Received: 21 January 2025/ Revised: 30 January 2025/ Accepted: 10 February 2025

CASE REPORT

Journal of Hacettepe University
Physical Therapy and Rehabilitation

Enhanced Recovery of Post-Thyroidectomy Vocal Function Through Electrical Muscle Stimulation: A Physiotherapy Case Report

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ABSTRACT

Purpose: The study aims to evaluate the efficacy of NMES combined with soft tissue mobilization and task-specific vocal exercises in restoring vocal function.

Method: The intervention involved eight weeks of physiotherapy, with NMES applied to stimulate the vocal cord muscles complemented by soft tissue mobilization using olive oil and structured vocal exercises. The Voice Handicap Index (VHI) was utilized to assess the impact of the intervention on the patient's vocal function, physical aspects, and emotional well-being.

Results: The patient's VHI score improved dramatically from 95 (severe impairment) to 7 (minimal impairment) post-treatment. Significant improvements were noted across all VHI domains, highlighting enhanced vocal function and quality of life.

Discussion: This case underscores the critical role of physiotherapy in managing post-thyroidectomy vocal cord paralysis. The synergistic application of NMES and complementary therapies proved effective in restoring vocal function. These findings advocate for the integration of NMES into routine post-operative car.

Key Words: Neuromuscular Electrical Stimulation, Vocal Cord Dysfunction, Post-Thyroidectomy Rehabilitation, Recurrent Laryngeal Nerve Injury, Voice Handicap Index

INTRODUCTION

The thyroid is an essential endocrine gland that plays a primary role in almost all metabolic processes and thyroid disorders such as thyroid cancer or hyperthyroidism are some of the most common endocrine diseases and surgical resection of the thyroid gland (thyroidectomy) may be necessary for the treatment of this disorder (1). Thyroidectomy is a surgical procedure that involves the removal of all parts of the thyroid gland, located in the neck. The surgery can be total (removing the entire gland) or partial, depending on the patient's need (1,2).

Thyroidectomy has potential postoperative complications among which is recurrent laryngeal nerve (RLN) injury (3). The patient's quality of life can be negatively influenced by the incidence of potential complications leading to increase in an individual's health care costs and requiring a lifelong alternative therapy (4).

During thyroidectomy operation, injury to the RLN leads to vocal cord paralysis (5). Vocal cord paralysis is characterized by hoarseness of voice, breathing difficulties, pitch loss, and inability to talk loudly. Post-surgical Physiotherapy focuses on increasing the lung capacities of the patient, as the respiratory centers become depressed after administration of general anesthesia, and the long-term effect after surgery causes an overall weakness of the respiratory system and weakness of the incised muscles.

A systematic review of 27 articles and 25,000 patients revealed that the average incidence rates of temporary and permanent Unilateral Vocal Fold Paralysis after thyroidectomy are 9.8% and 2.3%, respectively (6). In a large multi-institutional study, RLN injury occurred in nearly 6% of thyroid surgeries (4). The incidence of RLN palsy after thyroid surgery is up to 8% for transient palsy and ranges from 0.3% to 3% for permanent palsy (7). Furthermore, a

study reported that unilateral vocal cord paralysis is a complication of total thyroidectomy and in 0.3-3% of thyroid operations, the recurrent laryngeal nerve is permanently injured, and in 3-8% of procedures, there is temporary paralysis (5).

The application of electrical current within a muscle, referred to as Neuromuscular Electrical Stimulation (NMES), will elicit muscle contraction by depolarization of the nerve fibers within the treated region (8). NMES has been studied for enhancing vocal function recovery post-thyroidectomy. Some case studies suggest that NMES combined with voice therapy can improve outcomes in patients with vocal fold issues related to nerve weakness (9).

Furthermore, Vocal cord paralysis often leads to significant voice impairments, necessitating rehabilitation strategies. We assumed that NMES combined with soft tissue mobilization and task specific vocal function exercises may improve vocal function in a patient with vocal cord paralysis post thyroidectomy. Hence, the aim of this case study is to evaluate the efficacy of NMES combined with soft tissue mobilization and task-specific vocal function exercises and to also assess the rehabilitation outcomes for individuals with vocal fold paralysis due to recurrent laryngeal nerve injury. By documenting and addressing these aspects, the study aims to contribute to the growing body of literature supporting innovative rehabilitation strategies for vocal cord paralysis and ultimately aims to provide evidence-based recommendations for post-operative vocal rehabilitation strategies.

