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Development and validation of the Gothenburg Trismus Questionnaire (GTQ)

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Abstract

Objective—To develop and validate a comprehensive, self-administered questionnaire for patients with limited ability to open the mouth, trismus.

Materials and methods—We derived the Gothenburg Trismus Questionnaire (GTQ) from empirical evidence in the medical literature and interviews with medical experts as well as patients. The draft version was tested in a pilot study (n=18). Patients with a maximal incisal opening (MIO) of 35 mm were included. The study comprised patients with benign jaw-related conditions (n=51), patients treated for head and neck (H&N) cancer (n=78) and an age- and gender-matched control group without trismus (n=129).

Results—The GTQ instrument was well accepted by the patients, with satisfactory compliance and low rates of missing items. After item reduction, due to items not being conceptually relevant and/or low factor loadings, the GTQ demonstrated high internal consistency (Cronbach's alpha 0.72–0.90), good construct validity and known-group validity.

Conclusion—We developed a trismus-specific self-administered questionnaire, the GTQ, that showed good psychometric properties. We suggest this questionnaire, that has clear clinical

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relevance, to be adopted and used in clinical practice and in research, acting as a screening tool as well as an endpoint in intervention and jaw physiotherapy/rehabilitation studies.

Keywords

trismus; health related quality of life; head and neck cancer

Introduction

Trismus is defined as a limitation in the mouth/jaw-opening ability due to a reduced mandible mobility^{1, 2}. Trismus can occur from benign jaw related conditions, often referred to as temporomandibular disorders (TMD). According to a NIH consensus panel, TMD refers to “a collection of medical and dental conditions affecting the temporomandibular joint (TMJ) and /or the muscles of mastication, as well as contiguous tissue components”.^{3, 4} It can also result from local or metastatic tumor growth of head and neck (H&N) tumors, and more importantly, as a debilitating side-effect to H&N oncology treatment, especially radiotherapy.⁵ An objective measure of trismus is the limited ability to open the mouth, maximal incisal opening (MIO), 35 mm^{1, 6}. Trismus affects many important aspects of daily life, such as chewing, diet normalcy, difficulties in eating, an inability to practice effective oral hygiene, pain, speech and overall health related quality of life (HRQL).^{4, 7}

In Sweden, approximately 1,200 patients are diagnosed with H&N cancer every year. Of these, 90% receive radiotherapy and/or chemotherapy and the remaining 10% undergo surgery and/or additional radiotherapy.⁸ In this patient category, the etiology of trismus can be the result of tumor growth and/or a side-effect of treatment damaging critical structures of chewing, such as the masseter and pterygoid muscles, damage to nerve or supportive tissue or to the TMJ⁹. The incidence of trismus is particularly increased after chemoradiotherapy¹⁰ and external beam radiation therapy to the area¹¹. There is a steep dose-effect relationship with increased probability of trismus with increasing radiation doses¹². Magnetic resonance imaging after radiotherapy demonstrates abnormalities in several structures involved with chewing which suggests multi factorial mechanisms behind this condition¹³.

The prevalence of post treatment trismus ranges between 5–45%^{7, 14} varying because of different treatment strategies, as well as diverse and inconsistent manners of assessing trismus attributed to the lack of uniform criteria.

Patient reported outcome (PRO) instruments are becoming more and more important because reliable measures of how the patients' experience their symptoms can be considered equally important in clinical research as survival and mortality. Although several H&N specific HRQL questionnaires exist today¹⁵, no questionnaire has specifically addressed trismus. Some of the existing questionnaires only partially cover relevant questions, and most do not take the pain aspect into account.

Due to the paucity of PRO questionnaires specifically addressing trismus, the present study was initiated with the aim to develop and validate a comprehensive, trismus specific self-administered questionnaire, the Gothenburg Trismus Questionnaire (GTQ). This

questionnaire could serve as a screening tool and endpoint in intervention and jaw physiotherapy/rehabilitation studies in trismus patients.

METHODS

GTQ development

The GTQ was developed in two stages: 1) input from an expert panel, literature review and patient interviews, to elicit and evaluate items (content validity); and 2) evaluation of the instruments' measurement properties (including reliability, validity and responsiveness).

