

## Research Article

## Orofacial myofunctional Therapy in Head and Neck Cancer Patients with Limited Mouth Opening

Viviane de CARVALHO<sup>1</sup>, MSc, PhD, Sandra Regina DIONIZIO<sup>2</sup>, José Francisco de GÓIS FILHO<sup>3</sup> – MSc, PhD

<sup>1</sup>Speech-language pathologist, Department of Speech Language, Cancer Institute Arnaldo Vieira de Carvalho, São Paulo, Brazil.

<sup>2</sup>Speech-language pathologist, Postgraduate student of Cancer Institute Arnaldo Vieira de Carvalho, São Paulo, Brazil.

<sup>3</sup>Chief of Department of Head and Neck, Cancer Institute Arnaldo Vieira de Carvalho, São Paulo, Brazil.

\*Corresponding author: Dr. Viviane de Carvalho, 1089, Padre Dehon, ZIP CODE: 81630-090, Curitiba – Brazil,

E-mail: vivicarvalhofono@yahoo.com.br

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## Abstract

There are different types of treatment for head and neck cancer, including: surgery, chemotherapy and radiotherapy. Their use alone or combined can lead to sequelae in the temporomandibular joint, resulting in limited mouth opening. However, there are few studies have been published that evaluated exercise therapy in oncology related trismus, and no standard of care exists. The objective of this study was to verify the influence of a 7-week structured orofacial myofunctional exercise program on increasing the mouth opening in head and neck cancer patients with trismus. The sample consisted of 17 patients aged between 45 and 77 years, 15 men and 2 women with mouth opening less than 40 mm. Postoperative radiotherapy was performed as an adjuvant treatment in all patients in the sample, with the median dose 65Gy. After 7 weeks, the initial mouth opening average went from 25.37 mm to 33.76 mm, demonstrating that these exercises contributed to the treatment of temporomandibular disorders and stomatognathic functions in this group of head and neck cancer patients.

**Keywords:** Trismus; Head and Neck Cancer; Exercise Therapy

## Introduction

The trismus is defined as a tonic contraction of the masticatory muscles leading to reduction in vertical mouth opening below 20 to 40 mm [1]. This variability in the cut-off point is due to lack of uniformity in the literature regarding the criteria for the diagnosis of trismus [2].

Between 2 and 68 % of patients with head and neck cancer have a limitation in mouth opening [2-3]. Smaller percentages (2-5%) are found at diagnosis, especially in patients with nasopharyngeal tumors and oral cavity and oropharynx due to tumor extension into the area of the temporomandibular joint (TMJ) and masticatory muscles. However, the increased

prevalence of trismus is observed after cancer treatment: surgery and/or radiotherapy and/or chemotherapy [2-3]. Surgical treatment may involve the manipulation of masticatory structures and may cause fibrosis or scar contracture. Mouth opening after radiotherapy decreases on average by approximately 20% compared to mouth opening prior to radiotherapy. The prevalence of trismus increases with increasing doses of radiotherapy to mastication structures [4-5]. Radiotherapy may in turn compromise the locoregional blood vasculature leading to atrophy of the masseter and pterygoid muscles. It can also lead to muscle fibrosis, probably induced by abnormal increase of fibroblast proliferation [3-6]. There may be scar tissue from radiation or surgery,

nerve damage, or a combination of these factors that can lead to mandibular hypomobility that will result in both muscle and temporomandibular joint degeneration [3,7-9].

Trismus interferes with oral hygiene, speech, mastication, swallowing and nutritional intake contributing to weight loss, difficulties in examination of the oropharynx and obtaining adequate dental treatment [3,6]. The limited mouth opening severely impairs health-related quality of life and negatively affects daily life activities in patients with head and neck cancer [10].

