ORIGINAL

Early and Long-Term Effects of Physiotherapy for Trismus in Patients Treated for Oral and Oropharyngeal Cancer

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Abstract

Objective: Study aim was to analyze early and late effects of physical therapy in the mouth opening of patients with trismus after treatment for oral and oropharyngeal cancer. **Methods:** This was an ambispective cohort study, including 29 patients with oral and oropharyngeal squamous cell carcinomas treated by surgery and/or adjuvant radiotherapy. Physical therapy including an active range of motion exercises, manual stretching and CRAC (contract-relax, antagonist-contract) technique were applied. Information about tumor, cancer treatment, physical therapy and mouth opening was obtained from the medical or physical therapy records. Assessment of mouth opening was performed at three moments: pre-physical therapy, at the end of the last session of treatment (early results) and when patients were invited for a new functional evaluation (long-term results). **Results:** Mouth opening increased significantly in both early and long-term evaluations ($p < 0.001$). The initial mouth opening measurements (23.2mm) were significantly smaller than the post-physical therapy (33.9 mm) and long-term measurements (38.1 mm) ($p < 0.001$). Effect size was 1.0 and 1.4, related to early and late results, respectively. Surgically treated patients seem to have a better long-term response than those treated with adjuvant radiotherapy ($p = 0.053$). **Conclusions:** Mouth opening increased significantly after physical therapy in patients with trismus, and these results were sustained after therapy had been concluded. There seems to be a larger increase in mouth opening in patients treated exclusively by surgery than in patients treated with adjuvant radiotherapy.

Keywords: head and neck neoplasms, physical therapy (specialty) oropharyngeal neoplasms, trismus.

INTRODUCTION

Trismus, i.e. restricted mouth opening, is a frequent problem of head and neck cancer patients, occurring in 2% of head and neck cancer patients due to tumor growth and can be induced by surgical treatment or radiotherapy in approximately 8% of patients[1]. The incidence of trismus can vary from 5 to 38%[2] and one of the reasons for this variation is the lack of uniform criteria for diagnosis, visual assessment of trismus and retrospective study design[3-4]. There is controversy regarding the mouth opening values considered normal, consequently, trismus has also been variously defined[3,5]. In a recent cross-sectional study, Dijkstra et al.[3] determined a cut-off point for trismus in head and neck oncology of 35mm, based on the extent of the restrictions in mouth opening and mandibular function perceived by the patients. Recently Jager-Wittenaar et al.[6] reported that maximal mouth opening can be assessed reliably in head and neck cancer patients, regardless of the observer.

Trismus resulting from tumor invasion is observed when mouth closing muscles or the temporomandibular joint are involved, or may be due to reflex muscle spasms. Radiotherapy is also considered one of the factors frequently related to the development of trismus due to fibrosis and reduction in the range of movement. Moreover, radiation can affect the bone structures (mandible) due to alterations in the blood vessels, leading to infections and osteoradionecrosis[4,7-12]. Resections of oral or oropharyngeal tumors can also cause trismus, particularly those surgeries that induce scar contraction in mouth closing muscles. Postsurgical trauma can lead to hematoma, abscess and weakening of the lateral pterigoid, digastric, mylohyoid, geniohyiod and infrahyiod muscles[1,8,13-15].

Restricted mouth opening may impede biting, chewing, speech, laughing, yawning, oral hygiene and may have an impact in quality of life[11-12]. However, limi-

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ted evidence exists as to how trismus, due to head and neck cancer or its treatment, can most effectively be prevented or treated[4]. Treatment modalities include surgery, pharmacotherapy (analgesics and muscle relaxants) and physical therapy. These modalities can be used alone or in any combination[5,8,13,14,16-17]. Several manual, mechanical and electrotherapy resources have been described for treating trismus. The most popular include isometric exercises, therapy using a tongue depressor and mechanical devices for stretching, in addition to the use of hot and cold compresses[7,8-9,18-23].

