




Inpatient Decongestive Therapy for Lymphedema in Acute Postsurgical Head and Neck Cancer Patients*

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Abstract

Introduction Head and neck lymphedema is an omnipresent morbidity related to head and neck cancer therapies. Studies on therapy for these patients in the acute postsurgical population have not been published to date.

Objective To assess changes in the measurements of lymphedema in surgical head and neck cancer patients during the hospital stay with implementation of modified decongestive therapy (MDT).

Methods Patients aged > 18 years undergoing neck dissection with or without primary-site resection or laryngectomy between 2016 and 2019 were included. Facial measurements were obtained prior to beginning MDT and again prior to discharge. A total facial composite measurement was calculated and used to assess change over time. Rates $\geq 2\%$ of change were considered significant.

Results A total of 38 patients were included (subsites: larynx = 27; thyroid = 4; oral cavity = 3; and neck = 4). The mean number of days between surgery and the start of lymphedema therapy was 3.0 days. The mean number of days between measurements was 5.2 days. Reduction in the total composite score was observed in 37 (97%) patients, and 35 (92%) patients had a total composite reduction score > 2%. Tumor subsite and surgery type did not portend toward greater percent change, except for those patients treated with total laryngectomy, regional flap reconstruction, and neck dissection ($p = 0.02$).

Keywords

- ▶ lymphedema
- ▶ complete decongestive therapy
- ▶ head and neck cancer
- ▶ head and neck surgery
- ▶ manual lymph drainage

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Conclusion Acute postsurgical inpatient MDT was associated with reduced total composite measurements in patients after head and neck surgery. As the first published study on lymphedema therapy in this acute postsurgical period, further prospective case-control studies are warranted to explore further benefits of acute therapy.

Introduction

Head and neck malignancies account for ~3% of all cancers in the United States, with ~66 thousand patients developing head and neck cancer (HNC) each year.¹ Due to improved therapies and an increased number of survivors, more patients are living with the late effects of cancer-related therapies. Head and neck lymphedema (HNL), internal and external, is a common and sometimes debilitating complication of the treatment of HNC.² A large network of lymphatics and approximately one-third of the body's total lymph nodes are located in the head and neck.³ Lymphedema occurs when the lymphatic system is either overloaded or damaged and cannot clear the high protein lymphatic fluid within the interstitial tissues. This in turn causes inflammation, connective-tissue proliferation and overall functional impairment of the lymph system and extremities.^{4,5} It is also believed that the development of fibrosis is the end result of lymphedema due to this inflammatory response.^{6,7} A four-year, prospective, longitudinal study by Ridner et al.⁸ at Vanderbilt University found that more than 90% of HNC patients experienced some form of internal, external, or combined lymphedema, and over half of those patients developed fibrosis.

Although lymphedema is well recognized in patients with urinary, breast and gynecologic cancer, it has more recently become an increased focus in HNC.^{2,9-13} The long-term effects of lymphedema in the craniofacial region are not simply a cosmetic nuisance: they can lead to severe functional and psychosocial issues when affecting the lips, tongue, throat, eyes, mouth, and neck. The ability to communicate, swallow, breathe and see can be greatly impeded by the lymphatic swelling, affecting the quality of life of many patients.¹³⁻¹⁵ Additional deficits related to HNL may extend to dysfunction of the arms and shoulders with reduced cervical range of motion.^{16,17}