Treatment of reduced mouth opening requires the participation of an interdisciplinary team. Currently, different therapies have been used with increasing mouth opening such as transcutaneous electrical nerve stimulation; electromyography, acupuncture, laser therapy, muscle relaxants, some tools such as rubber plugs, wooden tongue blades, Therabite exercisers, dynamic bite openers and physical exercises [2,3,6].

Nevertheless, there are few researches assessing the effect of orofacial myofunctional therapy (OMT) in reducing the trismus. Dijkstra et al [11] showed that after exercise therapy the increase in mouth opening was significantly less in the group of patients with trismus related to head and neck cancer as compared to the increase in mouth opening in the group with trismus not related to cancer. The authors concluded that trismus related to head and neck cancer is difficult to treat with exercise therapy. Grandy et al [12] observed statistically no significant differences when it was compared two groups of exercise to increase mouth opening or when they were compared with control group. However the authors indicated that the exercises were not supervised and therefore were not controlled by the examiner. On the other hand, other article [13] showed that physical mouth opening exercises should be executed early after maxillectomy for the prevention and treatment of trismus. In this study, 22 patients with maxillary oncology began their mouth opening exercises at an early stage (1-2 weeks) after maxillectomy. Eleven patients chose Therabites as their instruments of mouth opening exercises, and the other 11 chose stacked tongue depressors to help their exercises. There were statistical increases in the final the maximal interincisor distances compared with the initial ones and no significant differences were achieved between groups.

However there is still a lacuna in literature on the influence of orofacial myofunctional therapy in the improvement of mouth opening of head and neck cancer patients.

Therefore, the objective of this study was to verify the influence of a 7-week structured orofacial myofunctional exercise program on increasing the mouth opening in head and neck cancer patients with trismus.

## Material and Methods

From March to October 2004, 21 consecutive patients with head and neck cancer with mouth opening less than 40 mm referred to The Speech Language Department at a large tertiary care cancer center for evaluation and treatment of trismus were included in this prospective study. However four patients were excluded for recurrent tumor or locomotion difficulties.

Thus the study series consisted of 17 patients, 15 male (88.2%) and two females (11.76%), aged between 45 and 77 (median 59 years).

All the patients were submitted to oral cavity and/or oropharyngeal primary surgical treatment. Furthermore, larynx resection occurred in three cases, two partial and one total. Tumors were classified as T4 or T3 (Table 1).

Postoperative radiotherapy was performed as an adjuvant treatment in all patients in the sample, with the median dose 65Gy. No patients underwent chemotherapy.

The study was approved by the institutional ethical review board and performed in accordance with the Declaration of Helsinki. All participants gave their informed consent to participate in the study.

The therapeutic program consisted of a 7-week structured exercise program which was conducted after an average of 1-2 weeks after radiotherapy.

In the first session an anamnesis and clinical evaluation were conducted, which included the measurement of mouth opening, measured by the digital caliper, (STARRET mode) with centesimal scale. For patients dentulous mouth opening was measured between the upper teeth and lower central incisors. In the case of edentulous patients the measurement was carried out between the upper and lower alveolar ridge or higher alveolar ridge and anterior mouth floor.

From the 1st to the 8th session of OMT, all patients were evaluated weekly by a speech language pathologist. The exercises were introduced gradually throughout the sessions (annex 1). Each of them was previously taught and practiced at orofacial myofunctional therapy session and then directed to be done at home four times a day.

OMT exercises were proposed based on the literature [6,11,14-16]. The main objectives of this therapeutic proposal were to encourage and enable the execution of mandible movements and masticatory muscles, preventing the formation of restrictive scar tissue and promoting oxygenation, mobility, coordination and mass increase; encourage perform mandibular exercises such as: opening and closing movements, protrusion, retraction and lateral movements; increase the opening of the mouth

through specific maneuvers of stretching and levers; functional rehabilitation as to the speech, chewing and swallowing.

