N in laryngeal cancer patients. *Quality of Life Research*. 2004 May 1;13(4):725-33.
29. Murphy BA, Gilbert J. Dysphagia in head and neck cancer patients treated with radiation: assessment, sequelae, and rehabilitation. 2009 Jan 31 (Vol. 19, No. 1, pp. 35-42). WB Saunders.