There are only four studies evaluating the effectiveness of physical therapy in ameliorating mouth opening in patients with trismus and most of them describe the comparative analysis of different techniques. In a randomized clinical study involving treated patients with head and neck cancer, Buchbinder et al.[18] reported that the use of TheraBite®, a device composed of an upper and lower tray that is inserted into the mouth between the teeth. The trays are manually opened by squeezing two short handles together, and this increased mouth opening significantly more than was achieved by exercises with wooden tongue blades or manual stretching. A similar study involving patients treated for oropharyngeal cancer demonstrated better mouth opening in the course of treatment, using the TheraBite® apparatus[20]. However, trismus resulting from head and neck cancer is more difficult to treat with exercise therapy (active range of motion exercises, hold-relax techniques, manual stretching and joint distraction) than trismus associated with other etiologies.[16] Shulman et al.[22] showed a significant benefit for irradiated patients using the biomechanical device DTS (Dynasplint® Trismus System). No studies evaluating long-term results of physical therapy were found in the literature.

Given the lack of conclusive data concerning the role of physical therapy in the treatment of trismus resulting from head and neck cancer, the aim of the present study was to analyze early and late effects of physical therapy in mouth opening of patients treated for oral and oropharyngeal cancer with trismus.

PATIENTS AND METHODS

Patients were curatively treated for oral and oropharyngeal cancer either by surgery or by surgery and adjuvant radiotherapy at the Department of Head and Neck Surgery of Hospital A.C. Camargo, between 1997 and 2000. Files were retrieved of patients who had been referred to the Department of Physical Therapy due to symptoms of trismus, irrespective of the treatment modality. Patients submitted to more than one surgery and those with recurrence were excluded. All participants gave their written informed consent. The study was approved by the Internal Ethics Committee.

Information obtained from the medical records was type and site of tumor, along with type and date of end of cancer treatment. Physical therapy files of the patients identified were also retrieved. The following data were collected from the files: interval between cancer treatment and start of the physical therapy, number of sessions and mouth opening before and after physical therapy.

Assessments of mouth opening were performed by one observer, at three moments: pre-physical therapy, at the end of the last session of treatment (post-physical therapy: early results), and in 2006 (long-term results) when patients were invited for a new functional evaluation. Maximal mouth opening was measured using a Mitutoyo digital pachymeter. In cases of complete frontal dentition, the maximal inter-incisal distance (11-41) was measured. In patients with an edentulous mandible and not wearing dentures, the distance between the incisal edge of 11 and the alveolar ridge of the mandible (location 41) was measured. In patients with an edentulous maxilla and not wearing dentures, the distance between the incisal edge of 41 and the alveolar ridge (location 11) was measured. In edentulous patients wearing dentures, the distance between the upper and lower dentures was measured, or if the patient did not wear dentures, the maximal distance between the two alveolar ridges (location 11-41) was measured. Criterion for trismus was defined as 35mm[3].

Patients underwent physical therapy procedures, which included active range of motion exercises, manual stretching and the CRAC (Contract-Relax, Antagonist--Contract) technique, which promotes stretching of the restricted muscles and increases mobility and joint amplitude[4,19]. After evaluation, all patients received written instructions with general guidance and description of exercises. Depending on the severity of trismus, health status and understanding of the exercises, patients were seen weekly, biweekly or monthly. In general, physical therapy stopped when a functionally acceptable mouth opening was reached or there was no further improvement in mouth opening.

DATA ANALYSIS

Statistical analysis included descriptive measures for quantitative variables and relative frequencies of the categorical variables. To compare the means of mouth opening at the three distinct evaluations, we used the ANOVA for repeated measures, followed by the Tukey HSD test for multiple comparisons. Effect sizes (mean change/ SD pre--treatment) were calculated to enable comparison of the results with those of previous studies. For all the statistical tests, an error of alpha=5% was used; i.e., the results were considered statistically significant when $p < 0.05$. The statistical tests were performed using the SPSS 15.0 and Statistic 5.0 software programs.