In all sessions, patients were asked about the increase or decrease in relation to the mouth opening and stomatognathic functions. The patients' adherence to treatment was evaluated by attending the 7 sessions and the number of exercises performed daily. In addition to collecting this information were measured vertical mouth opening at the beginning and end of session always by the same evaluator. In this analysis were used only the information concerning the final measurements performed between 1st and 8th sessions.

The database was built using Epi-Info 20009 and statistical analysis was performed using STATA version - 817.

## Results

This group of patients consecutively attended all sessions. After 7 weeks of OMT program the initial mouth opening average went from 25.37 mm to 33.76 mm (Table 1). Statistical analysis demonstrated that this difference (average 8.5 mm (95 % CI: 5.72 to 11.37) was significant (t test = 6.40 (16 g.l.)  $p < 0,001$ ).

All patients reported increased comfort for speaking and swallowing. Thirteen patients had reduction muscle rigidity, eleven in masticatory muscle pain and nine patients in facial edema.

## Discussion

Trismus is a common problem after treatment of head and neck cancer, especially after radiotherapy [17-18].

In this study it was observed a less than 15 mm mouth opening measure in 4 patients; between 15 and 26 mm in 5 patients; between 26 and 40 mm in 7 patients. All patients reported some impairment of chewing, swallowing and speaking due to restricted mouth opening. Several studies reported that trismus directly affecting many aspects of daily life, such as chewing, swallowing, speaking and maintaining oral hygiene [5-9,19].

The period of 7 weeks of OMT was established based on the average treatment sessions found in the literature to observe an increase in mouth opening [9,11-12] as well as appear to be a reasonable time to keep the patient's adherence to the proposed program.

However, patients that remained with reduction in mouth opening after seven sessions continued in OMT.

In this study all patients began therapy to increase mouth opening after radiotherapy. The literature recommends that as soon as radiation therapy begins, patients at risk of trismus need daily exercises, such as properly instructed stretching, to maintain maximum opening and jaw mobility [8-9].

There are few published studies concerning its treatment, and no standard of care exists. This study was proposed to establish a therapeutic program of 7 weeks to provide increased mouth opening of patients being treated for head and neck cancer. Specific programming involving maneuvers and manipulations in the orofacial and cervical region seeking to respect the limitations of each patient was developed. Each exercise (annex 1) had a specific goal.

Thermotherapy (warm, moist compresses) provides increase in the superficial blood circulation and increasing cellular metabolism, is indicated for myalgia. Already the cold compresses (cryotherapy) provide vascular vasoconstriction; analgesic action as a result of decrease in the speed of propagation of noxious stimuli and increased peripheral circulation [13].

The cervical and scapular regions were worked during the therapeutic process due to restriction of movement generated by surgery and radiotherapy. Exercises were proposed as lifting, lowering and rotation of shoulders; hyperextension and hyperflexion of the neck. Massage, stretching and manipulation in the cervical muscles such as sternocleidomastoid and trapezius sought to promote muscle oxygenation and reducing metabolic products, leading the organization, even partial, of muscle groups [14].

Massages in the masseter and temporalis muscle bilaterally firmly and contrary to the direction of contraction of the fibers aims to increase oxygenation and greater elongation of these muscles, favoring an increase in mouth opening [20].

The tongue is an important support structure and guidance in achieving the mandibular movement's due to the inclusion of its extrinsic muscles. Protrusion and elevation of the tongue out of the mouth were carried out to stimulate mandibular opening. Also, the lowering of the tongue out of the mouth intensifies the opening mouth. Tongue lateralization, outside or inside the mouth stimulates the movement of mandibular lateral and rotation stimulates the sequential movements<sup>14</sup>.

