

PHYSICAL THERAPY IN HEAD & NECK CANCER

PHYSICAL THERAPY TREATMENT FOR A PATIENT WITH
COMPLEX REHABILITATION NEEDS DURING AND AFTER CHEMORADIATION
FOR HEAD AND NECK CANCER

A Case Report

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The final copy of this case study has been examined by the signatory, and we find that both the content and form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

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ABSTRACT

Background and Purpose: This case report describes the extensive physical therapy needs of a patient with head and neck cancer, how these needs change over the course of cancer treatment, the measurements necessary for a comprehensive physical therapy assessment, and multimodal interventions through all phases of cancer treatment. **Case Description:** The patient was a 76-year-old male treated in an outpatient physical therapy clinic during and after chemoradiation to treat pharyngeal cancer. He presented with impaired quality of life, cancer-related fatigue, limited cervical mobility, shoulder weakness, temporomandibular dysfunction, and lymphedema. Physical therapy management included patient education, manual therapy to improve musculoskeletal mobility, therapeutic exercise for endurance, cervical and shoulder strengthening, temporomandibular exercises, postural education, and complete decongestive therapy to address lymphedema. **Outcomes:** Following treatment, the patient had improved pain, quality of life, fatigue, cervical mobility, deep cervical neck flexor endurance, temporomandibular function, shoulder elevation, upper trapezius strength, and lymphedema. He was independent with an exercise program and lymphedema management. **Discussion:** This case illustrates the role of the physical therapist in preventing complications during and restoring function and quality of life following treatments for head and neck cancer.

INTRODUCTION

Head and neck cancers (HNC), including cancers of the oral cavity, larynx, pharynx, salivary glands, paranasal sinuses, and nasal passages, are collectively the sixth most common cancer worldwide. In the United States, HNC, excluding thyroid, brain, and superficial skin cancers, account for approximately 2.5% of all cancers with 42,440 new cases expected to be diagnosed in 2014.¹ Advances in the treatment of HNC, such as less invasive surgical techniques and new chemoradiation protocols have contributed to improved survival rates. While intensive treatment regimens improve survival, a growing number of patients are facing long-term deficits that interfere with the most basic functional activities.^{2,3,4} Changes in speech, difficulty swallowing, altered ability to taste and smell, decreased saliva, and nutritional deficits interfere with the ability to eat, drink, and participate in social activities. Physical therapy-related deficits may include neck and shoulder dysfunction, temporomandibular disorder (TMD), craniofacial pain, lymphedema, decreased muscle length, changes in posture, balance and gait problems, neuropathy, fatigue, deconditioning, scar adhesions, and functional deficits.⁵

Patients report a frequent need for rehabilitation services through all phases of treatment and survivorship. In a longitudinal study of 80 patients with HNC, Oskam et al. found that the most commonly expressed rehabilitation professionals during treatment include a dental hygienist (77%), physical therapist (73%), speech therapist (42%), dietician (38%), and psychosocial care (27%). Ten years after cancer treatments, patients continued to express a need for dental hygiene (38%) and physical therapy (23%).⁶ Despite the demonstrated need for comprehensive physical therapy throughout treatment and survivorship, this population is not consistently referred for physical therapy by physicians and the availability of physical therapy services for HNC is typically limited and highly variable geographically.⁷

It is well recognized that HNC and the effects of treatment result in significant decline in function, psychological status, and quality of life (QOL). QOL is impaired at diagnosis, declines throughout treatment, and then improves somewhat during the year after treatment.^{8,9,10,11} QOL

of HNC survivors is directly or indirectly effected by many factors, including optimism, education level, any coexisting disease, number of somatic symptoms, household income, eating ability, support from others, whether the cancer is under control or not, and traveling time from the hospital.¹² QOL at the time of diagnosis and the change in quality of life, particularly in physical function, during treatment are major predictors of overall survival in patients with HNC.¹³ Physical therapy, as part of a multi-disciplinary rehabilitation program, has the potential to profoundly improve patient's quality of life and should be considered for this patient population.¹⁴

Many of the physical therapy-related deficits occur secondary to the development of radiation fibrosis syndrome (RFS).¹⁵ RFS is the abnormal production and accumulation of protein and fibrin in normal tissues following radiation exposure. The histological and clinical features may not be apparent for weeks, months, or even years after treatment. Patients with HNC are at higher risk for developing RFS due to the high doses of radiation that they receive and the critical structures within the radiation field. The severity of RFS is related to the dose of radiation, the radiation field, and the overall health of the patient. RFS directly leads to neuropathic pain, sensory loss, painful muscle spasms, muscle weakness, cervical dystonia, joint contractures, loss of soft tissue elasticity, osteoradionecrosis of the mandible, and adherence of the skin to tissues.¹⁶

The most common indication for referral and most frequently described deficit in the literature is shoulder dysfunction secondary to spinal accessory nerve damage following neck dissection and radiation. The spinal accessory nerve innervates the sternocleidomastoid and upper trapezius musculature. Neural damage results in impaired scapulohumeral rhythm, decreased shoulder abduction, shoulder pain, scapular winging, and scapular depression and downward rotation. Despite a shift toward the use of nerve-sparing, modified radical neck dissection techniques, 77% of patients report shoulder dysfunction, with 23% reporting moderate to severe dysfunction.¹⁷ The high rate of dysfunction indicates that accessory nerve damage

occurs even in nerve sparing surgeries, possibly due to traction of the nerve, devascularization, or microtrauma during surgery¹⁸ or secondary to radiation.¹⁹ Shoulder dysfunction may be further complicated by the development of secondary adhesive capsulitis and myofascial pain.²⁰

