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ORIGINAL ARTICLE

The prevalence and symptoms of temporomandibular disorders in head and neck cancer patients

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ABSTRACT

Objectives: This retrospective patient survey aimed to assess the prevalence of temporomandibular disorders (TMD) before and after curative oncological treatment and to identify possible risk factors.

Materials and Methods: Patients with squamous cell carcinoma in the tonsil or base of the tongue were included ($n = 217$). Medical records were collected to assess TMD prevalence before oncological treatment and at 6- and 12-month follow-up. Fisher's test and Pitman's test were used.

Results: Significantly reduced mouth opening was observed after oncological treatment at 6- and 12-month follow-up ($p < .001$). Symptoms from the temporomandibular joint and jaw muscles plus pain upon palpation ($p = .0083$, $p < .001$, respectively) and self-reported pain upon chewing (<0.001) and opening the mouth (<0.001) increased 12 months following radiotherapy. Pain and degree of mouth opening prior to treatment, self-reported depression, overall health status, brachytherapy and jaw exercise during radiotherapy were factors affecting the increase of TMD symptoms.

Conclusion: All TMD symptoms escalated significantly one year after radiotherapy except self-reported sounds from the temporomandibular joint. Reduction in the degree of mouth opening and pain in the jaw muscles and the temporomandibular joint when opening the mouth and upon chewing were commonly reported symptoms following radiotherapy. Several potential risk factors were identified.

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Introduction

Temporomandibular disorder (TMD) is a term describing musculoskeletal conditions of the face, jaw and temporal regions. TMD is frequently associated with pain and/or dysfunction such as impaired jaw function, pain in the temporomandibular joint (TMJ), muscles and/or related structures, and associated headaches. The aetiology of TMD is multifactorial and complex [1,2]. It is known from recent studies that the influence of psychosocial factors such as personality as well as behaviour and environment are important for the development of TMD [3]. In addition, there is a known association between a presence of psychosomatic symptoms and prevalence of TMD [2,4]. TMD symptoms tend to be more often reported in patients with psychosomatic symptoms, whereas somatic symptoms have been strongly associated with TMD onset, and perceived stress and previous life events also predicted TMD incidence [3].

Several studies have shown that the prevalence of TMD in the general population is high and is estimated to be 40–60% although only about 10% of the population have such severe symptoms that they seek professional help [5–7]. A fear of moving the mandible due to pain can result in a prolonged inactivity, which subsequently can lead to muscle weakness and stiffness in the joints and possibly further increases the pain [8]. Occlusal factors [9], oral parafunctions [9–11] and lifestyle factors [12] are also known risk factors influencing the development of TMD symptoms.

It is known that one cause of TMD symptom development is treatment for head and neck cancer (HNC) [13]. The main treatment modalities for HNC include radiotherapy (RT) with or without chemotherapy and surgical intervention, either as a single therapy or a combination therapy [14,15]. In the head and neck region, the anatomical structures are necessary for essential functions such as speech, swallowing, breathing, smell, and taste. The treatment of head and neck tumours may frequently impair some of these functions, which may result in pain, oral dysfunction, and impaired health-related quality of life [16,17].

Trismus, that is, restricted mouth opening, is one of the most common symptoms related to TMD and often appears as a result of RT to the head and neck region [18]. It has also

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been shown that the radiation dose to the masticatory muscles and the temporomandibular joint (TMJ) can predict the development of trismus [19,20]. Previous studies have also demonstrated that trismus can deteriorate years after radiotherapy and can be persistent [21,22]. A recent study reported that signs of tenderness of the masseter muscle as well as patient-reported problems such as stiffness of the jaw and pain upon movement increased at 6 months following RT [13].

Hence, tumours in this region as well as the consequences of their treatment can impair functions of the masticatory system severely. There is little known about the effects of RT in HNC patients and the development of TMD diagnoses such as trismus, myalgia and arthralgia. Information about risk- or influencing factors for TMD development in HNC patients is sparse in the literature. It could be that the psychosomatic factors are more relevant in this patient group and should be further evaluated.

Aim

The primary aim of the present study was to retrospectively determine the prevalence of TMD symptoms among patients diagnosed with squamous cell carcinoma in the tonsil and/or the base of the tongue, before and after oncological treatment. In addition, this study aimed to identify possible influencing factors contributing to changes in TMD symptoms.