The myotherapy aims to increase the muscle tonus and mobility of orofacial organs through isotonic (with motion and activity in range of motion, providing maximum mobility of the remaining structures), isometric (without movement and acting resistance in muscle tone) and isokinetic exercises (with resistance and performance in tone and range of force)[11-16,20]. The isotonic exercises used in this article were lips popping, suction cheeks, mouth opening and closing sequentially, repetition of bilabials syllables with vowels /a/, /i/, /u/ with maximum mouth opening. These exercises as well as increasing the mobility of the masticatory muscles also increase mouth opening. Especially the vocal exercises and suction cheeks, provide increased mouth opening indirectly, dodging the patient of his pain when performing unconsciously such a move.

**Table 1.** Characteristics of the patients included in the study according to age, gender, type of surgery and mouth opening measurements in first and last of eight orofacial myofunctional therapy sessions.

PATIENTS (N)	GENDER	AGE (years)	SURGERY TYPE	Mouth opening measurement 1 <sup>st</sup> session	Mouth opening measurement 8 <sup>th</sup> session
1	M	45	TG	28	43.2
2	M	45	TG+M	31	52.1
3	M	45	TG+M	33.1	50.3
4	M	48	TG	33.8	41.9
5	M	53	PG + Floor of Mouth + M	14.1	19.2
6	M	55	PG + Floor of Mouth + M	9.7	19
7	M	55	TOTAL PALATECTOMY	20	30
8	M	57	RETROMOLAR RESSECTION	38.1	51.6
9	M	57	TG+HSL	25.5	31
10	M	62	MAXILLECTOMY	20.9	31.4
11	M	64	MAXILLECTOMY	9.0	11.4
12	M	67	TL+PG	38.3	45.6
13	F	67	MAXILLECTOMY+M	29.2	31.6
14	M	68	TG	13.8	19.3
15	M	70	PG + Floor of Mouth	24.6	29.0
16	F	73	MAXILLECTOMY	19	22.2
17	M	77	TG+TL	39.8	44.6
<b>MÉAN</b>		59.2		25.2 mm	33.7 mm

Legend: TG = Total glossectomy, PG = Partial glossectomy, M = mandibulectomy, HSL = Horizontal supraglottic laryngectomy,, TL = Total laryngectomy.

The isometric exercises used were sustained mouth opening, use of wooden tongue blades, being gradually increased according to the evolution of the mouth opening of the patient. These exercises increase the stretch and tonus the muscles of mastication. The isokinetic exercises performed in this study were: mouth opening and closing exercises with resistance; mandibular laterality exercises, with resistance and mandibular protrusion and retraction with counter-resistance. Lateral pterygoid is one of the muscles responsible for opening mouth.

This muscle was worked through the exercises protrusion and mouth opening counter-resistance.

In this study we observed a statistically significant average increase of 8.5 mm in opening the mouth of the patient after 7 weeks of orofacial myofunctional exercises. However, some studies in the literature have shown absence or slight improvement exercise therapy [11,12-24].

Grandy et al [12] evaluated the amplitude of mouth opening in patients before and immediately after the completion of radiotherapy, comparing the effectiveness of two physiotherapy exercises and observed statistically not significant differences between two groups of exercise and control group.