Content validity of the GTQ

The items of the GTQ instrument were developed based on a literature review of published trismus studies, non-validated trismus-related questions and the experiences of an expert panel consisting of two stomatognathic physiologists, one otolaryngologist and a behavioural scientist specialized in psychometrics. The initial draft of the GTQ instrument consisted of 43 items. A five-point Likert scale was used, except for certain items covering pain and limited mouth opening, for which a seven-point Likert scale was used. For most items the recall period was set to one week. For certain items covering pain and limited mouth opening however, the recall periods were set to one month or "right now".

Confirmatory interview study—Confirmatory individual interviews were conducted with 18 patients (9 with H&N cancer and 9 with TMD) to confirm the relevance and interpretability of the items. Patients were administered the GTQ instrument draft and were thereafter probed on, for example, how items were perceived, whether patients found any items to be missing and the length of time needed to fill in the questionnaire. Furthermore, a subset of patients was contacted for a semi-structured phone interview.

Exploratory psychometric validation phase

Study design and participants—Patients with benign TMD disorders seen by a stomatognathic physiologist were included at the Institute of Odontology, Gothenburg, Sweden at their first visit to the clinic. Patients with H&N cancer and trismus were included at the department of Otorhinolaryngology at Sahlgrenska University Hospital, Gothenburg, Sweden and at the department of Otorhinolaryngology, Karolinska University Hospital, Stockholm, Sweden. H&N cancer patients were identified and considered eligible for the study at oncology grand rounds or at follow-up visits after termination of treatment when there were clinical signs of trismus (MIO $\geq$ 35 mm). Patients with poor language comprehension and cognition were considered non-eligible. Instruments were distributed to patients at the clinic and mailed back. Patients who had not returned their instruments within 2 weeks were reminded once. The study also comprised an age- and gender-matched control group of patients from the department of Otorhinolaryngology at Sahlgrenska University Hospital, Sweden. The control patients denied trismus and had no clinical evidence of such and answered the questionnaire in clinic.

Overall, 138 patients with trismus were included: 51 patients with TMD and 78 patients with H&N cancer. Nine patients failed to return the questionnaire, giving a response rate of 93%.

The control group consisted of 129 patients. Table 1 shows the sociodemographic and clinical characteristics of the participants.

References for validation

SF-36—The SF-36 is a widely used generic instrument for measuring HRQL, with a recall period of four weeks (standard version)^{16, 17}. It contains 36 items in eight domains: Physical Functioning (PF), Role limitations due to Physical problems (RP), Bodily Pain (BP), General Health (GH), Vitality (VT), Social Functioning (SF), Role limitations due to Emotional problems (RE), Mental Health (MH) and one question concerning perceived health during the last year. A score for each domain between 0 (worst) and 100 (best) HRQL is calculated using a standardized scoring system. The Swedish version has well-documented reliability and validity¹⁶.

EORTC QLQ-C30 and QLQ-H&N35—The EORTC QLQ-C30, assesses the physical and psychosocial functioning and symptom experiences of cancer patients in general¹⁸. To address additional symptoms associated specifically with H&N cancer and its treatment, the complementary 35-item module can be used, the QLQ-H&N35^{19, 20}. Recall period for both instruments is one week. Calculated scale scores range from 0–100. On the Functioning and Global QL scales a score of 100 corresponds to maximum functioning, whereas on the Symptom scales and items a score of 100 means worst possible symptoms²¹. The core instrument¹⁸ as well as the H&N cancer-specific module²⁰ have demonstrated satisfactory to excellent reliability and validity.

Statistics

Descriptive statistics was applied using standard methods. The psychometric qualities of the GTQ were assessed to determine reliability and validity. Scoring of the GTQ was carried out by calculating a mean for each domain, which is then transformed to a scale ranging between 0–100, where a higher score indicates greater perceived dysfunction due to trismus. Regarding missing items in a domain, non-missing items within that given domain were rescaled to generate a value comparable to subjects responding to all items. If more than 50% of the items within the domain were missing, the domain score was also set as missing. Tests for comparing GTQ scores for patients and controls were performed using the Mann–Whitney U-test. For pairwise comparison between groups for sociodemographic and clinical characteristics, the following tests were applied: Fisher's Exact test for dichotomous variables; the Mantel-Haenszel Chi Square Exact test for ordered categorical variables and the Mann-Whitney U-test for continuous variables. All tests were two-tailed and the significance level was set to 5% throughout.

