

Effects of exercise on swallowing and tongue strength in patients with oral and oropharyngeal cancer treated with primary radiotherapy with or without chemotherapy

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Abstract. Tongue strength is reduced in patients treated with chemoradiotherapy for oral/oropharyngeal cancer. Tongue strengthening protocols have resulted in improved lingual strength and swallowing in healthy individuals, as well as in patients following a neurological event. However, no studies have examined the efficacy of tongue strengthening exercises on tongue strength, swallowing, and quality of life (QOL; Head and Neck Cancer Inventory) in patients treated with chemoradiotherapy. A randomized clinical trial examined the effects of a tongue strengthening programme paired with traditional exercises vs. traditional exercises alone. Dependent variables included tongue strength, swallowing, and QOL in a group of patients with oral and oropharyngeal cancer treated with primary radiotherapy with or without chemotherapy. Differences with regard to tongue strength and oropharyngeal swallow efficiency (OPSE) were not observed within or between groups. QOL in the eating and speech domains improved following treatment in both groups. However, the experimental group demonstrated greater impairment in QOL in the social disruption domain following treatment, whereas the control group demonstrated a slight improvement in functioning. Tongue strengthening did not yield a statistically significant improvement in either tongue strength or swallowing measures in this patient cohort. Patient compliance and treatment timing may be factors underlying these outcomes.

Key words: tongue strength; exercise; swallowing; chemoradiation; quality of life.

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In order to preserve function, high-dose radiotherapy with or without chemotherapy (CXRT) has been utilized as the primary treatment for tumours of the head and neck in selected cases, and particularly for oropharyngeal tumours. Cure rates are comparable to those reported for surgical resection.¹⁻³ However, swallowing impairment occurs frequently as a sequela of treatment, primarily affecting the oral and pharyngeal phases of swallowing.⁴⁻⁶ In patients treated with primary CXRT for oral and oropharyngeal cancer, oral phase deficits include prolonged oral transit times and persistent oral residue.⁴⁻⁶ Pharyngeal phase dysphagia has also been documented in this population, including reduced tongue base posterior motion as well as reduced hyolaryngeal elevation and closure.⁴⁻⁸ Impaired oral and pharyngeal phase are significantly correlated with oral intake in this population.⁹ Within the oral phase, lingual strength is significantly impaired both before and after CXRT when compared to healthy subjects, with no significant change in strength after oncologic treatment.^{6,7} Tongue strength is correlated with the ability to eat and with transit time, bolus clearance, and swallow efficiency.^{6,7} In addition to swallow impairment, radiotherapy can result in altered taste and sensation, mucositis, oral pain, xerostomia, trismus, and fatigue affecting oral intake.¹⁰⁻¹² This cluster of symptoms can lead to weight loss and malnutrition in addition to altered quality of life (QOL).¹³ Patients exhibit reduced well-being and social isolation due to the inability to eat.^{14,15}

Muscle strengthening programmes have been shown to improve lingual strength in healthy populations, including both the young and the elderly.^{16,17} These programmes have also yielded improved swallow functioning in healthy individuals, as well as in neurologically impaired populations.^{17,18} Few studies have examined the effects of tongue strength on swallow function in patients with head and neck malignancy treated with primary chemoradiotherapy.¹⁹⁻²¹ Furthermore, few studies have examined the effects of swallow therapy programmes that include swallow manoeuvres targeting other structures in addition to tongue strengthening exercises.¹⁹⁻²¹ Two of these studies examined patients with a variety of head and neck tumour sites.^{19,20} Although exercise was found to slightly improve swallow physiology, no difference in the rate of aspiration and percutaneous endoscopic gastrostomy (PEG) removal was found when compared to a no-exercise arm.¹⁹