**Annex 1** – Orofacial myofunctional therapy program.

1 <sup>st</sup> Session	<p>Anamnesis  Clinical evaluation  Measurement of mouth opening  Thermotherapy (moist heat) on the ATM and masseter muscle for 10 minutes in the morning and in the evening  Cryotherapy quick touches with ice cube wrapped in a towel for 3 minutes in the afternoon.</p>
2 <sup>nd</sup> session	<p>Thermotherapy (moist heat) on the ATM and masseter muscle for 10 minutes in the morning and in the evening;  Masseter muscle massage: perform firmly massage at the masseter muscle from top to bottom 3 sets of 10 repetitions.  Cervical relaxation: Move the head up and down and side to side; each one 10 times  Suction cheeks for 5 seconds – 10 times  To open mouth maximum that to obtain, to count 3 seconds with open mouth and to close - to make 3 sets of 10 repetitions.</p>
3 <sup>a</sup> session	<p>Thermotherapy (moist heat) on the ATM and masseter muscle for 5 minutes in the morning and 20 minutes in the evening;  Cervical relaxation: Internal and external shoulders rotation; each one 10 times  Masseter muscle massage: perform firmly circle massage at the masseter muscle from top to bottom 3 sets of 10 repetitions.  Lips popping - 3 sets of 10 repetitions.  To open mouth maximum that to obtain, to count 3 seconds with open mouth and to close - to make 3 sets of 10 repetitions  Tongue popping (except patients underwent to total glossectomy) 3 sets of 10 repetitions  Mouth opening counter-resistance – 3 sets of 10 repetitions</p>
4 <sup>a</sup> session	<p>Thermotherapy (moist heat) on the ATM and masseter muscle for 5 minutes in the morning and 20 minutes in the evening;  Cervical relaxation: Internal and external shoulders rotation; each one 10 times  Masseter muscle massage: perform firmly circle massage at the masseter muscle from top to bottom 3 sets of 10 repetitions.  Temporal muscle massage: perform firmly circle massage at the masseter muscle from bottom to top 3 sets of 10 repetitions.  To open mouth maximum that to obtain, to count 3 seconds with open mouth and to close - to make 3 sets of 10 repetitions  Oral closing counter-resistance, to count 5 seconds and release; to make 3 times.  Stacked wooden spatulas for 1 minute – to make 3 times</p>

5 <sup>th</sup> session	<p>Thermotherapy (moist heat) on the ATM and masseter muscle for 5 minutes in the morning and 20 minutes in the evening;</p> <p>Cervical relaxation: slow clockwise and anti-clockwise head rotation; each one 10 times</p> <p>Masseter muscle massage: perform firmly circle massage at the masseter muscle from top to bottom 3 sets of 10 repetitions.</p> <p>Temporal muscle massage: perform firmly circle massage at the masseter muscle from bottom to top 3 sets of 10 repetitions.</p> <p>To open mouth maximum that to obtain, to count 3 seconds with open mouth and to close - to make 3 sets of 10 repetitions</p> <p>Speak the vowels / i / and / u / with exaggerated lip movements - 10 times</p> <p>Onward chin, to count 5 seconds in this position and to come back toward the normal position - to make this 3 times.</p> <p>Stacked wooden spatulas for 1 minute - 3 times</p>
6 <sup>th</sup> ses- sion	<p>Thermotherapy (moist heat) on the ATM and masseter muscle for 5 minutes in the morning and 20 minutes in the evening;</p> <p>Cervical relaxation slow clockwise and anti-clockwise head rotation; each one 10 times;</p> <p>Masseter muscle massage: perform firmly circle massage at the masseter muscle from top to bottom 3 sets of 10 repetitions.</p> <p>Temporal muscle massage: perform firmly circle massage at the masseter muscle from bottom to top 3 sets of 10 repetitions.</p> <p>To open mouth maximum that to obtain, to count 3 seconds with open mouth and to close - to make 3 sets of 10 repetitions</p> <p>Repeat quickly / ba / with exaggerated lip movements in 10 seconds</p> <p>Mouth opening counter- resistance, to count 5 seconds and release; to make 3 times.</p> <p>Stacked wooden spatulas for 1 minute - 3 times</p>
7 <sup>a</sup> session	<p>Thermotherapy (moist heat) on the ATM and masseter muscle for 5 minutes in the morning and 20 minutes in the evening;</p> <p>Cervical relaxation:</p> <p>Temporal muscle massage: perform firmly circle massage at the masseter muscle from bottom to top 3 sets of 10 repetitions.</p> <p>To open mouth maximum that to obtain, to count 3 seconds with open mouth and to close - to make 3 sets of 10 repetitions</p> <p>Repeat quickly /pa / with exaggerated lip movements in 10 seconds</p> <p>Onward chin counter- resistance, to count 5 seconds in this position and to come back toward the normal position - to make this 3 times.</p> <p>Stacked wooden spatulas for 1 minute - 3 times</p>
8 <sup>a</sup> session	<p>Clinical revaluation</p> <p>Measurement of mouth opening</p> <p>Maintenance of mouth opening exercises if necessary</p>