Item reduction and subscale identification

As a first step, items with ceiling or floor effect with more than 40% of participants choosing the highest or the lowest response option, were considered for omission. If items had more than 5% missing responses, they were also considered to be removed.

Item reduction was further influenced by the principal component analysis with varimax and oblimin rotation. Factor analyses were performed on variables to identify items that correlate

strongly enough to form homogeneous domains. Items were retained if the factor loadings were 0.4 and conceptually relevant in that factor. Moreover, examination of scree-plots, eigenvalues (> 1 , Kaiser's criterion)²² and proportion of the total variance accounted for, were considered when determining the number of factors.

Reliability—Reliability of the GTQ domains was assessed using Cronbach's alpha coefficient where an alpha value > 0.7 was considered as supporting internal consistency reliability²³. Test-retest reliability was assessed for 17 of the patients between inclusion and 2 weeks later, when they were administered the GTQ once more. Test-retest reliability was assessed using Intra-class Correlation Coefficients (ICC). ICC values 0.4–0.75 were considered to represent fair to good reliability and values > 0.75 excellent²⁴ reliability.

Construct validity—The Spearman correlation coefficient was used to evaluate convergent and discriminant validity. Convergent validity refers to how well constructs that theoretically should be related to each other are, in fact, observed to be related. Discriminant validity, on the other hand, is based on the assumption that constructs that theoretically are *not* related to each other should demonstrate low correlations. For assessment of convergent and discriminant validity the GTQ domains were compared to the domains of the EORTC questionnaires and the SF-36. Another form of discriminant validity is the known-group validity which explores the ability of an instrument to discriminate between groups of patients with different health status. Known-group validity was assessed by comparing GTQ domain scores between TMD and H&N cancer patients, and patients without trismus.

Ethical considerations—The study was approved by the Regional Ethical Review Board at Gothenburg University and performed in accordance with the Declaration of Helsinki.

RESULTS

The sociodemographic and clinical characteristics of the study population are shown in table 1. Patients with TMD were in general younger, more often of female gender and had experienced symptoms for a longer time than the H&N cancer patients (Table 1)

Confirmatory interview study

Individual interviews confirmed the relevance of the symptom items of the GTQ. No patient found the pilot version of the GTQ upsetting, disturbing or difficult to understand.

Item analyses and item reduction

The final GTQ is included in Appendix A. No items were omitted due to ceiling effects or missing responses whereas 18 items were excluded due to floor effect (Appendix B). Item convergent validity was good, with all items demonstrating a correlation of 0.40 with their relevant domains, signifying scaling success²⁵. The items "Has your facial pain interfered with your daily activities during the last month?" and "Has your limitation to open your mouth interfered with your daily activities during the last month?" were removed since they were judged as redundant being covered by other items.

Factor structure of the final GTQ

An exploratory approach using principal component analyses was applied. After item reduction three factors with an eigenvalue >1 , explaining 64% of the variance were identified. Examination of scree-plots also suggested retaining three components for rotation. The three domains further nullified scaling errors giving better internal reliability. All domains had items loading predominantly in the domain-specific factor (Table 2). Results of the Oblimin and the Varimax analyses were in accordance with each other (only the Varimax analyses results are presented, Table 2). Two items; “Problems eating at normal pace” and “problems chewing” were omitted since they did not load distinctively enough in one factor. The revised GTQ version thus contained 13 items over three domains; Jaw related problems (six items), Eating limitation (four items) and Muscular tension (three items). The remaining 8 items (Appendix A), measuring pain at different time points, limitations in opening mouth and impact, were retained as single items.