METHODS

Case Report

The study is a single case study of a 14 years old female patient who underwent thyroidectomy. A written consent was obtained from the parent of the patient. Before to the surgery, the patient's radiological investigation of plain X-ray revealed an opacity of soft tissue density projected to the anterior neck causing mild compression of the trachea but no calcification was observed within it. A laboratory investigation of thyroid function tests reveals a high TSH (thyroid stimulating hormone) of 48.040 mlU/L with a reference range of 0.380–5.330 mlU/L. Free T3 (Triiodothyronine) was found to be within the normal range 5.00 pmol/L (3.6 – 6.0 pmol/L) and significantly low level of T4 (Thyroxine) which was 2.04 pmol/L (7.2–16.4 pmol/L). The patient was referred for Physiotherapy on account of inability to speak properly after thyroidectomy.

On general observation, the patient was alert and oriented and had endomorphic body somatotype, she was afebrile, acyanosed and not any postural asymmetry.

No abnormality was detected on segmental assessment of both the upper limb and lower limb, thorax, back and abdomen. However on the assessment of the head and neck region, a surgical scar was observed around the neck (figure 1).

On local physical examination of the neck region, there was no loss of muscle function, all muscles were up to power of 5 on Manual Muscle Testing. There was no loss of sensation of both crude touch and deep sensation. The patient was not aphasic but observed to lose her pitched and feminine voice. When talking, she was not audible and seemed to be very fast.

Figure 1. Surgical scar after thyroidectomy

Intervention and Outcomes

The patient was seen for two (2) sessions per week for a period of eight (8) weeks in Physiotherapy department after the surgical wound had been properly healed. The Voice

Handicap Index (VHI) was used to assess the patient's voice description and the effects of her voice on her life before and after treatment (table 1). The VHI has three domains namely Function, Physical and Emotional aspects of patients' voices, the VHI has shown excellent psychometric properties in other patient populations such as stroke and Parkinson's diseases, The psychometric attributes of the VHI demonstrated that the questionnaire is feasible (missing data less than 1%), reliable (Cronbach $\alpha > 0.9$), and valid (71.5% of the total variance is explained by five factors, correlates with voice severity, Parkinson's disease disability, and impairment, and differentiates other subjects from subjects without Parkinson's disease).

Table 1. The VHI scoring (11)

Score	Severity	Common Association
0 – 30	Mild	Minimal amount of handicap
31– 60	Moderate	Often seen in patients with vocal nodules, polyps, or cysts
60– 120	Severe	Often seen in patients with vocal fold paralysis or severe vocal fold scarring.

The portable Comfy Stim is a TENS/NMES machine produced by Medi-Stim, a company specializing in medical devices aimed at pain management and rehabilitation. The machine was used in the treatment of the patient in this study, Synchronous EMS Mode was used, which is ideal for stimulating both vocal cord muscles simultaneously, aiming for improved coordination and tone. The electrode placement is applied at the anterior aspect of the neck near the thyroid cartilage (figure 2).

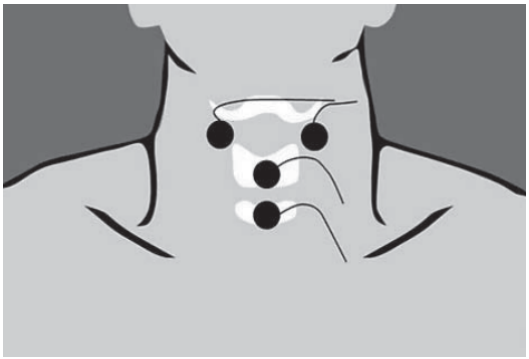

Figure 2. Electrode Placement

The active electrode is placed just above the thyroid cartilage and the reference electrode is placed slightly below the cartilage. Since the goal is to stimulate nerve regeneration, low-frequency EMS is considered, a pulse width of 120 microseconds is used (to target small muscles), and a pulse rate of 20 Hz (to mimic normal muscle activity), contraction, and relaxation time of 5 seconds each, ramp time of 1 second and intensity starts low and gradually increases to a comfortable level as tolerated by the patient (8,9).

An olive oil was used to serve as a medium for gentle soft tissue mobilisation (STM). This was done over the platysma muscles and gentle mobilisation of the vocal cords, this is to improve local circulation and to maintain the physiological features of the muscles and other structures of the neck as well as to subtle the scar formation.