Materials and methods

Subjects

Patient records of all available patients diagnosed with squamous cell carcinoma in the tonsil and the base of the tongue and who were referred to the Department of Oral and Maxillofacial Surgery, Public Dental Health Service, and Sahlgrenska University Hospital, Gothenburg, during a ten year-period (2009–2018) were included in this retrospective cohort study. A total of 380 patients journals were reviewed and 217 patients who were treated in the department and received curative RT targeting the head and neck region were included in the analysis. The inclusion criteria were available records of measurements of mouth opening and/or questions asked about other signs and symptoms of TMD such as self-reported pain in the jaw muscles and/or the TMJ before initiation of RT. Adjuvant RT with or without chemotherapy was an inclusion criterion; only surgical treatment led to automatic exclusion from the study.

Assessments and study protocol

Available recorded measurements or signs of pain and dysfunction in the temporomandibular region were gathered to assess prevalence before treatment and at 6- and/or 12-month follow-up. Measurements (in mm) of maximal incisal opening (MIO), which is the maximal distance between the edges of the incisors of the mandible and the maxilla, were made with a ruler when the patients were sitting in an upright position. Measurements were performed before oncological treatment and at 6- and 12-month follow-up. At all visits, patients were asked if they had any symptoms from the masticatory system and to explain any symptoms of pain and/or other disorders. If any TMD symptoms were reported, the dentist performed a palpation of the area (TMJ or the masticatory muscles) to confirm pain. Possible self-reported symptoms included pain upon chewing in the masticatory system, pain in the masticatory system when opening the mouth, pain in the TMJ, and pain in the jaw muscles. Information about the patient's general health status, smoking and alcohol habits was also gathered and assessed in this study. Additionally, information regarding whether jaw exercises were recommended was documented and assessed as a possible contributing factor.

Oncological treatment

A majority of the patients in the present study ($n = 178$, 82%) received external RT, generally administered once or twice daily, 5 days a week, in 2 Gy fractions to a total of 68 Gy. The remaining patients received RT administrated with 3 Gy per day, 5 days a week for 4 weeks, to a total of 60 Gy.

A majority of the patients ($n = 213$, 98%) received chemotherapy. Chemotherapy was generally given as induction therapy with two courses of treatment with cisplatin–flouruoracil before the start of RT, or concomitant cisplatin administered weekly throughout RT. The remaining patients ($n = 4$, 2%) received only RT.

When applicable, brachytherapy was given after completed external beam RT according to local guidelines. Brachytherapy was administered to 19.8% ($n = 43$) of the patients in total, generally to patients with tumours in either the tonsil or the base of the tongue. The dosage of the local boost varied between 10-25 Gy. Additionally, 8% ($n = 17$) of the patients underwent surgery.

Jaw exercise

A total of 127 patients (59%) showed a decrease of MIO after oncological treatment. A majority ($n = 114$, 90%) received jaw-exercise by a mechanical jaw trainer. The remaining patients ($n = 12$, 10%) were given jaw-stretching exercises. Jaw exercises was assessed as a possible influencing factor in regards of development of TMD-symptoms.

Statistical analysis

For descriptive purposes, categorical variables were reported as number and percentage, and continuous variables as mean and standard deviation (SD). Fisher's test for paired comparison was used to test for changes in symptoms before and after treatment. Pitman's test was used to test associations between baseline variables and differences in symptoms before and after treatment. All tests were two-tailed and conducted at a 5% significance level. The data were processed in SPSS version 27.

Ethics

The study outline was approved by the Swedish Ethical Review Authority (2020-01831).

Results

A total of 217 patients with HNC met the inclusion criteria. Patient demographics such as age, social status, gender, tumour classification, tumour location, World Health Organization's (WHO) International Classification of Functioning, Disability and Health (ICF) [23], American Society of Anaesthesiology (ASA) Physical Status Classification System [24], and oncological treatment, are presented in Table 1.