Reliability

All three domains showed good internal consistency (Cronbach’s $\alpha > 0.70$) and test-retest reliability was excellent for all three domains (Table 3).

Construct validity

All items in the 21-item GTQ version showed good variability, i.e. they spanned all possible response alternatives (Table 4). No floor- or ceiling-effects were noticed among the patients, with one exception; for the domain Muscular tension, a tendency towards a floor effect was observed among the H&N cancer patients.

Convergent and discriminant validity—Convergent and discriminant validity was assessed by comparing the GTQ domains with the EORTC questionnaires and the SF-36 (Table 5 and 6). Only weak correlations were found between the GTQ domain Muscular Tension and the domains from the EORTC QLQ-H&N35 and the SF-36. The GTQ domain Jaw Related Problems correlated moderately to the SF-36 domains Bodily Pain and Vitality. There was also a moderate correlation between Jaw Related Problems and several of the domains of the EORTC QLQ-H&N35. Concerning the GTQ domain Eating Limitation, the strongest correlation was found to the domains Social Eating and Swallowing in the EORTC QLQ-H&N35.

Known-group validity—The known-group validity is shown in Table 7. The GTQ could discriminate between trismus and non-trismus patients, as shown by the statistically significant differences between the study group and the control group in all domains. Furthermore, H&N cancer patients reported significantly lower scores on Jaw related problems ($p < .0001$) and Muscular tension compared to TMD patients ($p < .0001$).

DISCUSSION

Because of the need for PRO questionnaires that specifically addressing trismus, we developed and validate a comprehensive, trismus specific self-administered questionnaire,

the Gothenburg Trismus Questionnaire (GTQ). The results showed good psychometrics properties and the final GTQ (Appendix A) consist of questions with clear clinical relevance.

Trismus is a common complication of H&N cancer and its treatment with surgery and chemoradiation as major causes of trismus. Mandibular opening worsens as the dose of radiation delivered to the pterygoid muscles increases (24% for every 10 Gy).^{12, 26} Ectopic activity in the trigeminal nerve with involuntary spasm in the masseter and pterygoid muscle with ultimate contracture of the tendons, ligaments, and other soft tissues of the jaw likely underlie the development of trismus in H&N cancer patients with radiation fibrosis syndrome (RFS).²⁷

Although it is still unknown as to what causes TMD, contributing factors are thought to be related to trauma or destructive oral habits and growth abnormalities which can lead to malocclusion. In most instances however, the cause is unclear.²⁸

In Sweden, the incidence of trismus after H&N oncology treatment has been estimated to be as high as 38–42%.¹¹. To the best of our knowledge, the incidence of TMD in Sweden is unknown, but an increase in the prevalence of symptoms of TMD has been observed over the last two decades.² Despite the frequent occurrence of trismus associated with several conditions, no questionnaire specifically validated for addressing trismus-specific symptoms exists. The present study therefore described the development and validation of such an instrument.

The principal component analyses identified three domains, Jaw related problems, Eating limitations, and Muscular tension. These domains represent aspects that are known to be of great difficulty to trismus patients and are of high clinical relevance in TMD patients as well as in H&N cancer patients.

Evaluation of construct validity demonstrated low to moderate correlations with most of the domains in the EORTC and SF-36. This was as expected as for many diseases, trismus included, disease-specific instruments are needed to assess clinically important changes in health status that are too specific to be detected using generic health status instruments²⁹.

Compared to TMD patients, the H&N cancer patients reported significantly less problems in the domains “Jaw related problems” and “Muscular tension”. These results may be related to the fact that the entire mastication apparatus is involved in TMD patients, i.e. both the mastication muscles and the TMJ. The condition also involves inflammation and increased muscular tension and pain. H&N cancer patients, on the other hand, primarily suffer from a radiation-induced muscular fibrosis and a mechanical effect of the jaw opening capacity. Other possible explanations to these results may involve that the TMD patients have experienced symptoms of longer duration (more chronic in nature), were somewhat younger and a larger proportion of females.²

Parallel with the increased importance of PROs, the methodology for developing PROs has evolved. To cover everything that is relevant and ensure that items are comprehensive the patient input is today more emphasized and strongly recommended already in the exploratory phase when generating items³⁰. In this initial validation, 18 items were omitted

due to substantial floor effects. This might be explained by the fact that item generation was based on clinical experience and empirical evidence only, i.e. no patient interviews were carried out prior to the exploratory item generation.