Surgery and radiation result in pain, scar tissue, and fibrosis in the anterior neck. Patients often assume a forward-head and shoulder posture. Cervical mobility declines following radiation and surgery. In this researcher's experience, patients receiving radiation to the upper neck (e.g. tongue cancer) experience a loss of upper cervical mobility. Swisher et al. found that 73% of patients reported impairments on the Neck Disability Index.²¹ Two case studies demonstrated positive effects of soft tissue mobilization, muscle energy techniques, kinesiotaping, and resistance exercises on cervical function in head and neck cancer patients.^{22,23}

TMD is a common complication of HNC treatments effecting up to 45% of patients receiving curative doses of radiation²⁴ and may present as limited mouth opening, pain with chewing and talking, and joint sounds.²⁵ TMD may be the result of local invasion of the tumor, surgery, and radiation leading to fibrosis and structural changes, hypertonicity of the muscles of mastication, and capsular restrictions of the temporomandibular joint (TMJ). Mouth opening of <35mm can result in problems with speech, oral hygiene, dental procedures, and oncology follow-up.

Head and neck lymphedema is a common consequence of surgery and radiation for HNC. It is estimated that 45.7% to 75% of HNC survivors develop lymphedema, most commonly in the neck and submental areas.²⁶ Head and neck lymphedema is characterized by persistent swelling and the accumulation of protein rich fluid due to the obstruction, destruction, or removal of lymphatic structures. Lymphatic stasis leads to inflammation and fibrosis of the tissue. Lymphedema may profoundly impact basic functions such as chewing, swallowing, speaking, and breathing and decrease quality of life.^{27,28} Visible deformity leads to negative psychosocial sequelae including reduced self-esteem and poor socialization.²⁹

Fatigue is a nearly universal complaint among cancer survivors and is often reported as the most distressing symptom. Yet, it is often not evaluated properly and therefore frequently undertreated.³⁰ Cancer-related fatigue is defined as an unusual, persistent, and subjective sense of tiredness related to cancer or cancer treatment that interferes with functioning.³¹ Cancer-related fatigue is considered pathological when it occurs during normal activities, persists over long periods of time, and does not respond to rest.³²

Despite evidence that physical therapy needs exist throughout all phases of treatment for HNC, comprehensive physical therapy rehabilitation programs are rarely available and have not been described in the literature. The purpose of this case study is to describe the extensive physical therapy needs of a patient with head and neck cancer, how these needs change over the course of cancer treatment, the measurements necessary for a comprehensive physical therapy assessment, and interventions through all phases of cancer treatment.

CASE DESCRIPTION

History

The patient was a 76-year-old male diagnosed with squamous cell carcinoma of the pharynx. He presented to the otolaryngologist with an intractable sore throat. Laryngoscopy revealed a lesion at the pharynx. Further biopsy and computed tomography confirmed malignancy with lymphadenopathy.

The patient was referred to Lee Memorial Health System's Head and Neck Cancer Pathway, a multidisciplinary team of medical and rehabilitation professionals including the otolaryngologist, oncologist, radiation oncologist, oral surgeon, gastroenterologist, nurse navigator, speech therapist, dietician, and physical therapist. The Head and Neck Cancer Pathway is illustrated in Figure 1. This team provides evaluation and treatment from time of diagnosis through survivorship, as needed. Overall care is coordinated by the nurse navigator. During the first 2 weeks after diagnosis, the patient and his physicians decided to proceed with a combined modality treatment including 35 radiation treatments and 5 rounds of chemotherapy.

Prior to initiating treatments, the oral surgeon removed 2 teeth at risk of decay during radiation. The vascular surgeon placed a venous access catheter. The gastroenterologist placed a percutaneous endoscopic gastrostomy (PEG) tube for nutritional supplementation during treatment. Speech therapy performed a modified barium swallow study revealing flash penetration with continuous drinking of thin liquids, but swallow function was otherwise normal. An esophogram revealed no significant impairments, strictures, hiatal hernia, and normal motility. The patient met with the dietician who instructed the patient in use of the PEG tube and maintaining appropriate nutritional intake during treatment. The nurse navigator discussed coordination of care and resources for support during treatments.