The therapeutic management of HNL in HNC patients is a growing topic of research interest, as this condition crosses over multidisciplinary departments, from otolaryngology to speech and language therapy, including occupational therapy, physical therapy, and rehabilitation. Historically, the technique of manual lymph drainage (MLD), a series of gentle circular massage strokes applied to the skin to increase lymphatic flow, has been used.¹⁸⁻²⁰ More recently, Foldi et al.^{4,5} combined the MLD technique with compression bandaging, physical exercises, and a skin-care regimen to create a complete decongestive therapy (CDT), which is now considered the "gold standard" for lymphedema treatment. The HNL program at M.D. Anderson Cancer Center created a series of formal evaluation and treatment techniques which

include patient interviews, visual assessment of the craniofacial, neck and shoulder areas, functional assessments of communication and swallowing, photography, tape measurements, and staging scales of edema to characterize the appearance and severity of the swelling.^{3,13} They compared outpatient lymphedema therapy and self-administered home-based CDT. Across all patients, 60% demonstrated improvement in HNL after therapy. Patients who fully adhered to the protocol were 8.1 times more likely to improve (3.3 times with partial adherence) when compared with non-compliant patients.¹³ More recently, innovative use of near-infrared fluorescence lymphatic imaging before and after therapy with a pneumatic compression device (now available for home use) demonstrated improved lymphatic flow away from damaged lymphatics and improved patient-reported outcomes.²¹ A study by Tacani et al.²² also demonstrated improvements in lymphedema and pain in patients undergoing therapy. It is important to point out that these studies have evaluated lymphedema therapy in the outpatient setting. To date, there have been no studies looking at the efficacy of lymphedema therapy during the acute postoperative inpatient stay.² In this study, we aim to assess change in facial measurements relative to lymphedema in surgical HNC patients with therapy during the inpatient postsurgical admission.

Methods

Institutional Review Board approval (IRB; approval # 9510) was obtained. Patients who underwent the head and neck surgeries listed in **Table 1** between August 2016 and May 2019 were prospectively referred for decongestive therapy and were enrolled in the study. The inclusion criteria were adults 18 years of age and older undergoing neck dissection with or without primary-site resection or laryngectomy. Those with a history of previous chemoradiation therapy or prior head and neck surgery were included. Free-flap patients were excluded unless inclusion was requested by the surgeon; however, those undergoing locoregional flap reconstruction were included. We chose to exclude free-flap patients because there was no consensus amongst the faculty surgeons that performing decongestive techniques on acute postoperative patients may or may not introduce some risk of anastomotic compromise. To avoid introducing bias, these patients were excluded from subgroup analyses but included in the data presentation purely for observational purposes in **Table 2**. Those with a white-blood-cell count greater than 10 thousand (indication of infection), carotid

Table 1 Timing and frequency of treatment sessions

	Mean	Standard deviation (Range)
Days between surgery and initiation of therapy	3.0	± 2.9 (1–14)
Days between measurements – duration of therapy	5.2	4.4 (1–21)
Number of therapy sessions	3.9	1.9 (2–10)

Table 2 Demographic variables with mean composite score change and percentage improvement