Furthermore, some items may have produced unacceptable floor effects due to how they were phrased. For example, a patient may have a cramping feeling concentrated to the jaw only and could therefore have underreported on “Cramping feelings in the face or jaw “. This item was omitted due to a pronounced floor effect, but may still be clinically relevant if presented as two separate items. This is also relevant for two other items, “Fatigue/stiffness in your jaw” and “Problems opening your mouth wide or taking a big bite”.

A key issue when developing PROs is to select the optimal recall period. What is the most appropriate recall period is dependent on the characteristics of the phenomenon of interest. Recall always asks patients to rely on their memory to aggregate and summarize their experience, which may introduce a variety of inaccuracies and biases that can affect the data, and studies have shown that shorter recall periods are more optimal when symptoms are fluctuating^{31, 32}. Therefore, the recall period for severity items as well as for the pain and MIO related questions in the future will be referred to the last week (or now), instead of the last month as were the case for some questions in the first GTQ version.

A limitation of the study is the cross-sectional design, preventing us from investigating the GTQ’s ability to detect responsiveness to change over time. Another limitation is the above-mentioned lack of patient input in the exploratory phase of the item generation phase. While many validation studies completely lack patient input, we performed patient interviews during the confirmatory phase. None of the 18 patients in the pilot study said that they were missing any question, when specifically asked.

Conclusion

In conclusion, we developed a trismus-specific self-administered questionnaire, the GTQ. We suggest this questionnaire to be used in clinical practice and in research, acting as a screening tool as well as an endpoint in intervention and jaw physiotherapy/rehabilitation studies.

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Appendix A. GTQ

Symptom domains

Jaw related problems	fatigue/stiffness in jaw
	aches or pain in face and jaw
	pain moving jaw (opening mouth/chewing)
	problems opening mouth wide or taking a big bite
	pain or soreness in jaw muscles
	problems yawning
Eating limitations	eat solid food
	put food in mouth
	eat soft food
	bite off
Muscular tension	clench your teeth
	press with your tongue
	noises from jaw

Single items

Facial pain	How much facial pain do you have right now?
	How strong was the worst pain you have had during the last month?
	On average, how strong has your pain been during the last month?
Facial pain impact	Has your facial pain interfered with your social, leisure and family activities during the last month?

	Has your facial pain affected your ability to work (including both gainful employment and household duties) during the last month?
Jaw limitation	How limited are you in your ability to open your mouth?
Jaw limitation impact	Has your limitation to open your mouth interfered with your social, leisure and family activities during the last month?
	Has your limitation to open your mouth affected your ability to work (including both gainful employment and household duties) during the last month?

Appendix B. Items removed from the original GTQ

pain or soreness in your neck muscles	problems with your jaw going out of joint, getting stuck or locked
cramping feelings in the face or jaw	headaches
problems with spillage when eating	burning pain in your mouth
drink	spit
grind your teeth	brush teeth
chew chewing gum	bite/ chew/ suck your cheek/ lips/ tongue
sing	exercise
kiss	smile/laugh
talk	gargle
facial pain interfered with daily activities	limitation to open mouth interfered with daily activities
problems eating at normal pace	problems chewing

Socio-demographic and clinical characteristics of study patients and the control group