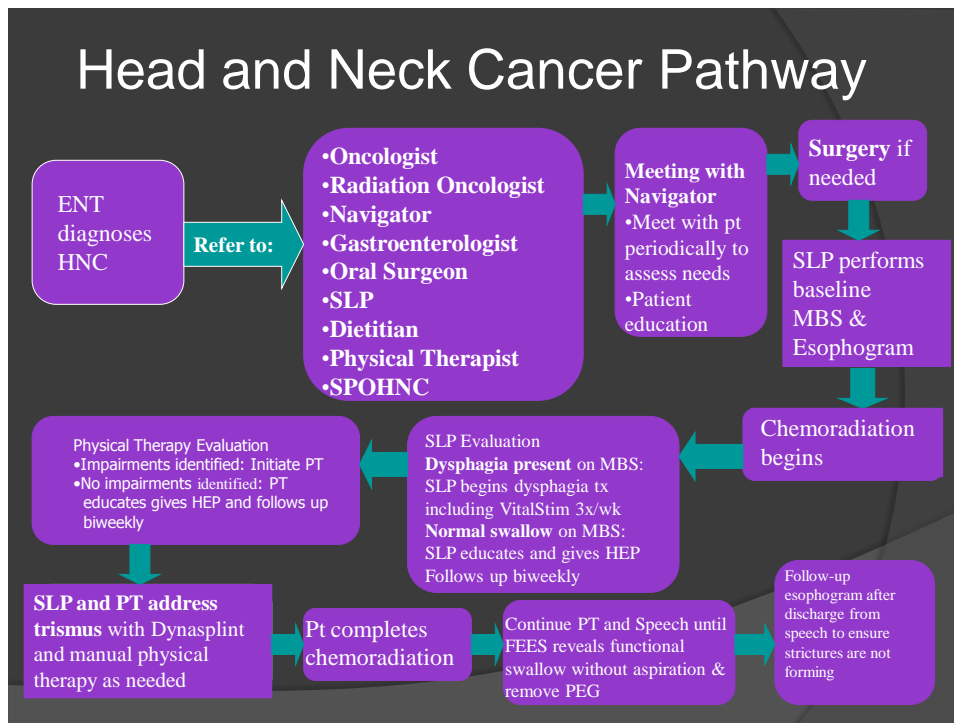


Figure 1. Head and Neck Cancer Pathway³³

The patient presented to physical therapy 3 weeks after initiating radiation and chemotherapy. At the initial evaluation, he had difficulty speaking due to painful mucositis and radiation necrosis in the mouth. His wife assisted with the history. They reported significant decline in function due to cancer-related fatigue and mouth pain. Prior to cancer, the patient

worked 2 days per week as a general surgeon and led an active lifestyle. He exercised regularly, which included running, riding a bike, using an elliptical, lifting weight, and golfing. At this time, he was able to work one morning per week and walk 20 minutes per day.

The patient's self-reported medical history included type 2 diabetes, hypothyroidism, hyperlipidemia, coronary artery disease, ischemic cardiomyopathy with left ventricular ejection fraction of 40%, premature ventricular contractions, and single artery coronary artery bypass grafting in 2002. He underwent right rotator cuff repair in 1993 and right subacromial decompression in 2012. He reported no history of tobacco and drinks socially. Medications include Emend, Lipitor, Coreg, Lumigan, Vicodin, Lamisil, Glucophage, Synthroid, Allopurinol, aspirin, calcium, and vitamin D3 supplements.

Systems Review

Review of systems revealed hypotension, low heart rate, and normal oxygen saturation at rest. A PEG tube was present and used to provide supplemental nutritional intake due to the patient's difficulty swallowing and oral pain. The skin on the anterior neck was warm and red secondary to radiation treatments. Wounds were visible on the left, lateral tongue. Edema was noted in the oral mucosa, particularly on the left side of the tongue and inside of the left cheek. Mucositis limited verbal communication and ability to eat. He was able to eat yogurt and drink water with difficulty. A Fentanyl pain patch reduced oral pain "somewhat." The patient rated pain as 2/10 on the Numerical Pain Rating Scale (NPRS), but pain increased to 8/10 after eating or talking. The NPRS scale asks the patient to assign a number between 0 and 10 to describe his perceived pain level, with 0 representing "no pain" and 10 representing the "worst possible pain." The 11-point numeric pain scale has been found to yield moderate reliability.³⁴ This scale is used to assess pain at every treatment session in our facility because of its simplicity and efficiency. The patient had limited knowledge of the physical impacts of radiation therapy on function, cancer-related fatigue, and energy conservation. The most prominent impairments for this patient

were TMD, difficulty elevating the shoulders, and fatigue. He denied changes in cervical mobility or edema in the neck.

Table 1. Review of Systems

	Initial Eval During Chemoradiation	Reevaluation 2 Weeks After Chemoradiation	Discharge 6 weeks After Chemoradiation
Resting BP	108/62	100/60	98/60
Resting HR	46bpm	52bpm	48bpm
Resting SpO2	98%	96%	98%
Weight	154	148	155
PEG tube	Present – supplementing	Present –all nutrition	Present – supplementing
Integumentary	Generalized erythema anterior neck. Wounds on left lateral tongue anterior 4mm x 8mm, posterior 6mm x 13mm	Generalized erythema anterior neck. Wound on left lateral tongue 8mm x 28mm	No impairments on neck. Tongue wound decreased to 3mm x 6mm.
Pain	Average: 2 At worst: 8	Average: 0 At worst: 8	Average: 0 At worst: 5

Prior to the initial examination, the patient completed the Functional Assessment of Chronic Illness Therapy (FACIT-F). This self-administered outcome measure consists of the Functional Assessment of Cancer Therapy (FACT-G), a measure of QOL, and FACIT-Fatigue subscale, a measure of cancer related fatigue. The FACT-G is further divided into 4 subscales, physical well-being, social/family well-being, emotional well-being, and functional well being. This questionnaire has been studied extensively, has strong validity across many cancer diagnoses and is listed in the National Institutes of Health repository of evidence-based measures Patient-Reported Outcomes Measurement Information Systems (PROMIS).^{35,36,37} The FACIT-F has excellent internal consistency and reliability.³⁸ Normative reference scores and minimally important differences are reported in Table 2. The patient scored 105/160 on the FACIT-F. On

the subscales he scored greater than 1 standard deviation below mean scores for head and neck cancer patients in physical and functional well-being and greater than one standard deviation above the mean in social support.