RESULTS

Initially, 58 patients complaining of restricted mouth opening had been referred to the Physical Therapy Department and were submitted to the prescribed therapy. Among these, 26 died and 32 were initially selected to participate in the study; however, 1 was unable to communicate and 2 missed follow-up. Thus, 29 patients treated for squamous cell carcinoma of oral cavity or oropharynx were included in the study. Patient´s characteristics, data on the tumor and cancer treatment are summarized in Table 1. Among patients submitted to radiotherapy (n = 22), the dosage varied from 4460 to 7240 cGy (median 6040 cGy). Dental status did not change during physical therapy treatment.

Table 1. Descriptive statistics of the population.

Patient, tumor and treatment characteristics	N (%)
Age, mean (SD)	51.5(11.7)
Gender	
male	17 (58.6)
female	12 (41.4)
Trismus	
yes	25 (86.2)
no	4(13.8)
Tumor site	
oral cavity	21 (72.4)
oropharynx	8 (27.6)
Tumor size	
T1	2 (6.7)
T2	9 (31.1)
T3	8(27.6)
T4	5 (17.3)
Tx	5 (17.3)
Cancer treatment	
surgery	7 (24.1)
surgery + adjuvant radiotherapy	22 (75.9)
Interval between end of the treatment and start physical therapy in months. Mean (IQR)	400.72 (38-272)
Interval between end of the treatment and long-term evaluation in months. Mean (IQR)	3.201.03 (2.577-3 406)
Number of sessions. Mean (IQR)	7.93 (3-11)

Mouth opening before and after physical therapy, as well as at the long-term evaluation, is presented in Figure 1. The initial mouth opening measurements (23.2 mm) were significantly smaller than the post-physical therapy (33.9 mm) and long-term measurements (38.1 mm) ($p < 0.001$), although no statistically significant difference was found between the post-physical therapy and long-term measurements ($p = 0.149$). Effect size was 1.0 and 1.4, related to early and late results, respectively. No statistically significant association was found between mouth opening improvement and the time of referral to physical therapy or number of sessions ($p > 0.999$ and $p = 0.265$, respectively).

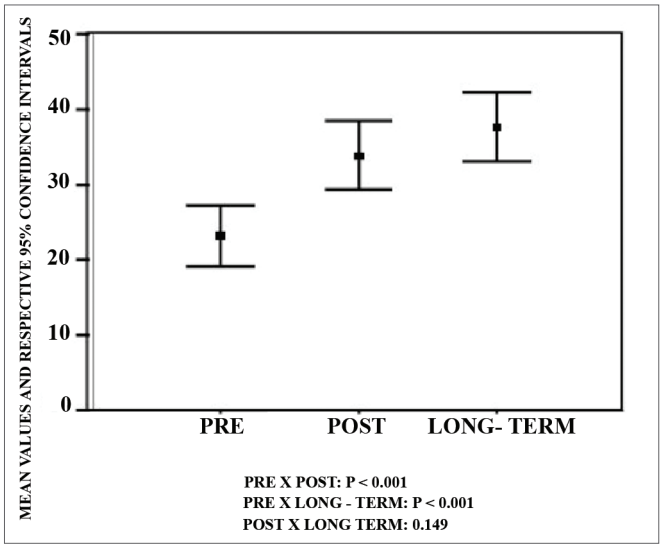


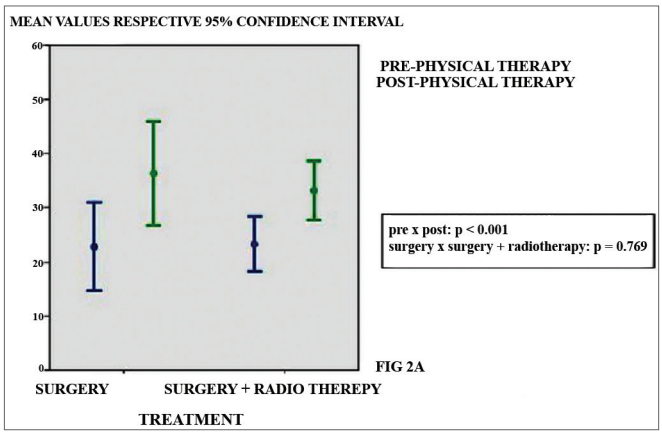
Figure 1. Graphic representation of the improvement in mouth opening (mm) at three distinct moments: pre-physical therapy, post-physical therapy and long-term values.