Table 1

	Study group		Control group		Test between groups*		
	Temporomandibular disorder (TMD) (n=51) mean (range) n (%)	H&N cancer trismus (n=78) mean (range) n (%)	(n=129) mean (range) n (%)	TMD vs. H&N p-value	TMD vs. controls p- value	H&N vs. controls p- value	
MIO (mm)	28.5 (10 – 35)	28.7 (10 – 35)	N/A	0.52	-	-	
Age (years)	42 (16 – 78) n (%)	59 (23 – 87) n (%)	52 (16 – 89) n (%)	<0.0001	0.0001	0.0026	
Gender							
Male	11 (22)	41 (53)	52 (40)				
Female	40 (78)	37 (47)	77 (60)	0.0007	0.0249	0.1158	
Marital status							
Single	28 (55)	21 (40)	32 (25)				
Married/Cohabitant	23 (45)	47 (60)	97 (75)	0.1313	0.0003	0.0361	
Smoker	10 (20)	20 (26)	25 (19)	0.5662	1.0	0.3756	
Duration of trismus (years from diagnosis of symptoms to response date of questionnaire)				0.0001			
0 – < 1	13 (25)	45 (58)	45 (58)				
1 – < 2	11 (22)	24 (31)	24 (31)				
2 – < 3	10 (20)	0 (0)	0 (0)				
3 – < 4	2 (4)	0 (0)	0 (0)				
4 – < 5	4 (8)	0 (0)	0 (0)				
5	11 (21)	9 (11)	9 (11)				
Cancer location							
Tonsil			28 (36)				
Tounge			9 (12)				
Tumour colli			8 (10)				
Palate			6 (8)				
Tongue base			5 (6)				
Oropharynx			7 (9)				

	Study group		Control group		Test between groups*		
	Temporomandibular disorder (TMD) (n=51) mean (range)	H&N cancer trismus (n=78) mean (range)	(n=129) mean (range)	TMD vs. H&N p-value	TMD vs. controls p- value	H&N vs. controls p- value	
Other H&N cancers			15 (19)				
TMD							
Disc problems	22 (43)						
Arthritis	15 (29)						
Muscular	10 (20)						
Trauma	3 (6)						
Luxation	1 (2)						

MIO= Minimal incisal opening, TMD = Temporomandibular disorders

* For pairwise comparison between groups the following test were applied: Fisher's Exact test for dichotomous variables; the Mantel-Haenszel Chi Square Exact test for ordered categorical variables and the Mann-Whitney U-test for continuous variables. Smokers as compared to non-smokers.

Table 2

Principal component analyses (Varimax) GTQ items

GTQ domains	Item	Factor 1	Factor 2	Factor 3
Jaw related problems	Fatigue/stiffness in jaw	0.63914	0.25514	0.37581
	Aches or pain in face and jaw	0.76468	0.10698	0.38048
	Pain moving jaw (opening mouth/chewing)	0.85096	0.16938	0.21332
	Problems opening mouth wide or taking a big bite	0.67349	0.29597	−0.10935
	Pain or soreness in jaw muscles	0.81551	0.17544	0.30631
	Problems yawning	0.67106	0.35649	0.26457
Eating limitations	Eat solid food	0.31124	0.76669	0.16101
	Put food in mouth	0.36799	0.73987	0.00607
	Eat soft food	0.00827	0.83695	−0.02636
	Bite off	0.35162	0.67980	0.30994
Muscular tension	Clench your teeth	0.22598	0.00993	0.75049
	Press with your tongue	0.08866	0.17717	0.72691
	Noises from jaw	0.24525	0.01396	0.76191

Table 3

Reliability estimates

GTQ	Internal consistency ^a Trismus patients n=129	Test-retest ^b ICC
Jaw related problems	0.90	0.97
Eating limitation	0.82	0.97
Muscular tension	0.72	0.97

^aCronbach's alpha^bTest-retest sample size n=17

Table 4

Descriptive statistics grouped by GTQ domains

Study groups	Domains	Items (n)	Range	% Floor	% Ceiling	Median	SD
<i>TMD Trismus patients (n=51)</i>	Jaw related problems	6	17–100	0	14	75.0	21.8
	Eating limitation	4	0–94	2	0	56.2	26.6
	Muscular tension	3	0–100	4	6	58.3	26.9
<i>H&N cancer trismus patients (n=78)</i>	Jaw related problems	6	0–92	1	0	45.8	22.0
	Eating limitation	4	0–100	3	1	50.0	26.7
	Muscular tension	3	0–83	21	0	25.0	16.8

TMD = Temporomandibular disorder

Table 5

GTQ scale correlations with SF 36 scales in trismus patients (n=129)