Changes in signs and symptoms of TMD before and after treatment

The most frequently reported clinical sign was a reduction in mouth opening, measured as MIO. The self-reported symptoms included pain upon chewing and/or mouth opening. These findings, observed before and after oncological treatment, are summarised in Tables 2 and 3. The MIO decreased significantly after oncological treatment both at the 6- and 12-month follow-up when compared to the pre-treatment values ($p < .001$). The prevalence of self-reported symptoms in the TMJ and clinical pain upon palpation of the TMJ increased from 1% before oncological treatment to 4.6% at 12-month follow-up ($p = .0083$). The prevalence of self-reported symptoms of the masticatory muscles and clinical pain upon palpation increased from 5% to 21% before oncological treatment and at the 12-month follow-up, respectively ($p < .001$). Both self-reported pain upon chewing and pain when opening the mouth changed from 2% and 1%, respectively, before oncological treatment, to 9% and 8%, respectively, at the 12-month follow-up ($p < .001$). The prevalence of self-reported sounds from the TMJ did not increase at follow-up and was the only self-reported symptom whose frequency remained unchanged before and after oncological treatment.

Risk factors

The possible influencing or risk factors that were evaluated in this study are presented in Table 1.

Deterioration of the MIO

Higher ASA classification, that is, worse general health, led to a significantly larger reduction of the MIO ($p = .034$). A greater MIO before oncological treatment resulted in a larger reduction of the MIO ($p < .001$) at 12-month follow-up post-RT. Patients who were given any kind of jaw exercise to perform in order to maintain a stable degree of MIO showed a greater decrease of the MIO at 12-month post-RT.

Table 1. Characteristics of patients included in the study.

	Mean (SD)
Age (years)	61.6 (9.2)
	n (%)
Male	160 (74)
Female	57 (26)
Married/cohabitant	152 (70)
Smoking status	
Non-smoker	92 (42)
Current smoker	88 (41)
Former smoker	37 (17)
WHO classification	
0 (no impairment)	170 (78)
1 (mild impairment)	29 (13)
2 (moderate impairment)	16 (7)
3 (big impairment)	2 (1)
ASA classification	
1 (A healthy person)	113 (52)
2 (Mild systemic disease)	89 (41)
2 (Severe systemic disease)	14 (6.5)
3 (Severe systemic disease that is a constant threat to life)	1 (0.5)
Tumour localisation	
Base of tongue	72 (33)
Tonsil	145 (67)
T classification	
1	36 (17)
2	104 (48)
3	39 (18)
4	38 (17)
N classification	
0	52 (24)
1	29 (13)
2	123 (57)
3	12 (5.6)
4	1 (0.4)
M classification	
0	216 (99)
1	1 (1)
Oncological treatment	
RT without chemotherapy	4 (2)
RT with chemotherapy	200 (90)
RT with chemotherapy, surgery	13 (8)
Brachytherapy	43 (19.8)
Dental status^{+}	
Molars	169 (78)
$\leq$5 teeth in total	39 (18)
Adentolous	6 (3)
Missing data	3 (1)
Parodontitis^{+}	
Healthy gum or gingivitis	116 (54)
Local parodontitis	61 (28)
General parodontitis	37 (17)
Missing	3 (1)
General diseases	
Diabetes (any type)	20 (9)
Vascular disease	86 (40)
Alcohol addiction	8 (4)
Rheumatic disease	6 (3)
Other physical pain	13 (6)
Kidney or liver disease	9 (4)
Thyroid disease	5 (2)
Lung disease	11 (5)
Self-reported depression	18 (8)
Jaw exercise given after oncological treatment	127 (59)
Deceased within 2 years following completion of oncological treatment	18 (8)

Self-reported pain in the TMJ and pain upon palpation of the TMJ

Patients who reported pain in the masticatory system upon chewing prior to oncological treatment had a significantly higher degree of pain in the TMJ and experienced more pain upon palpation of the TMJ ($p < .001$) at 12-month post-RT,

Table 2. Maximal incisal opening before oncological treatment and at 6- and 12-month follow-up.

	Before treatment Mean (SD) $n = 172$	6 months following oncological treatment Mean (SD) $n = 172$	12 months following oncological treatment Mean (SD) $n = 172$	Change over time (from before to 6; 12 months) p value
Maximal incisal opening	47.3 (8.5)	39.9 (9.5)	41.3 (8.7)	<.001; <.001

Table 3. Clinical signs and self-reported symptoms of temporomandibular disorders before oncological treatment and at 12 months following oncological treatment.