Before physical therapy, 4 patients (13.8%) presented normal mouth opening. In early evaluation and late evaluation, 16 (55.2%) and 21 (72.4%) patients showed normal mouth opening, respectively. The four patients with normal mouth opening were included because they had complaints before therapy. After rehabilitation, all of them showed improvement both in symptoms and in the values of mouth opening.

Mouth opening increased significantly for patients treated exclusively by surgery or with adjuvant radiotherapy in both early and late evaluations ($p < 0.001$), as shown in Figure 2. Surgically treated patients seem to have a better long-term response than those treated with adjuvant radiotherapy ($p = 0.053$). Early and long-term changes in mouth opening and effect sizes in both groups of treatment are shown in Table 2.

DISCUSSION

Resection of oral and oropharyngeal carcinomas includes extirpation of important structures with possible trauma to the temporomandibular joint, and/or radiation therapy with fibrosis of the masticatory muscles and scar contracture. The risk of these sequelae appears to be higher in patients treated by surgery followed by adjuvant radiotherapy, which includes 75.9% of the patients in this



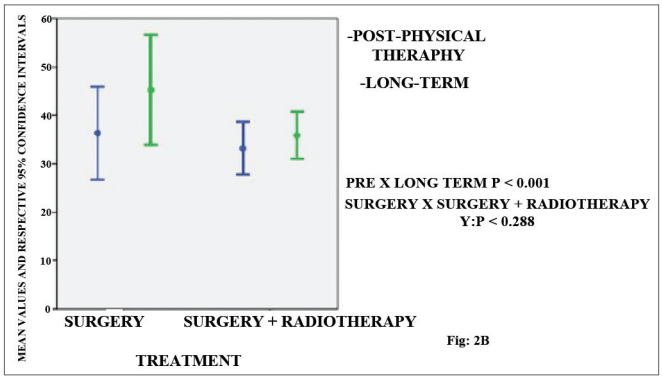


Figure 2 (A-B). Graphic representation of the improvement in mouth opening (mm) at pre-, post-physical and long-term evaluation, in patients treated by surgery and patients treated by surgery and adjuvant radiotherapy. (A) pre- and post-physical therapy (early results); (B) post-physical therapy (early results) and long term.

Table 2. Early and long-term increase in mouth opening of patients treated by surgery and patients treated by surgery and adjuvant radiotherapy.

	Surgery (n=7)	Surgery and radiation (n=22)	*p* value
Increase in mouth opening: mean (SD)			
early	13.4 (5.1)	9.8 (10.2)	0.769
late	22.4 (11.0)	12.5 (11.3)	0.053
Effect size			
early	1.53	0.08	
late	2.56	1.10	

study. The incidence of trismus in the oral and oropharyngeal cancer population is not precisely known, but it is probably one of the highest, since patients have multiple risk factors for trismus, including extensive tumor resection involving multiple anatomic subsites, midline mandibulotomy, radiation therapy and sometimes reconstruction.[12] Almost half of our patients had advanced tumors, which implies more extensive surgeries and need for reconstruction and adjuvant radiotherapy.

