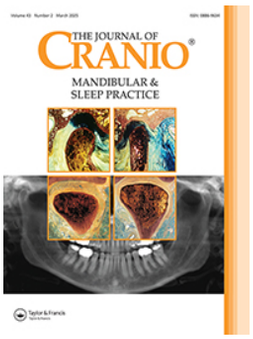

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RESEARCH ARTICLE

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Trauma and TMD: The association between orofacial trauma and temporomandibular disorders in a tertiary referral clinic

Loreine M.L. Helmer DDS[a,b], Michail Koutris DDS, MSc PhD[a], Thiprawee Chattrattrai DDS PhD[ac], Naichuan Su DDS PhD[d], Leander Dubois MD DDS PhD[b], Jan de Lange MD DDS PhD[b] and Frank Lobbezoo DDS PhD[a]

[a]Department of Orofacial Pain and Dysfunction, Academic Centre for Dentistry (ACTA), University of Amsterdam and Vrije Universiteit Amsterdam, Amsterdam, The Netherlands; [b]Department of Oral and Maxillofacial Surgery, Academic Medical Centre of Amsterdam (AUMC), Academic Centre for Dentistry (ACTA), University of Amsterdam, Amsterdam, The Netherlands; [c]Department of Masticatory Science, Faculty of Dentistry, Mahidol University, Bangkok, Thailand; [d]Department of Oral Public Health, Academic Centre for Dentistry (ACTA), University of Amsterdam and Vrije Universiteit Amsterdam, Amsterdam, The Netherlands

ABSTRACT

Objective: Between 5–12% of the population suffers from Temporomandibular disorders (TMDs). TMDs are known for their multifactorial aetiology and one of the proposed associated factors is orofacial trauma. This study investigated the possible association between orofacial trauma and TMD in a tertiary referral clinic.

Methods: Patients were diagnosed with one or more TMD diagnoses; myalgia, arthralgia, headache associated with TMD and/or a TMD function diagnosis. 659 consenting patients were included. The majority were female. Ages ranged between 18 and 86 years. All patients were included in a logistic regression analysis, and 236 were included in a network analysis.

Results: Neither analysis yielded a statistically significant association between orofacial trauma and TMD. Results showed associations between psychosocial variables and TMD diagnoses.

Discussion: These results are contradictory to a recent review, where an association between orofacial trauma and TMD was found. The results on psychosocial variables and TMD diagnoses are corroborated by literature.

Conclusion: In conclusion, in this tertiary referral clinic, no association between orofacial trauma and TMD was found.

KEYWORDS
Orofacial trauma; temporomandibular disorder; psychosocial factor; regression analysis

Introduction

Around 5 to 12% of the general population are affected by temporomandibular disorders (TMDs) [1]. Characteristic symptoms of TMDs are pain, temporomandibular joint (TMJ) sounds, and limitations in movement, such as a limited mouth opening [2]. TMD pain is situated in the orofacial region and includes masticatory muscle pain, TMJ pain, and headache attributed to TMD. TMDs are known for their multifactorial aetiology [3], and among the most important factors in this multifactorial aetiology are the psychosocial factors [4,5].

One of the proposed aetiologies of TMD is orofacial trauma. Orofacial trauma includes trauma to the mandible and the maxilla but also the nasal, zygomatic, and orbital areas of the face. Trauma in this region is commonly caused by traffic accidents, fights, falls, or assaults [6–8]. Treatment often consists of surgery or conservative treatment, depending on the presence of fractures, the location of these fractures, and their consequences in terms of anatomy. In the specific case of a fracture of the mandibular condyle, both surgical treatment and conservative treatment have a positive outcome [9,10].

A recent review describes an association between TMD and orofacial trauma [11]. However, most of the studies included in this review only investigated a selection of TMD diagnoses and a selection of types of orofacial trauma. As there are different TMD diagnoses and different types of orofacial trauma, it would be clinically relevant to see if certain types of TMD are associated with certain types of orofacial trauma for prevention and treatment purposes.

Network analyses provide insight into how different factors are directly or indirectly associated with each other [12]. A network analysis aims to recognize associations between variables and present them in

CONTACT Thiprawee Chattrattrai t.chattrattrai@acta.nl Department of Orofacial Pain and Dysfunction, ACTA, Academic Centre for Dentistry Amsterdam, University of Amsterdam and Vrije Universiteit, Gustav Mahlerlaan 3004, Amsterdam, LA 1081, The Netherlands

a structured figure. The method has been validated for the use of binary data [12]. Using a network analysis and preceded by conventional statistics, this study aims to answer the following questions: 1. Is there a direct or indirect association between TMD and orofacial trauma in a tertiary referral clinic? and 2. If so, is the association specific to a type of TMD or a type of trauma?

Materials and methods

Participants

Participants included in this study visited the tertiary referral clinic for orofacial pain and dysfunction at the Academic Centre for Dentistry Amsterdam (ACTA) between September 2020 and March 2023. All included participants were diagnosed with TMD, either with a pain diagnosis and/or with a dysfunction diagnosis, viz.: myalgia, arthralgia, TMD-related headache, or a TMD-function diagnosis such as disc displacement with or without reduction or degenerative joint disease. All included participants consented to the use of their self-reported and clinical data for scientific purposes (Institutional Review Board file numbers U23.047 and U23.048). The Medical Ethics Committee of ACTA (file number 2,020,233) approved this study and stated that the Dutch Law on Research Involving Human Subjects Act (WMO) did not apply.