Table 2. Reference Values for FACIT-F³⁹

	Normative Reference Value		
	All Cancers, Mean Score (SD)	Head & Neck Cancers, Mean Score (SD)	Minimally Important Difference Points on Scale
FACIT-F			
FACT-G	80.4 (15.9)	73.1 (17.8)	5-7
Physical well being	21.2 (6.2)	19.2 (6.3)	2-3
Emotional well being	18.1 (4.5)	17.7 (5.1)	3
Social well being	22.3 (4.8)	20.2 (5.3)	2
Functional well being	18.8 (6.4)	15.9 (6.8)	2-3
FACIT - Fatigue	-	-	3-4

Table 3. Outcome Measure Scores

Measure (Score range)	Initial Evaluation During Chemoradiation	Reevaluation 2 Weeks After Chemoradiation	Discharge 6 weeks After Chemoradiation
FACIT-F (0-160)	105	72	135
FACT-G (0-108)	67	58	98
<i>Physical Well-Being (0-28)</i>	13	9	25
<i>Social Well-Being (0-28)</i>	26	23	23
<i>Emotional Well-Being(0-24)</i>	14	16	24
<i>Functional Well-Being (0-28)</i>	14	10	22
FACIT-Fatigue (0-52)	24	14	37
TMD Disability Index (0-50)	27	30	8

He also completed the Temporomandibular Disorder Disability Index which consists of 10 questions regarding disability associated with TMD. Each question is scored from 0-4 with higher scores representing greater disability. The patient scored 27/50 points, reporting significant difficulty with communication, oral care, eating, chewing, social activities, yawning,

mouth opening, kissing, sleep, and little pain relief from any form of treatment. The psychometric properties of this questionnaire have not been reported, but it is widely used in TMD research and clinical applications.

Clinical Impression Based on History and Systems Review

The patient reported symptoms of cancer-related fatigue, edema, oral pain, TMJ dysfunction, and shoulder weakness. Oral pain, edema, and TMJ immobility limited his ability to communicate, eat, perform oral care, and participate in social activities. Fatigue limited his ability to work, exercise, and complete household activities. Shoulder weakness limited his ability to reach overhead. Because he was undergoing chemoradiation, he was at risk for development of lymphedema, radiation fibrosis, and cervical dysfunction.

Tests and Measures

Based on the information obtained during the history and systems review, the physical therapist decided to proceed with tests and measures to assess cervical, shoulder, and temporomandibular dysfunction, loss of strength, posture impairment, soft tissue mobility, and lymphedema. The tests and measures are listed in Table 4.

Although the patient denied loss of cervical ROM during cancer treatments, baseline measurements of active flexion, extension, side bending, and rotation range of motion of the cervical spine using a gravity goniometer (Baseline Bubble Inclinator) were recorded. Measurements were taken as described by Piva, Childs, and Browder. This efficient and economical method of measuring cervical range of motion has been shown to have adequate reliability for clinical use (Interclass correlation coefficient [ICC] = 78-.91 and minimal detectable change [MDC] = 9-16 degrees).⁴⁰ Neck extension was measured with the mouth open and mouth closed with the teeth together to account for soft tissue restrictions in the anterior neck. Rotation was measured in supine with one thin pillow under the head to accommodate thoracic kyphosis. Deep cervical neck flexor endurance was tested in hook-lying by having the patient maximally retract the chin and lift the head 2.5 cm above the plinth while keeping the chin

retracted to the chest. This test has shown acceptable reliability.⁴¹ The patient maintained the position for 32 seconds, revealing slight deficit when compared norms for young healthy males of 39.1 ± 20.0 seconds⁴².

Active shoulder flexion and abduction were measured in sitting using a JAMAR 12 1/2" Plastic Goniometer as described by Norkin.⁴³ Shoulder flexion and abduction were limited bilaterally, right greater than left. Passive shoulder range of motion was screened in supine. Although measurements were not recorded, the examiner determined that the patient demonstrated full passive mobility without capsular restriction. Strength testing of the upper trapezius muscles was performed as described by Kendall.⁴⁴ The patient demonstrated 4/5 strength on the right and 4+/5 strength on the left.

Active mandibular depression was measured at 32mm millimeters as the maximal interincisal distance using a ruler.⁴⁵ Palpation of the TMJ during active mandibular depression revealed premature anterior translation of the head of the mandible during the first 1/3 of the available range of motion.

Postural observation revealed mild forward head posture, which the patient was able to correct with verbal cuing. Palpation of anterior structures of the neck and face identified mild edema of the left cheek and tenderness of the left anterior neck. No deficits were noted in myofascial mobility, muscular hypertonicity, or hyolaryngeal mobility.

Cervical passive intervertebral motion was tested as described by Olson.⁴⁶ A 7-point ordinal rating scale (0-6) was used to rate mobility, with 3 being normal, 0 ankylosed, and 6 unstable.⁴⁷ C0-C1 mobility was tested as forward and backward bending of the cranium in relation to C1. C1-C2 mobility was tested as upper cervical rotation with the lower cervical spine locked in full cervical lateral flexion. Mobility in segments C2-C3 through T1-T2 was evaluated with passive cervical upglide. The patient was noted to have slight restriction of C0-1 forward-bending and C4-5 upglide. Interrater reliability for passive intervertebral motion testing is generally poor to moderate, with Kappa values ranging from -0.09 to 0.63.⁴⁸ Despite generally

low interrater reliability,⁴⁹ the majority (98%) of manual therapy trained physical therapists base treatment choices at least partially on passive intervertebral motion testing, attributing moderate to strong face validity to these techniques.⁵⁰