Variable	N ^o of patients (%)	Mean measurement change, cm (SD)	Mean % improvement (SD)	> 2% improvement, n (%)	p-value ^a
Mean age: 58 years (SD: ± 14)	38	−7.5 (± 5)	4.7 (± 3.1)	35 (92)	
Previous lymphedema treatment					0.40
Yes	9 (24)	−9.1 (± 6.8)	5.5 (± 3.8)	8/9 (89)	
No	29 (76)	−7.1 (± 4.4)	4.5 (± 2.8)	27/29 (93)	
Previous radiation therapy					0.40
Yes	9 (24)	−9.1 (± 6.8)	5.5 (± 3.8)	8/9 (89)	
No	29 (76)	−7.1 (± 4.4)	4.5 (± 2.8)	27/29 (93)	
Previous chemotherapy					0.15
Yes	5 (13)	−11.2 (± 8.2)	6.6 (± 4.5)	5/5 (100)	
No	33 (87)	−7.0 (± 4.3)	4.5 (± 2.8)	30/33 (91)	
Previous surgery					0.55
Yes	5 (13)	−6.4 (± 2.4)	4.0 (± 1.5)	5/5 (100)	
No	33 (87)	−7.7 (± 5.3)	4.8 (± 3.2)	30/33 (91)	
Preoperative hypothyroidism					0.95
Yes	7 (18)	−7.0 (± 4.4)	4.8 (± 3.2)	6/7 (86)	
No	31 (82)	−7.7 (± 5.2)	4.7 (± 3.1)	29/31 (94)	
Tumor subsite					
Larynx	27 (71)	−8.4 (± 5.4)	5.2 (± 3.2)	25/27 (93)	0.18
Thyroid	4 (11)	−6.4 (± 5.1)	4.7 (± 3.8)	4/4 (100)	0.97
Oral cavity	3 (8)	−5.5 (± 2.2)	3.3 (± 1.3)	3/3 (100)	0.39
Neck	4 (11)	−4.8 (± 3.2)	3.0 (± 2.0)	¾ (75)	0.23
Type of surgery					
Total laryngectomy, no flap	22 (58)	−7.3 (± 4.6)	4.6 (± 2.8)	20/22 (91)	0.69
No neck dissection	2 (5)	−8.0 (± 8.4)	4.8 (± 4.9)	1/2 (50)	
Lateral neck dissection	17 (45)	−7.3 (± 4.6)	4.5 (± 2.8)	16/17 (94)	
With thyroidectomy	12 (32)	−6.7 (± 4.7)	4.2 (± 2.8)	11/12 (92)	
Without thyroidectomy	5 (13)	−8.5 (± 4.5)	5.4 (± 2.9)	5/5 (100)	
Central neck dissection	3 (8)	−7.3 (± 3.8)	4.5 (± 2.4)	3/3 (100)	
With thyroidectomy	1 (3)	−5.1	3.1	1/1 (100)	
Without thyroidectomy	2 (5)	−8.4 (± 4.6)	5.3 (± 2.9)	2/2 (100)	
Total laryngectomy with local flap	5 (13)	−12.5 (± 7.4)	7.6 (± 4.1)	5/5 (100)	0.02
No neck dissection	3 (8)	−14.0 (± 9.2)	8.6 (± 4.6)	3/3 (100)	
Lateral neck dissection with thyroidectomy	2 (5)	−10.2 (± 5.9)	6.3 (± 4.3)	2/2 (100)	
Total thyroidectomy with lateral neck dissection	3 (8)	−7.4 (± 5.8)	5.4 (± 4.3)	3/3 (100)	0.70

(Continued)

Table 2 (Continued)

Variable	N° of patients (%)	Mean measurement change, cm (SD)	Mean % improvement (SD)	> 2% improvement, n (%)	p-value ^a
Partial glossectomy with neck dissection	2 (5)	-5.8 (± 3.0)	3.5 (± 1.7)	2/2 (100)	0.57
Lateral neck dissection alone	4 (11)	-4.75 (± 3.2)	3.0 (± 2.0)	3/4 (75)	0.23
Free flaps	2 (5)	-5.2 (± 0.5)	3.1 (± 0.4)	2/2 (100)	0.43
Composite resection of the floor of the mouth, mandible, neck dissection	1 (3)	-4.8	2.8	1/1 (100)	
Total laryngectomy, lateral neck dissection	1 (3)	-5.5	3.3	1/1 (100)	

Abbreviation: SD, standard deviation.

Note: ^aPaired *t*-test.

stenosis > 50%, or those unwilling or unable to consent were excluded. The potential risks of undergoing therapy, such as pain, hematoma, wound issues, were discussed with the patients before initiation.

Patients received daily lymphedema therapy, which involved manual lymph drainage and skin care, from Monday through Friday, with sessions lasting ~ 30 minutes; compression bandaging was not utilized to avoid placement over fresh surgical wounds. As bandaging was not performed as part of the standard protocol, we termed our technique modified decongestive therapy (MDT). Therapy began on postoperative day one, unless the consult was delayed, at which point the therapy began following the consult. Therapy was continued until the day of discharge. The therapy was performed by three speech and language pathologists (coauthors) who have advanced training in HNL care. The mean number of therapy sessions performed was 4 (standard deviation: [SD]: ± 1.9), and the number of therapy sessions performed ranged from 2 to 10.