	Before treatment n (%)	12 months following oncological treatment n (%)	Change over time p value
Symptom from the temporomandibular joint plus pain upon palpation	2 (0.9)	10 (4.6)	.0083
Symptom from the jaw muscles plus pain upon palpation	12 (5.5)	46 (21.2)	<.001
Self-reported pain upon chewing	4 (1.8)	20 (9.2)	<.001
Self-reported pain when opening mouth	3 (1.4)	17 (7.8)	<.001
Self-reported sound from the temporomandibular joint	2 (0.9)	2 (0.9)	.053

than those who did not. The patients who did not receive any kind of jaw exercise to perform had a significantly higher reporting of pain in the area of the TMJ as well as pain upon palpation ($p = .019$).

Self-reported pain of the jaw muscles plus pain upon palpation of the muscles

The patients who reported symptoms of pain in the jaw muscles and experienced pain upon palpation of the jaw muscles before treatment were the same individuals who had a significantly higher reporting of pain in the jaw muscles and clinical pain upon palpation at 12-month post-RT ($p = .022$). The younger the patients, the higher the frequency of self-reported pain of the jaw muscles and pain upon palpation ($p = .040$) at one-year post-RT. The patients who did not receive any jaw exercises had a higher self-reported pain of the jaw muscle and pain upon palpation ($p < .001$) one-year post-RT.

Self-reported pain upon chewing

Three factors significantly affected the degree of self-reported pain upon chewing after oncological treatment. Self-reported pain upon chewing before RT displayed the strongest effect ($p < .001$), followed by patient-reported crepitation and/or clicking of the TMJ before RT ($p = .016$) and brachytherapy ($p = .030$). This implies that patients who reported these symptoms prior to RT or received brachytherapy, had a higher degree of self-reported pain upon chewing post-treatment.

Self-reported pain when opening mouth

Patients with self-reported depression before treatment showed a strong significance ($p < .0085$) with self-reported pain during mouth opening at one-year follow-up, followed by patients who did not receive any kind of jaw exercise to perform ($p < .001$).

Discussion

The aim of this study was primarily to retrospectively present the prevalence and symptoms of TMD among patients diagnosed with squamous cell carcinoma in the tonsil and/or the base of tongue, before and after oncological treatment. In addition, the study aimed to identify possible influencing factors contributing to TMD.

The main findings were that all signs and symptoms of TMD measured in this study, except for self-reported sound from the TMJ, deteriorated significantly at 1-year post-treatment. The results also indicated that pain in the temporomandibular region before treatment, overall health status, and treatment modalities such as brachytherapy may be of importance regarding the experience of TMD symptoms.

Clinical findings and changes in TMD signs and symptoms before and after treatment

Both objective (clinical findings) and subjective (self-reported) symptoms increased at 1-year after RT. Common self-reported symptoms included pain when opening the mouth, pain upon chewing, pain of the jaw muscles and pain in the TMJ. Clinical findings were reduced mouth opening and pain upon palpation of both the chewing muscles as well as the TMJ. All patients in this study were treated with RT and their masticatory system were exposed to ionising radiation. Subsequently, this resulted in a statistically significant decrease of the mouth opening both at the 6- and 12-month follow-up visits post-RT. This is in line with other studies that have shown an incidence of trismus (MIO < 35 mm) of approximately one-third of patients undergoing RT [18,20].

It is known from previous studies that RT affects the masticatory system. Pain in the jaw muscles, stiffness and pain upon jaw movement, and a decreased mouth opening have been previously reported [19]. This is verified in the present study through a high prevalence of self-perceived pain in the masticatory system and pain upon jaw movement after RT in comparison to before oncological treatment.

This retrospective study on TMD in HNC patients found an incidence of signs and symptoms of TMD in between 1% and 5% before oncologic treatment, i.e. significantly lower compared to the general population [5–7]. It is possible that the patients in this cohort were affected by the fact that they were examined at baseline soon after receiving a malignant disease diagnosis, which could have affected the reporting of the TMD symptoms. The patients' focus on the malignant diagnosis could be a cause of the somewhat low incidence of the signs and symptoms of TMD in this cohort. It is also known from previous studies that women report TMD signs and symptoms more frequently than men [9]. Females have also been related to an increased risk of developing and maintaining myofascial pain [9]. In this cohort, the patients were 74% male ($n = 160$) and this imbalance could be contributing to the low degree of reported signs and symptoms prior to treatment.