Lymphedema was quantified using M.D. Anderson Cancer Center Head and Neck Lymphedema evaluation Protocol, which includes the circumferential neck composite score and modified Foldi Lymphedema Rating Scale.⁵¹ Circumferential measurements of the neck were taken at the most superior aspect of the neck, mid-cervical, and most inferior aspect of the neck. These values were summed to calculate the neck circumference composite score of 109.3 cm. An additional vertical circumference from the submental area to the top of the head <1 cm in front of the ear was taken to account for edema in the face and submental region. Vertical circumference was 58.9 cm. The reliability and validity of circumferential tape measurements have not been established.⁵² Circumferential measurements are efficient and economical measures of edema in the neck in the clinical setting. The MDACC HNL rating scale scores lymphedema based on examination and patient complaint. In Stage 0 the patient complains of tissue heaviness, but edema is not visible. Stage 1a shows soft, visible edema without pitting, while 1b demonstrates soft pitting edema. Stage 1a and 1b are considered reversible. Stage 2 displays firm pitting edema without tissue changes and is not reversible. Stage 3 is the most severe stage and characterized by irreversible tissue changes, such as hyperkeratosis and papillomatosis.⁵³ At initial examination, the patient's lymphedema in the anterior neck and left cheek was described as Stage 1A. It is difficult to differentiate between acute, inflammatory edema caused by radiation and more chronic secondary lymphedema.

Table 4: Tests and Measures

Measure	Initial Evaluation During Chemoradiation	Reevaluation 2 Weeks After Chemoradiation	Discharge 6 weeks After Chemoradiation
ROM Cervical (degrees)			
Flexion	58	57	70
Extension with TMJ open	55	57	55
Extension with TMJ closed	50	46	50
R Lateral Flexion	33	43	45
L Lateral Flexion	28	45	45
R rotation	60	67	85
L rotation	60	72	85
AROM Shoulder (degrees)			
Flexion	R 124, L 154	R 110, L 148	R 135, L 164
Abduction	R 92, L 122	R 75, L 115	R 110, L 135
TMJ ROM (mm)			
Mandibular depression	32	28	35
Strength			
Upper trapezius (0-5)	R 4, L 4+	R 4, L 4	R 4+, L 4+
Deep cervical flexors (sec)	28	22	32
Posture	Forward head, able to correct with verbal cuing	Forward head, able to correct with verbal cuing	Erect posture
Spinal segmental mobility	C0-C1: 2/6 in forward bending C4-C5: 2/6 in left upglide All others 3/6	C0-C1: 2/6 in forward bending C4-C5 and C5-6: 2/6 in left upglide All others 3/6	3/6 in all directions C0 to C7
Palpation	Edema in left cheek wall. Tenderness left anterior neck.	Edema in left cheek wall and inferior to the chin. Tenderness left anterior neck.	Increased tissue density inferomedial to the L mandible and chin.
Lymphedema			
Stage of Lymphedema	Stage Ia	Stage Ib	Stage Ia
Neck Composite Score (cm)	109.3	112.5	107.1
Vertical circumference (cm)	58.9	60.1	58.5

Clinical Impression Following the Initial Examination

Based on the examination findings, the patient was given the physical therapy diagnoses of cancer related fatigue, limited cervical mobility, shoulder weakness, TMD, and acute edema.

He was scheduled to undergo continued radiation and chemotherapy, which would likely worsen the current symptoms. During radiation, he was at risk for developing secondary lymphedema. The patient, a physician himself, demonstrated excellent understanding of the medical treatments for HNC, but he had poor understanding of the effects of cancer and chemoradiation on function and the need for rehabilitation.

INTERVENTION

At the initial examination, the patient received extensive education, including the role of physical therapy in maintaining and regaining function during and after treatment for head and neck cancer, energy conservation, maintaining an active lifestyle during treatment, the importance of skin care, and the impact of nutrition and hydration in reducing symptoms. He was instructed in a home exercise program including cervical active range of motion in all directions, upper trapezius and pectoralis stretches, and postural reeducation exercises. These included cervical retraction, scapular retraction, and supine deep neck flexor endurance training to maintain cervical mobility, deep neck flexor endurance, posture, and muscle length during treatment. Shoulder shrugs were introduced to address upper trapezius weakness. He was also instructed in active mandibular depression emphasizing temporomandibular rotation and progressive relaxation focusing on the muscles of the head and neck. The patient and his wife demonstrated good understanding of the home exercise program and felt comfortable managing his physical therapy-related deficits at home while he completed chemoradiation. He was scheduled for a follow-up physical therapy visit in 6 weeks.

The patient returned to therapy two weeks after completing chemoradiation. He reported “severe” fatigue. He continued to work at a reduced schedule, performing surgeries 1 morning per week. He stopped walking for exercise 3 weeks prior. He tried to return to an exercise program by walking for 45 minutes on the treadmill, but this resulted in severe fatigue and he had not tried it again. He also complained of painful wounds on the left lateral tongue and left inner cheek wall and severe inflammation of the oral mucosa, making it difficult to talk or eat. Mouth

opening had declined to 28mm and he reported a tendency to “clench the jaw.” Significant improvements were noted in cervical lateral flexion and rotation, likely due to high compliance with upper trapezius stretches and cervical active range of motion home exercises. A slight, although not statistically significant, decline was noted in cervical extension with the mouth closed, due to myofascial restrictions in the anterior neck and hypertonicity of the suprahyoid musculature. Declines were also noted in left upper trapezius strength and deep neck flexor endurance. Although the patient denied increased edema in the head and neck, the neck composite score increased 3.2 cm and the vertical circumference of the head increased 1.2cm, with soft, pitting edema noted in the submental region and left cheek. The patient agreed to begin physical therapy treatment two times per week for 4 weeks to restore cervical and TMJ mobility, strengthen postural and shoulder musculature, address lymphedema, improve endurance, and address cancer-related fatigue.