Facial measurements using a measuring tape were obtained just prior to beginning the MDT. The measurements were again taken after the MDT, prior to hospital discharge, to assess changes. The method was adapted from the technique developed at the M. D. Anderson Cancer Center.¹³ Six composite facial measurements and one measurement of the facial circumference were taken (► Fig. 1). The left and right hemifacial composite measurements were combined to yield a total composite score which was used to assess changes over time. The present study defined clinically-detectable improvement in HNL as a drop in lymphedema stage or a minimum threshold of 2% of reduction in the composite measurement.¹³ In this light, we defined a 2% difference in the total composite measurement during the acute inpatient stay as a “significant” change in our acute surgical patient population.

Statistical Analysis

The statistical analysis was performed using the Statistical Analysis System (SAS, SAS Institute, Cary, NC, United States) software, version 9.4, to compare outcomes between groups. The *p*-values in ► Table 2 were calculated using a two-tailed *t*-test to analyze the nominal descriptive variables. The percent-

age change was used as our variable of analysis. The *p*-values in ► Table 3 were calculated using a single-factor analysis of variance (ANOVA) to perform a subgroup analysis. The percentage change was used as our primary outcome variable. Values of *p* < 0.05 were considered statistically significant.

Results

A total of 43 patients met inclusion criteria, and 5 patients were excluded for the following reasons: 1 died prior to discharge, 1 left the hospital against medical advice, and 3 lacked pre-discharge measurement. The 38 patients (27 male, 11 female) remaining were analyzed. The median age was 58 years. The mean number of days between surgery and the start of lymphedema therapy was 3 (SD: ± 2.9 days) [► Table 1]. The mean number of days between measurements was 5.2 (SD: ± 4.4 days). The mean number of therapy sessions was 4 (SD ± 1.9 sessions). The demographic information of the analyzed patients is included in ► Table 2. In total, 9 (24%) patients had a history of radiation therapy, 5 of which also had a history of chemotherapy. History of surgery in the region was

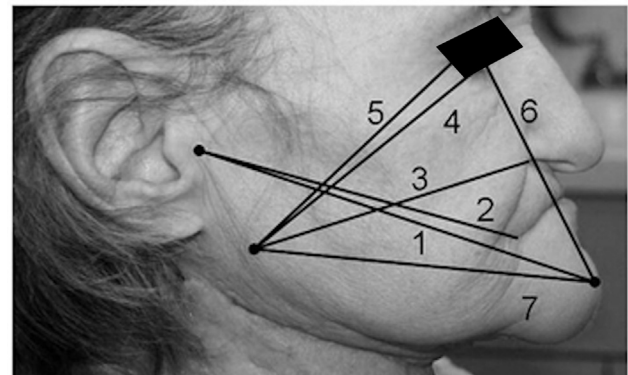


Fig. 1 Diagram of the seven composite facial measurements recorded pre- and posttherapy, described in Smith and Lewis¹³ (2010).^{a,b,c} ^aCircumferential facial measurements (cm): diagonal circumference (around chin to back of head). ^bComposite facial measurements (cm): tragus to mental protuberance, tragus to mouth angle, mandible angle to nasal wing, mandible angle to medial canthus, mandible angle to lateral canthus, chin to medial canthus, mandible angle to mental protuberance. ^cTotal composite score (cm): addition of all composite facial measurements (seven in total).

Table 3 Subgroup analysis of percentage change across groups

Subgroup	p-value ^a
Tumor site	0.48
Larynx	
Thyroid	
Oral cavity	
Neck	
Surgical subgroup	
Total laryngectomy, no flap, all	0.92
Total laryngectomy, no flap, lateral neck dissection	0.44
Total laryngectomy, no flap, central neck dissection	0.65
Total Laryngectomy, local flap, all	0.62

Note: ^aAnalysis of variance (ANOVA).

observed in 5 (13%) patients, and 7 (18%) patients had hypothyroidism. During surgery, the internal jugular vein of two patients undergoing total laryngectomy and bilateral neck dissection had to be sacrificed. Both had significant change in composite scores across the treatment period. Bilateral surgical procedures were performed in 22 (58%) patients.