GTQ domains	PF	RP	BP	GH	VT	SF	RE	MH
law related problems	-0.01	-0.04	-0.51	-0.13	-0.24	-0.19	-0.16	-0.20
<i>p-value</i>	0.903	0.667	<0.001	0.136	0.006	0.029	0.070	0.023
Eating limitation	-0.24	-0.24	-0.46	-0.25	-0.45	-0.32	-0.20	-0.36
<i>p-value</i>	0.008	0.008	<0.001	0.004	<0.001	0.001	0.021	<0.001
Muscular tension	0.08	0.07	-0.28	-0.14	-0.18	0.02	-0.07	-0.12
<i>p-value</i>	0.392	0.458	0.002	0.111	0.043	0.844	0.455	0.177

SF 36; PF=Physical Functioning, RP=Role limitations due to Physical problems, BP=Bodily Pain, GH=General Health, VT= Vitality, SF=Social Functioning, RE=Role limitations due to Emotional problems, MH=Mental Health

Table 6

GTQ scale correlations with EORTC QLQ C30 and H&N35 domains in H&N cancer patients (n=78)

GTQ Domains	Jaw related problems	Eating limitation	Muscular tension
EORTC QLQ-C30 (p-value)			
Physical Functioning	−0.05 (0.669)	−0.30 (0.008)	0.02 (0.834)
Role Functioning	−0.24 (0.034)	−0.41 (<0.001)	0.15 (0.195)
Emotional Functioning	−0.21 (0.062)	−0.35 (0.003)	−0.03 (0.805)
Cognitive Functioning	−0.26 (0.025)	−0.37 (0.001)	−0.06 (0.589)
Social Functioning	−0.24 (0.038)	−0.51 (<0.001)	−0.08 (0.486)
Global QoL	−0.25 (0.025)	−0.49 (<0.001)	−0.10 (0.365)
Fatigue	0.27 (0.019)	0.51 (<0.001)	0.05 (0.641)
Nausea and vomiting	0.03 (0.770)	0.31 (0.006)	−0.06 (0.587)
Pain	0.45 (<0.001)	0.44 (<0.001)	0.12 (0.303)
EORTC QLQ-H&N35			
Pain	0.49 (<0.001)	0.40 (<0.001)	0.27 (0.016)
Swallowing	0.38 (<0.001)	0.65 (<0.001)	0.10 (0.368)
Senses	0.36 (<0.002)	0.44 (<0.001)	0.13 (0.247)
Speech	0.37 (<0.001)	0.41 (<0.001)	0.04 (0.759)
Social eating	0.37 (<0.002)	0.55 (<0.001)	0.07 (0.550)
Social contact	0.17 (0.133)	0.31 (<0.007)	0.16 (0.171)
Sexuality	−0.10 (0.413)	0.25 (0.046)	−0.18 (0.146)
Teeth	0.22 (0.051)	0.12 (0.316)	0.14 (0.215)
Opening mouth	0.33 (<0.004)	0.17 (0.131)	0.05 (0.681)
Dry mouth	0.11 (0.338)	0.24 (0.038)	0.08 (0.491)
Sticky saliva	0.29 (0.010)	0.52 (<0.001)	0.24 (0.038)
Coughing	0.23 (0.042)	0.08 (0.493)	−0.08 (0.492)
Feeling ill	0.36 (0.002)	0.34 (<0.003)	0.04 (0.752)

Table 7

Mean GTQ scores (CI) for trismus and non-trismus patients

	Study group		Controls	p-value*
	TMD trismus n=51	H&N cancer trismus n=78	n=129	
Jaw related problems	73.2 (67.1–79.3)	43.5 (38.6–48.5)	5.1 (3.4–6.8)	< 0.00001
Eating limitation	52.2 (44.7–59.6)	45.0 (38.9–51.1)	1.3 (0.3–2.2)	< 0.00001
Muscular tension	54.0 (46.4–61.6)	20.4 (16.5–24.2)	13.0 (10.0–16.1)	< 0.00001

* Study vs. control group comparison

GTQ: 0 indicating the most favourable state and 100 indicating the least favourable