Risk factors

Patients who reported pain in the masticatory system and pain when opening their mouth prior to RT revealed a more significant deterioration of symptoms compared to patients who did not report experiencing any symptoms. These results are in line with a previous study which demonstrated that pain in the jaw muscles prior to treatment and pain when moving the jaw is correlated to radiation-induced trismus [19]. Therefore, it is possible that patients with TMD prior to cancer treatment are at higher risk of being affected by treatment related side effects in comparison to patients without signs or symptoms of TMD before treatment.

The results showed that the worse the general overall health status was prior to RT, the more reduced the patient's mouth opening was at follow-up. This implies that the state of the overall physical wellbeing may be of importance in relation to the reduction in of mouth opening post-RT. Our results also showed that variables that significantly affected the decrease in mouth opening one year after RT included the degree of mouth opening at baseline and whether jaw exercises were given. Surprisingly, the patients who received jaw exercises were the ones who showed a greater decrease of moth-opening at 1-year follow-up. This could be due to the fact that jaw exercise was not given as a treatment to all patients, but rather to the patients who already showed a decrease in mouth opening at any follow-up post-RT. However, the results showed that the patients who received jaw exercise had a significantly lower reporting of pain of the jaw muscles and lower reported pain upon palpation of the muscles at one-year after treatment. This could indicate that jaw exercises might reduce the signs and symptom of jaw muscle pain after RT targeting the head and neck. This is in line with previous work evaluating the effects of jaw exercise following treatment for HNC. Patients who performed jaw exercises for 10 weeks after developing trismus (approximately 3–6 months following RT) improved significantly regarding jaw-related problems measured with the Gothenburg Trismus Questionnaire, where jaw muscle pain is a part of the domain [25]. Another study found that performing structured jaw exercises decreased the risk of facial pain up to three years after RT for HNC [26].

Depression was shown to significantly affect self-reported pain when opening the mouth at one-year follow-up. This finding is in accordance with the well-known association between psychosomatic symptoms and prevalence of TMD. Previous studies have shown that TMD symptoms seem to be more present in patients with psychosomatic symptoms, such as depression, and thus these can be seen as a risk factor. Psychosomatic symptoms can also play a role in predicting new onset TMD [2,4].

An interesting finding was that additional brachytherapy was one of the factors that significantly affected the aggravation of self-reported pain upon chewing. Previous studies have shown that the absorbed dose to the masseter muscle was a predictor for both objective and patient-reported trismus (MIO < 35 mm) [19]. In the same study, the authors also concluded that the patients who received a high radiation dose to other structures in the masticatory system, in particular the TMJ and/or the lateral pterygoid muscle, could be anticipated to be at risk for radiation-induced trismus. A local high dose to the masticatory structures when using brachytherapy can therefore possibly be seen as a risk factor.

Study limitations

A comprehensive TMD examination was not performed for the patients in this retrospective study, which may be considered a limitation. There are only some aspects of a comprehensive TMD examination that have been applied to these patients, probably due to the lack of guidelines on how and what to examine in regards to TMD symptoms in HNC patients. Additionally, there were no specific guidelines on when to give jaw exercises nor on which exercises to give, therefore, some of the patients in the sample were told to perform jaw exercises, making it somewhat difficult to assess natural changes over time. The clinical significance of the change of the degree of pain cannot be known from this study since no numeric or visual scales of pain were used. This study only presents the changes in the reporting of pain and pain upon palpation, which is a limitation.

The ASA Physical Status Classification System was used in this study, which is a clinical description of general health. Self-reported general health was not assessed in this study, which could have given a wider perspective and placed the patient in a different category regarding overall health status. The lack of this could be seen as a limitation.

Conclusion

Both objective and subjective symptoms of TMD are common among patients with HNC. All signs and symptoms of TMD deteriorated significantly at 1-year after RT. Restricted mouth opening, pain in the jaw muscles, pain in the area of the TMJ, pain upon mouth opening, and pain upon chewing are the commonly reported symptoms following RT. Pain prior to RT, the degree of mouth opening prior to treatment, depression, health status, and brachytherapy are possible

influencing- or risk factors that were shown to significantly affect the deterioration of the symptoms. It is possible that jaw exercises may reduce symptoms of pain in the jaw muscles.

Disclosure statement

This study was not supported by any funding agency.

No financial interest or benefit has been arisen from the direct applications of this research.

Data availability statement

Data cannot be shared publicly because the ethical approval for this study applies for reports of data on a group level, not an individual level.

Therefore, data for individual cannot be made publicly available.

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