The data on primary outcomes related to change in the total composite score of the facial measurements and percentage change across the treatment period are detailed in **Table 2**. A subgroup analysis of tumor subsite and surgery type was also performed (**Table 3**). Overall, 37 (97%) patients had a reduction in the total composite score across the treatment period, with a mean decrease of 7.5 cm (average of 4.7%), and 35 (92%) patients had a total composite reduction score greater than 2%, which was defined as clinically significant. Of the patients that did not have significant reduction in the composite score, two underwent total laryngectomy with bilateral neck dissection, and one underwent selective neck dissection.

No statistically significant differences were observed in terms of score reduction between groups treated with prior

radiation therapy, prior chemotherapy, prior surgery, prior lymphedema treatment or preoperative hypothyroidism. Tumor subsite and surgery type did not portend toward greater percentage change, except for the subgroup submitted to total laryngectomy, regional flap reconstruction, and neck dissection ($p = 0.02$). In the subgroup analysis, no individual variables specific to tumor subsite or surgery type showed statistically significant difference in percentage change (**Table 4**). In particular, when patients treated with or without laryngectomy and those treated with or without lateral neck dissection were examined, no statistically significant difference in percentage change was found.

Discussion

Treatment of HNL can improve overall quality of life by decreasing symptom burden and functional impairment.¹⁴ Jeans et al.²³ interviewed HNL patients and found four common themes expressed by them, including: “it feels tight,” “it changes throughout the day,” “it requires daily self-monitoring and management,” and “it affects me in other ways.” Smith et al.³ reported that most of their patients complained of cosmetic concerns, but more than one-third reported functional complaints, including trouble with breathing and swallowing. A more recent study, by Jeans et al.,²³ evaluated both internal and external lymphedema-related morbidity, and noted more severe aspiration and dysphagia, increased diet modification, and long-term sequelae such as enteral tube dependence in those suffering from both internal and external edema.¹⁵ While there has been a significant amount of research regarding lymphedema in other sites, in particular the breast and the extremities, studies in the head and neck population are less prolific.² To our knowledge, all reported HNL data are based on outpatient therapy, presumably due to concerns that therapy may interfere with the healing of surgical wounds and/or lack of trained professionals able to administer therapy in the inpatient setting.³ A 2019 systematic review² of head and neck lymphedema studies noted a paucity of literature and no randomized controlled trials. None of the studies included had been performed in the inpatient or acute postsurgical settings.² While the studies^{2,24} that have

Table 4 Subgroup analysis based on surgery type

Variable	N ^o of patients (%)	Mean measurement change, cm (SD)	p-value ¹	Mean % improvement (SD)	p-value	> 2% improvement, n (%)
Total laryngectomy						
Yes	27 (75)	-8.3 (5.44)	0.23	5.1 (3.2)	0.31	25 (93)
No	9 (25)	-5.9 (3.9)		3.9 (2.8)		8 (89)
Lateral neck dissection						
Yes	29 (81)	-7.6 (5.4)	0.91	4.8 (3.3)	0.86	27 (93)
No	7 (19)	-7.9 (4.2)		5.0 (2.6)		6 (86)

Abbreviation: SD, standard deviation.

been performed show convincing evidence of the benefits of the compliance to an outpatient treatment regimen, we strive to evaluate the efficacy of the treatment in the acute postoperative setting.