In this study, mouth opening increased significantly after physical therapy, in both early and long-term evaluations. Mouth opening in the early post-physical therapy evaluation and in the late evaluation was significantly higher than in the pre-evaluation, an increase of 14.9 mm. Only four studies evaluated the effect of physical therapy on oncology related trismus, and two of these 18,20 analyzed TheraBite®. This apparatus increased mouth opening to 13.6 mm in 9 patients submitted to head and neck dissection and/or reconstruction combined with radiation therapy, 5 years preceding the trial. The values of these results were significantly higher than those obtained with exercises using wooden tongue blades (6.0 mm) applied in 7 patients or manual stretching in 5 patients (4.4 mm) 18. No follow-up data were presented in this study and the sample sizes of the groups were too small. Another study analyzed the effectiveness of a TheraBite® apparatus in 7 patients who were treated for an oropharyngeal squamous cell carcinoma immediately after surgery20. The mean increase in mouth opening after follow-up from 12 to 48 weeks was 9.7 mm. The third study16 showed an increase of 2.8 and 5.8 mm in 6 and 21 head and neck cancer patients with or without recurrence, respectively. Finally, the fourth study42 showed a mean change of 13.6 mm in 20 patients recently diagnosed with trismus following radiation therapy, using DTS®. Neither of the studies presented the T stage of cancer. In two cohort studies, other interventions related to head and neck cancer were evaluated: microcurrent electrotherapy (10 treatments in 5 days) and pentoxifylline (8 weeks, 400 mg 3 times daily), with mean increase of 2.6 and 4.0 mm[24-25].

Compared with the results of five of the six above-mentioned studies, the effect sizes of the present study were lower than those calculated from the results of the studies of Buchbinder et al.18 (2.6 for TheraBite®, 1.5 for tongue blade and 1.1 for forced opening) and Cohen et al.20 (1.8), but better than Lennox et al.24 and Chua et al.25 (both 0.3). Dijkstra et al.16 found effect sizes of 0.74 with traditional techniques, being 0.46 for patients with recurrence (n=6) and 0.72 without recurrence (n=21). Although the effect size of the present study seems to be worse than previous studies, the effect size relates the mean change as a result of the exposure to the variance within the population before the exposure. A large effect size indicates that the mean change is large relative to the variance before the exposure. Our mouth opening values before physical therapy were greatly heterogeneous (4-41mm) and if we look to the mean change in mouth opening (10.8 mm for early evaluation and 15 mm for late evaluation) we see that the results are comparable or even better than previous studies. Besides that, in the previously mentioned studies, it is not clear whether the increase in mouth opening was sustained after therapy was concluded. Our study is the first to show maintenance/improvement of the results.

The importance of the use of mouth opening gain techniques is well known, but the studies seem to indicate the advantage of using the TheraBite® System for head and neck cancer patients. In a developing country, such devices are too expensive and consequently, they are not available to most of the patients. Moreover, these were the reasons why we needed to study the efficacy of traditional techniques and we chose to study CRAC and massage as the therapeutic approach. Although TheraBite® allows patients to control the opening force, so that they have more treatment control, less anxiety and increased compliance, the selected techniques of the current study are simple, low-cost and self-applied, also favoring their performance at home as an exercise program. We found that an important aspect of rehabilitation was the application of hand-assisted stretching forces, and the use of wooden tongue blades for mechanical stretching may also have contributed to the results. The patient stacks a series of depressors and inserts one end between the teeth. Additional depressors are then pushed in, forcing the mandible to open more widely.

Because most of these patients had undergone surgery and/or radiation therapy many days before their referral for physical therapy, their rehabilitation posed a significant challenge. Rose et al.[23] recently observed that simple jaw exercises can be a useful aid to help prevent side effects of trismus due to radiotherapy treatment. Besides that, our study corroborate our clinical practice showing that even patients referred late to physical therapy can have good effects of treatment.

Although the number of sessions was not homogeneous among patients, resulting in an eventual bias, the fact that mouth opening showed immediate results with the use of the proposed technique favored patient adherence to practicing exercises at home. This could also have contributed to patients keeping up with the exercises according to the physical therapy guidance provided, even after the treatment program ended, which may explain the maintenance of improvement shown by the long-term results.

The patients who had exclusively undergone surgical treatment apparently demonstrated better mouth opening results, when evaluated in the long term, confirming the well-known effect of radiation fibrosis caused by radiotherapy[7-12].

The results of this study indicate that mouth opening increases significantly after physical therapy in patients with trismus, and these results were sustained after therapy had been concluded. The increase in mouth opening seems to be greater in patients treated exclusively by surgery than in patients treated with adjuvant radiotherapy.

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