Table 5: Interventions Performed at Each Visit Post Radiation

Treatment	Days after completing radiation							
	14	19	21	26	28	33	35	40
Complete Decongestive Therapy	*	*	*	*				
TMJ opening with rolling motion	*							
TMJ relaxation	*							
TMJ stretching with hold-relax			*	*				
Self TMJ distraction				*				
Myofascial mobilization anterior neck	*	*	*	*	*	*	*	*
Cervical upglides	*	*	*	*	*	*	*	*
Upper cervical mobilizations	*	*	*		*	*	*	*
NuStep	*	*	*	*	*	*	*	*
Upper extremity strengthening	*	*	*	*	*	*	*	*
Lower extremity strengthening	*	*	*	*	*	*	*	*

Cancer-Related Fatigue

At the second physical therapy visit, the patient and his wife were educated in activity modification and energy conservation to avoid fatigue, remaining as active as possible and resting appropriately. Physical activity is the most researched and possibly the most effective treatment for cancer-related fatigue. According to the NCCN Clinical Practice Guidelines on CRF, “exercise has a powerful effect of cancer-related fatigue, and fatigue levels were 40% to 50% lower in exercising participants, even in studies with small sample sizes. The evidence supporting exercise as an intervention for fatigue is category 1 based on the number of studies conducted, good quality of the designs, large effect size of exercise on cancer-related fatigue, and consistent outcomes across studies.⁵⁴ Physical activity has been shown to improve quality of life, functional capacity, physical function, body composition, pain, weakness, depression, and distress following HNC.⁵⁵

The patient was instructed to use a pedometer to assess his current activity level for 3 days using the STAR Program Pedometer Log.⁵⁶ Several studies have found that using pedometers may be beneficial in motivating cancer survivors to increase their activity level.^{57,58,59} During all treatment sessions, the patient performed progressive resistance exercises for the upper and lower extremities and endurance exercises including the Nu-Step and step ups. He received extensive education on progression of exercise to challenge strength and endurance while avoiding over-fatigue and injury.

Cervical Mobility

A combination of manual therapy techniques, cervical ROM exercises, and postural reeducation exercises were performed to improve cervical mobility and posture. Manual therapy techniques to restore arthrokinematics at hypomobile segments were performed in supine, including up glides and down glides of C4-5 and C5-6.⁶⁰ To address upper cervical flexion hypomobility, suboccipital release was sustained for 2 minutes followed by C0-C1 flexion mobilization.⁶¹ All cervical mobilizations were grade 3 or 4 in order to improve segmental

mobility. Soft tissue mobilization of the suboccipitals, paraspinals, upper trapezius, scalene, sternocleidomastoids, infrahyoids, and suprahyoids was performed. Postural reeducation exercises included scapular retraction, cervical retraction, and deep neck flexor endurance to address forward head posture and impaired deep cervical neck flexor endurance.⁶²

Temporomandibular Dysfunction

Physical therapy exercises and manual therapy were implemented to improve temporomandibular depression.⁶³ At the initial examination and first treatment session post radiation, the patient was instructed to palpate the TMJ as he performed active mandibular depression, using a rolling motion without anterior translation. Initially, this exercise was performed with the tip of the tongue on the roof of the mouth and lips closed. He gradually increased the ROM to part the lips and open the mouth further without anterior translation. He was also instructed in progressive relaxation of the muscles of the face and neck with emphasis on the muscles of mastication. Although myofascial restrictions were suspected in the medial pterygoid and masseter, oral pain prevented palpation of these structures and soft tissue mobilization techniques were deferred.

Although the relationship between TMD and posture is controversial and unclear,⁶⁴ several studies support a relationship between TMD and atlanto-occipital extension.^{65,66,67,68} Forward head posture results in anterior translation of the mandible, shortening of the posterior cervical muscles, and lengthening of the anterior cervical and submandibular muscles.⁶⁹ This results in increased muscular activity of the sternocleidomastoid and masseter.^{70,71} Manual therapy and exercises to address cervical soft tissue, joint restrictions, and posture, described above, likely positively influenced TMJ function.

During the third treatment session, the patient reported that he began manual stretching of mandibular depression using his fingers to apply a downward force to the inferior incisors. The patient was instructed in the use of hold-relax stretching to further improve mouth opening. He applied a 30 seconds downward stretch, and then performed a 5 second isometric contraction of

the muscles that elevate the mandible, followed by a 5 second stretch downward. This was repeated 8 times. Following this exercise, mandibular depression improved from 31mm to 34 mm. The hold-relax stretch was repeated into right and left lateral deviation, further improving depression to 35mm. The patient was instructed to perform contract-relax stretches prior to eating. During the fourth session, the patient was instructed in self-distraction of the left TMJ.

There is evidence to support the use of deep tissue mobilization, manual mobilization of the TMJ, and stretching devices such as DynaSplint and Therabite to address limited TMJ depression following head and neck cancer.⁷² Unfortunately, these techniques could not be employed due to the friability of the oral mucosa and intra-oral pain.