The present study aims to assess changes in postsurgical lymphedema in the acute inpatient setting, making it distinct from prior postsurgical outpatient studies. Our findings suggest a reduction in the total composite facial measurements in nearly all (37, 97%), patients and a significant reduction (greater than 2%) in most (35, 92%). Our findings also suggest a comparable reduction in measurements regardless of prior treatment with chemoradiation therapy, prior surgery, or preoperative hypothyroidism, tumor subsite, or surgery type. Our measurement period was based on the postoperative day of consult and the discharge date. Though there was a mean period of three days between the time of the surgery and the date of the consult, the mean length of the MDT was five days, which we believe is adequate to achieve change from the start to the end of the treatment due to the daily treatment regimen. Our findings suggest a significant (> 2%) reduction in measurements across nearly all treated patients regardless of prior treatment or exposure. This is encouraging, as we hope to prove that early intervention in the acute postsurgical period expedites overall edema improvement with treatment compliance. It is important to point out that traditional complete decongestive therapy (combination of MLD, compression taping/bandaging, exercise, and skin care) was not performed in this cohort, but our modified decongestive therapy, which included almost all of the complete decongestive therapy, except bandaging. Bandaging was not performed due to the complexity of our surgical wounds and the need for easy access to exams by nursing staff and care providers. Regardless, we believe our modified technique is safe and appropriate for this acute postsurgical population.

It goes without saying that further case-matched controlled studies comparing those undergoing and not undergoing acute lymphedema therapy are warranted to clarify the contribution of the expected postsurgical edema improvement and lymphedema therapy. Given the lack of a case-matched control group in the present study, it is difficult to discern if the difference in measurements found in patients prior to and after decongestive therapy are due to a decrease in the lymphedema or in the acute edema secondary to surgical trauma. However, the present study provides novel data regarding the progression of postsurgical head and neck edema change with a modified, safe lymphedema program.

During the course of the study, we observed a greater proportion of patients who were open to and dispositioned for outpatient lymphedema therapy, due to the increased confidence in the process through their inpatient experience. We attribute this observation to the sense of improved overall well-being in those undergoing therapy. Anecdotally, we found improvement in lymphedema in our patients to have a demonstrable impact on their self-confidence and mood. Previous studies¹¹ found that patients reported they looked better and shared that their outpatient lymphedema therapy was the treatment that made them feel most well

during their hospitalization. One patient's note stated: "Help me, massage helps reduce headache pain, massage helping with fear... I wanted this massage so bad[ly] today." Outpatient metrics such as those used herein may be further modified for the inpatient population in future studies.

Limitations

The present study has inherent limitations. A case-matched control group undergoing total composite measurements without therapy is absent, and begs the question: "Is the improvement in measurements over the inpatient stay partly due to the normal progression/improvement in postoperative swelling?" The lack of a case-matched control group prevents the conclusion that decongestive therapy rather than a natural reduction in postoperative swelling is responsible for the observed reduction in total composite measurements. A randomized-controlled trial is currently ongoing at our institution to clarify this issue. Other limitations of the study design include the lack of blinding for the parties performing measurements, which may have led to observation and selection biases, as well as inability to properly document possible confounding factors. Further, institutional staffing restricts the ability to consistently perform therapy on weekends, limiting the continuity of care of some patients and possibly masking potential benefits. Depending on the day of the surgery, those patients operated on in the late week could experience treatment delay. Standardization of the treatment protocol to reduce delays is ongoing. Finally, ideally, a patient-reported outcome measure to assess quality of life or pain improvement, for example, through the course of care, would be ideal. This was attempted; however, due to the lack of consistent administration of this measure, the data was not included in the present manuscript. Standardization of the treatment protocol is necessary, given the variability in which postoperative day the patients initiated therapy.

Conclusion

A clinically-significant reduction in the total composite facial measurements of patients submitted to head and neck surgery was observed in those who underwent decongestive lymphedema therapy in the acute inpatient setting. Despite the lack of a control group, we have demonstrated that decongestive therapy is feasible, tolerable, and effective in the immediate postoperative period.

Conflict of Interest

The authors have no conflict of interests to declare.

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