Improved QOL was found after prophylactic exercise programmes during CXRT, with improved global functioning noted as compared to a no-exercise arm.²⁰ Tongue exercise was found to improve lingual strength in six patients who underwent primary chemoradiotherapy.²² A randomized clinical trial found lingual exercise to have no effect on lingual strength but improvement in QOL in a group of nasopharyngeal cancer patients treated with CXRT.²¹

The current study sought to address these gaps in the literature regarding the use of tongue strength exercise protocols (with or without traditional exercise) in patients with head and neck cancer treated with chemoradiotherapy. Specifically, we sought to (1) determine if an isometric tongue strengthening exercise programme with traditional therapy is more effective than traditional therapy alone with regard to tongue strength and oropharyngeal swallow function in patients with newly-diagnosed oral and oropharyngeal cancer who have undergone radiotherapy ± chemotherapy, and (2) examine the comparative effects of the two therapies on QOL as measured by the Head and Neck Cancer Inventory (HNCI)²³ at baseline and 6 weeks post-exercise. We hypothesized that patients receiving tongue strengthening exercises with traditional therapy would present with improved tongue strength, oropharyngeal swallow functioning, and QOL compared to controls. We also hypothesized that increased tongue strength would correlate with oropharyngeal swallow function. Finally, we hypothesized that the tongue strengthening protocol combined with traditional therapy would result in improved QOL relative to patients receiving traditional therapy alone.

Patients and methods

Subjects

Patients with newly diagnosed American Joint Committee on Cancer²⁴ stage II to stage IV oral and oropharyngeal cancer who underwent radiotherapy ± chemotherapy were recruited across multiple sites for the current study. Patients with planned neck dissection post-radiotherapy were included in this study. Institutional review board approval was obtained at all participating sites. Patient eligibility criteria included: age 21–79 years and no prior head and neck cancer, preexisting swallowing disorder, or neurologic history that might adversely affect cognition, tongue function, or swallowing. Patients with and without dysphagia

were included. Patients with a history of cervical spine surgery or other neurosurgical procedures that might affect swallowing were excluded. After providing informed consent, patients were randomized to one of two groups: (1) traditional exercise group (control group), or (2) tongue exercise group with traditional exercise (experimental group). Randomization was performed using a computer-generated randomization table.

Therapy protocols

Both groups underwent 6 weeks of exercise starting 1 month post-radiotherapy ± chemotherapy, including either: (1) traditional therapy (i.e., range of motion exercises; control group), or (2) tongue strengthening exercises with traditional therapy (experimental group). The control group underwent 6 weeks of tongue and laryngeal range of motion exercises (i.e., Mendelsohn maneuver).²⁵ These exercises were designed to maintain flexibility of the oral and pharyngeal structures for improved swallow function. Although the Mendelsohn manoeuvre has been found to improve coordination and timing of pharyngeal structural movement, it was considered a laryngeal excursion exercise in this study. The experimental group underwent 6 weeks of traditional exercises plus an isometric lingual resistance exercise programme utilizing active resistance in all directions (i.e., protrusion, lateralization, elevation) with the tongue against a tongue depressor.¹⁶ Both groups underwent tongue strength and swallow assessments and QOL questionnaires at 4 weeks post-chemoradiotherapy (baseline) and at 10 weeks post-radiotherapy.

The nutritional and/or hydration intake method (i.e., oral, gastrostomy, jejunostomy, nasogastric tube, intravenous hydration) and specific oral diet type were documented at each evaluation.

Tongue strength testing

Tongue strength was assessed by a speech pathologist via the Iowa Oral Performance Instrument (IOPI), an instrument designed to quantify oral tongue pressures.²⁶ Maximum tongue strength (P_{max}) was measured in kilopascals (kPa). Subjects were seated with the tongue pressure bulb positioned behind the central incisors, or behind the alveolar ridge in edentulous patients. Subjects were instructed to press up on the bulb with the tongue and squeeze the bulb against the roof of the mouth as hard as possible for 2 s. Three trials of maximum pressure were performed, with

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