Shoulder Dysfunction

Past history of rotator cuff repair, spinal accessory nerve damage to the accessory nerve secondary to radiation, and overall physical deconditioning resulted in loss of shoulder elevation and impaired scapulohumeral rhythm. A Cochrane review of exercise interventions for shoulder dysfunction following HNC treatments demonstrates improved pain, range of motion, and shoulder disability with progressive resistance training.⁷³ The patient participated in supervised progressive resistive strengthening with the goal of improving scapular stability and upper extremity strength. The exercises are listed in Table 6. An electromyographic study of scapular muscle exercises in patients with head and neck cancer found that 3 exercises, the shoulder shrug, overhead press, and combined adduction and flexion, provided the greatest recruitment of the upper trapezius muscle after spinal accessory nerve damage.⁷⁴ The patient was unable to perform overhead press due to subacromial pain. McNeely and colleagues found that HNC survivors had significantly greater improvements in pain, disability, muscular strength, and UE endurance with a progressive resistance program rather than a program of stretching and light resistance.⁷⁵ In this study, the exercises consisted of scapular retraction, scapular elevation, elbow flexion, elbow extension, external rotation, and abduction in the plane of the scapula.

Table 6. Scapular Stabilization and Upper Extremity Strengthening Exercises

Shoulder Shrug	Abduction in the plane of the scapula
Adduction/flexion/internal rotation	Extension
Abduction/flexion/external rotation	Horizontal abduction
Scapular retraction	Elbow flexion
Scapular protraction	Elbow extension
Scapular elevation	Chest press
External rotation	Row machine

Lymphedema

Complete decongestive therapy (CDT) was performed during the first 4 visits. CDT consisted of education regarding skin care, spouse-assisted manual lymphatic drainage (MLD), and the use of lymphedema-specific exercises to prevent lymphedema based on the M.D. Anderson Cancer Center Head and Neck Cancer treatment model.⁷⁶ MLD was performed to redirect fluid from the anterior neck and left cheek to the bilateral axillary lymph nodes via the anterior and posterior cervical lymphatic channels as described by Foldi.⁷⁷ The patient's wife was independent with MLD after 3 instructional sessions and continued treatment at home 1-2 times daily. Following MLD, the patient performed 5 repetitions each of diaphragmatic breathing, shoulder shrugs, scapular retraction, cervical rotation, cervical extension, cervical lateral flexion, shoulder shrugs, scapular retraction and diaphragmatic breathing. These exercises were adapted from the Lymphedema Support Network Head and Neck Cancer Specific-Exercises and have been shown to improve edema more than a general exercise program, particularly when performed 3-5 times per day.⁷⁸ These exercises also support the physical therapy goals to restore cervical ROM, upper trapezius strength and postural stability. Three exercises, tongue protrusion, whispering vowel sounds and smiling, were deleted due to oral pain. Use of a compression garment was discussed with the patient. He preferred to manage lymphedema with MLD and exercises without use of a compression garment, unless symptoms worsened.

OUTCOMES

Pain

At discharge, the patient reported that he only experienced pain along the lateral border of the tongue with eating and extended talking. Pain with these activities decreased from 8/10 to 5/10. A two point reduction of pain on the NPRS represented a clinical difference.⁷⁹ He was able to discontinue all pain medication. The decrease in oral pain coincided with healing of the wounds on the lateral border of the tongue.

Quality of Life

The FACT-G score declined during chemoradiation from 67/108 to 58/108 at initiation of physical therapy intervention. During physical therapy, it rebounded and surpassed initial levels, climbing to 98/108. Physical, Emotional and Functional Well-Being scores all improved significantly (see Tables 2 and 3). The only scale that did not improve during physical therapy was the Social Well-Being Score. The patient reported difficulty participating in social activities due to pain with eating and talking.

Fatigue

The FACIT-Fatigue score improved to 37/52, a 23 point improvement (minimal detectable change is 3-4 points⁸⁰). One week after initiating physical therapy intervention, the patient reported improved energy to 6/10 with 0 being no energy and 10 being normal energy, less need to rest, and was able to resume walking on the treadmill for 20 min without incline, stretching, performing UE strengthening with 5 lbs hand weights, and swinging a golf club. He decided to retire from his medical practice in order to focus on rehabilitation. By the third week, the patient reported 7/10 energy, began a light resistance weight lifting program in his community gym, and increased treadmill walking to 25 min at a 5 degree incline.

Cervical Function

From initial evaluation during chemotherapy to discharge, cervical range of motion improved in all directions except extension. There was a 90% chance that the change in range of

motion exceeded measurement error.⁸¹ Cervical range of motion continued to improve in all directions, except extension with mouth open, from completion of radiation to completion of physical therapy. However, only flexion and rotation increased significantly enough that there was a 90% chance that the change in range of motion exceeded measurement error. Normal values for active range of motion have not been published for men over 70 years of age. At discharge, the patient's range of motion significantly exceeded normal AROM values of people between 50 and 59 years of age in all directions except extension.⁸² At discharge, all restrictions in passive intervertebral mobility had resolved. Deep neck flexor endurance increased from 22 seconds to 32 seconds. This remains slightly deficient when compared to the norm for men of 39.1 ± 20.0 established by Domenech⁸³. The patient was observed to have improved cervical posture.

Temporomandibular Function

The TMD Disability index improved from 30/50 to 8/50. Upon discussion with the patient, many of the remaining deficits reported on this index were related to oral pain, not TMD. Mandibular depression improved to 35 mm at discharge. Normal range of motion for mandibular depression ranges from 35 mm to 50mm and decreases with age.⁸⁴ Although still limited, the patient reported improved functional mobility. He was able to complete oral care, eat normally and speak without TMJ pain. He only noticed limited opening when yawning or trying to eat a large sandwich.