However there was a trend suggesting that trismus was mainly present in the control group, the group that had no physiotherapy exercises. In this group there was a mean reduction of mouth opening of 4.94 mm and exercises groups 1 and 2 were 3,80 and 1,38 respectively. A tendency was seen, which was not of statistical significance, to suggest that patients in this last group presented with a lower mean rate of diminished mouth opening as compared to the group 1 and control group. It is possible that these results could be different with larger samples. Furthermore these exercises were not supervised and therefore were not controlled by the examiner.

One of the first articles carried out in this area was conducted by Buchbinder et al [21], who performed a randomised trial in patients who had undergone radiotherapy for cancer of the head and neck. Three groups of patients were evaluated and compared: 1) unassisted exercise, 2) mechanically assisted mandibular mobilization with stacked tongue depressors combined with unassisted exercise, and 3) the Therabite System combined with unassisted exercise. The initial average maximum incisal opening (MIO) for the study population was 21.6 mm, and did not vary significantly among the groups. These authors showed that standard stretching exercises with or without the use of tongue depressors, and exercises with the passive jaw moving device Therabite, did increase mouth opening significantly, although net increase in MIO of group 3 (13.6 mm) was significantly greater than group 1 (6.0 mm) and group 2 (4.4 mm). The improvement in mouth opening of group 2 was lower than found in our study.

A recent systematic review [22] compare the effect of exercise therapy versus no exercise therapy on jaw mobility, expressed in millimeters mouth opening, in head neck cancer patients with radiotherapy-induced trismus. Three of the four selected articles showed a significant increase in maximal interincisal opening (MIO) after exercise therapy using a jaw-mobilizing device. Recent studies [23-25] have also demonstrated superior results in increasing mouth opening using jaw devices, such as, Dynasplint system®, Therabite® and Engström jaw, when compared to mandibular exercises, with improvements varying from 5.4 to 7,2mm. However, these values were similar to findings in this study.

Pauli et al [15] investigated the impact of structured exercise with jaw mobilizing devices on trismus and its effect on trismus symptomatology and health-related quality of life in head and neck cancer patients. The program consisted of three steps: 1) warm up movements consisting of jaw opening 10 times without using the jaw device; 2) passive stretching, with the jaw mobilizing device, 30 seconds (if possible), repeated five times; 3) five repetitions of active exercise (bite towards resistance). The patients in the intervention group were randomized into two exercise groups; one using the Therabite® and one using the Engström jaw mobilizing device. A control

group of patients with trismus and head neck cancer were matched. There was a difference significantly on mean MIO improvement between the intervention group (6.4 mm) and control group (0.7 mm), three months post-intervention. However, in this study is also not possible to know how much the myofunctional exercises without the use of jaw devices influenced the improvement of mouth opening.

Therefore, although the literature has shown the best results in reducing trismus using jaw devices, in the light of present knowledge-day, exercises therapy can bring benefits in the mouth opening even if to a lesser extent. Furthermore, OMT can improve oral functions, such as speech, swallowing and chewing, and help to reduce edema and facial pain.

In our study, all the patients reported improvements in mastication, swallowing and speech, as well as presented a reduction in complaints about muscle rigidity, both facial edema and pain.

At least, two main limitations study can be found. This article is a non-randomized controlled trial. In this study, the follow-up time in this study was limited to know outcome maintenance and possible deterioration of improvements over time.

## Conclusions

This study demonstrated that orofacial myofunctional therapy contributed toward the treatment of temporomandibular dysfunctions in these head and neck cancer patients, improving both mouth opening capacity and stomatognathic functions.

## Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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