The patient was instructed to be enrolled in an Islamic school (Islamiyyah) which involves a regular recitation of the holy book as was usually done in this setting. The nature of the Islamic schools is that the teacher reads and the students repeat after him as a method of learning the sacred book and other Islamic books, so we incorporated that in our treatment plan to be part of her home program because the Islamic schools run every day of the week except Thursdays and Fridays. The idea of this method was adapted from a study that reported significant improvement following a rehabilitation program combined with vocal therapy exercises in patients with unilateral vocal cord palsy following total thyroidectomy surgery (5).

RESULTS

Based on severity categorization of VHI, the patients have a vocal fold paralysis or severe vocal fold scarring with a score of 95 VHI. Before the commencement of treatment, the function, physical and emotional aspect of her voice, was found to be 34, 29 and 32 respectively. Treatment commences as planned for the period of 8 weeks.

After 8 weeks of treatment, the VHI score was obtained and the score was found to significantly reduce to a VHI score of 7.

The table 2 shows the comparison of VHI scores before and after treatment. It shows that the patient significantly improved with mild voice deficit indicating a minimal handicap based on VHI severity categorization.

Table 2. Comparison of VHI score Pre and Post Treatment

VHI domain	Treatment Score	
	Pre	**Post**
Function	34	5
Physical	29	2
Emotion	32	0
Total	95	**7***

*Significant reduction < 30 on VHI score

DISCUSSION

NMES combined with soft tissue mobilization and task specific vocal exercises improves vocal function in a patient with post thyroidectomy vocal cord paralysis, as evidenced by a reduction in VHI scores and improved phonation as well as overall quality of life of the patient. The case report presents a compelling narrative on the rehabilitation of a 14-year-old female who experienced vocal cord dysfunction following thyroidectomy. The results of the intervention underscore the importance of integrating physiotherapy modalities, including neuromuscular electrical stimulation (NMES), into the treatment plan for vocal fold paralysis.

The Voice Handicap Index (VHI) scores revealed a significant improvement across all domains (function, physical, and emotional) after the eight-week intervention. This aligns with existing literature emphasizing the efficacy of NMES in improving vocal cord function by targeting muscle reactivation and neural regeneration (Jacobson et al., 1997; Formánek et al., 2020). The synchronous stimulation of vocal cord muscles through NMES facilitated coordinated contraction, enhancing voice tone and quality. Notably, the use of low-frequency electrical stimulation (20 Hz) with a pulse width of 120 microseconds closely mimics natural muscle activity, promoting optimal rehabilitation outcomes.

Physiotherapy's holistic approach, encompassing both NMES and soft tissue mobilization, played a critical role in addressing the underlying dysfunction. Gentle mobilization techniques using olive oil, targeted at the platysma and neck structures, likely improved circulation and reduced scar adhesion, supporting muscle pliability and structural integrity. These manual interventions are in line with the principles of scar management and muscle preservation in post-surgical cases, as highlighted in earlier studies (10).

Furthermore, incorporating vocal exercises through recitation in Islamic schools was innovative, leveraging repetitive and structured voice use to reinforce neuromuscular control. This task-specific practice reflects the principles of motor learning, where consistent practice strengthens neuromuscular pathways.

The results of this case demonstrate that physiotherapy interventions, particularly NMES, are not only effective but essential in managing post-thyroidectomy complications such as vocal fold paralysis. The observed transition from a severe to a minimal voice handicap highlights the transformative potential of tailored physiotherapy programs.

CONCLUSION

This case underscores the vital role of physiotherapy in managing vocal cord paralysis following thyroidectomy. Through the synergistic application of NMES, soft tissue mobilization, and task-specific exercises, the patient achieved remarkable improvements in vocal fold paralysis and quality of life post-thyroidectomy. Physiotherapy interventions, with their ability to restore neuromuscular function, represent a cornerstone in the rehabilitation of patients with vocal fold paralysis.

Acknowledgments

Author Contributions: IAA conceived and designed the study, draft the methods, result and discussion part of the manuscript. NHM assisted in refining the study, draft the introductory part of the study and proof read the entire manuscript. SAD assisted in patient rehabilitation and collection of data.

Financial Support: The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

Conflict of Interest: The author(s) state that there are no potential conflicts of interest concerning the research, writing, and/or publication of this article.

Ethical approval: This study was approved by Hacettepe University Faculty of Physical Therapy and Rehabilitation Unit Research Ethics Committee (FTREK 24/40).

How to cite this article: Abubakar IA, Musa NH, Dauda SA. Enhanced Recovery of Post-Thyroidectomy Vocal Function Through Electrical Muscle Stimulation: A Physiotherapy Case Report. Journal of Hacettepe University Physical Therapy and Rehabilitation. 2025;3(3),140-144.

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