Shoulder Function

The patient demonstrated clinically meaningful improvements in active shoulder flexion and abduction with greater than 95% confidence.⁸⁵ Final shoulder mobility remained below age related norms of 165.0 degrees flexion (right 135 degrees, left 164 degrees) and 157.9 degrees abduction (right 110 degrees, left 135 degrees) for people 61 to 93 years of age.⁸⁶ Reaching objects on a high shelf requires 148 degrees of flexion and reaching behind the head requires 112

degrees of abduction.⁸⁷ At discharge, the patient was able to complete both of these tasks with the left hand, but required compensatory movements to complete them with the right.

Upper trapezius strength also improved slightly from 4 to 4+ bilaterally. This does not represent a clinically significant change in strength. Although frequently used in the clinical setting to show small changes in strength, the use of pluses and minus signs adds a level of subjectivity and lacks reliability.⁸⁸ Clinically, the patient demonstrated improved strength and endurance in the upper trapezius by tolerating increased resistance and repetitions during shoulder shrugs and shoulder adduction/flexion. These exercises have the highest levels of upper trapezius electromyographic activity following neck dissection for head and neck cancer.⁸⁹

Lymphedema

Lymphedema in the anterior neck and face was visibly reduced at discharge. The Neck Composite Score showed a reduction in the sum of 3 circumferential measurements by 5.4 cm. The vertical circumference of the head decreased by 1.6 cm. However, use of tape measurement to assess head and neck lymphedema is limited by problems establishing consistent and reproducible reference points, lack of validity studies, and small sample sizes.⁹⁰ The M. D. Anderson's head and neck lymphedema rating scale improved from stage 1b (soft pitting edema) to stage 1a (soft visible edema with no pitting). This measure has not been validated and fails to consider the presence of fibrotic changes.⁹¹ Palpation revealed increased tissue density inferomedial to the mandible and chin indicating the development of fibrosis. All of the lymphedema measurements employed in this study fail to assess facial and internal (e.g. tongue, epiglottis, pharynx, larynx) edema.

Following discharge, the patient continued a daily exercise program and employed a personal trainer at his community gym twice weekly. The personal trainer had advanced training on exercise after cancer and the geriatric population. With the patient's permission, the physical therapist and personal trainer discussed the unique needs of this patient prior to initiating the personal training program.

DISCUSSION

This case report presents the complex physical therapy needs of a patient undergoing treatment for head and neck cancer during and after treatment. This patient presented to physical therapy soon after diagnosis and initiation of chemoradiation. This allowed the therapist to take baseline measurements and provide extensive education and a home exercise program to minimize the effects of cancer treatments. The patient returned for reexamination after completing chemoradiation. At this time, multiple physical therapy needs were identified and treatment was initiated. At discharge, the patient reported significant improvements in pain, quality of life, fatigue, cervical mobility, posture, muscle strength and endurance, TMJ depression, shoulder function, and lymphedema.

To date, there are no studies that describe comprehensive physical therapy evaluation and treatment during and after chemoradiation. While numerous studies describe the treatment of shoulder dysfunction or lymphedema, most fail to illustrate the need for multimodal physical therapy and the complex interactions between symptoms. One case study describes the management of a patient with concurrent lymphedema and TMD following mouth cancer, illustrating the importance of posture, soft tissue mobility and cervical mobility on TMJ function and the potential impact of lymphedema on TMJ function.⁹²

It is important to realize that rehabilitation of patients with HNC requires a multidisciplinary head and neck team including physical therapists, speech therapists, dietitians, nurses, dental health professionals and physicians is necessary to maximize quality of life and function following chemoradiation. Each member of the team supports the other's goals. For example, restoration of posture, cervical mobility, oral opening, and soft tissue mobility supports the speech therapist's swallowing goals. Improved hydration and nutrition following consultation with a dietician will support the physical therapist's goals of reducing fatigue and increasing strength. The physical therapist and dentist may cooperate to address TMD. The nurse navigator

identifies treatment gaps, ensures access to care and coordination between the patient and various team members.

This case report has multiple limitations. Thoracic segmental mobility and myofascial mobility in the torso were not addressed. Thoracic posture influences shoulder mobility, cervical function, and temporomandibular joint alignment, potentially resulting in cervical degenerative joint disease, shoulder impingement, subcranial restrictions, headache, and craniomandibular dysfunction.⁹³ Use of a handheld dynamometer would improve reliability of manual muscle testing. Long-term follow-up was not conducted. Survivors of head and neck cancer are known to develop physical therapy-related complications years after chemoradiation. While base-line measurements revealed multiple physical therapy-related deficits during chemoradiation, physical therapy intervention was not initiated until after completion of cancer treatments due to travel distance from patient's home to the physical therapy clinic, numerous medical appointments, and limited Medicare benefits.

The single patient design of the study limits the generalizability of the outcomes to other patients with head and neck cancer. Among this population, physical therapy needs can vary significantly. For example, patients that undergo neck dissection may present with post-surgical scarring, further disruption of the lymphatic pathways, and increased risk of spinal accessory nerve damage. The location of the tumor and subsequent radiation field also affects the structures involved. Chemotherapy may result in peripheral neuropathy and associated balance and gait changes. Chemotherapy can also cause cognitive impairments, limiting a patient's ability to participate in physical therapy.

Further research on the physical therapy outcomes, evaluation, and treatments of patients with head and neck cancer is needed. Larger studies are required to develop an evidence-based treatment approach for patients with head and neck cancer. Further research is also needed to explore the role of physical therapy within the multidisciplinary rehabilitation team to address the complex needs of patients and survivors of head and neck cancer

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