Variables

As part of their standard care, patients filled out a set of questionnaires before their first appointment in the clinic. The Axis II of the Diagnostic Criteria-Temporomandibular Disorders (DC-TMD) [5] is part of this set. The TMD diagnoses were established in combination with the clinical assessment of the DC-TMD (Axis I). Four TMD diagnoses, myalgia, arthralgia, TMD-related headache, and TMD-function diagnosis, were used as the dependent variables in the statistical analysis.

Also, part of the set of several psychosocial questionnaires (i.e., Dutch versions of the Patient Health Questionnaire-15, the Patient Health Questionnaire-9, the Generalized Anxiety Disorder-7, and a single item on psychological stress). All these questionnaires have proven validity [13]. The Patient Health Questionnaire-15 (PHQ-15) is a questionnaire for somatic symptoms. It contains 15 questions on somatic symptoms such as fatigue, pain, and trouble sleeping. With a range between 0 (not bothered) and 2 (bothered a lot) for every question, the maximum score of the questionnaire is 30. Cut-off points are 5 (low score), 10 (moderate score), and 15 or above (high score).

The Patient Health Questionnaire-9 (PHQ-9) measures the severity of depression, with nine items that can be scored from "not at all" (0) to "nearly every day" (3). The maximum score reaches up to 27, and concerning the severity of the depression, it distinguishes four categories, viz., over 5 (mild), over 10 (moderate), over 15 (moderately severe), and over 20 (severe).

The Generalized Anxiety Disorder-7 (GAD-7) measures the presence and severity of generalized anxiety. Like the PHQ-9, it scores from "not at all" (0) to "nearly every day" (3) and includes seven items, yielding a maximum score of 21. Cut-off points for the categories are comparable to the PHQ-15, viz., at 5 (low score), 10 (moderate score), and 15 or above (severe score).

The following single-item stress measure was used: "Overall, how much stress did you experience during last month?" The answer ranges from 0 (none) to 4 (very much).

Questions on orofacial and dental trauma were asked during the first visit to the clinic as part of the extensive anamnesis (oral history taking). The question was formulated as follows: "Has there been an orofacial trauma in the past (a trauma that involved the orofacial region)?" This could be answered with; "no", "yes, orofacial trauma" and/or "yes, dental trauma". An overview of all variables and their scores is available in Table 1.

Statistical analyses

To investigate possible direct associations between orofacial trauma and TMD diagnoses, binary logistic regression analyses were performed. An overview of the four dependent variables, namely the different TMD diagnoses and the independent variables and co-variables, is available in Table 1. To assess the unadjusted association between trauma and TMD for each TMD diagnosis, first univariable binary logistic regression analyses were performed, including only one independent variable (i.e. orofacial trauma or dental trauma). Then, the multivariable binary logistic regression analyses were performed including the independent variable of interest (i.e. orofacial trauma and dental trauma) and all the co-variables, to assess the adjusted association between orofacial trauma and TMD. Statistical significance was set at $p < .05$; the analyses were performed by IBM SPSS Statistics (v.29, IBM Corp, Armonk, NY, USA).

To investigate possible indirect associations between orofacial trauma and TMD diagnoses, a network analysis was used. In this network analysis, 11 variables were included: age, gender, orofacial trauma, dental trauma, myalgia, arthralgia, TMD-related headache, TMD-function diagnosis, somatic symptoms (PHQ-15), depression (PHQ-9), and

Table 1. Dependent, independent and co-variables as entered into the binary logistic regression and network analyses.

	Binary logistic regression analysis	Network analysis
	Measurement levels of variables	Measurement levels of variables
Dependent variables		
Myalgia	Binary 0 = No, 1 = Yes	Binary 0 = No, 1 = Yes
Arthralgia	Binary 0 = No, 1 = Yes	Binary 0 = No, 1 = Yes
TMD-related headache	Binary 0 = No, 1 = Yes	Binary 0 = No, 1 = Yes
TMD-function diagnosis	Binary 0 = No, 1 = Yes	Binary 0 = No, 1 = Yes
Independent variables		
Trauma variables		
Orofacial trauma	Binary 0 = No, 1 = Yes	Binary 0 = No, 1 = Yes
Dental trauma	Binary 0 = No, 1 = Yes	Binary 0 = No, 1 = Yes
Co-variables		
Psychological variables		
Somatic symptoms (PHQ-15)	As ordinal data (0 = None, 1 = Low, 2 = Medium, 3 = high)	As quantitative data (0–30)
Depression (PHQ-9)	As ordinal data (0 = None, 1 = Mild, 2 = Moderate, 3 = Moderately Severe, 4 = Severe)	As quantitative data (0–27)
Anxiety (GAD-7)	As ordinal data (0 = None, 1 = Mild, 2 = Moderate, 3 = Severe)	As quantitative data (0–21)
Stress	As ordinal data (0 = None, 1 = Mild, 2 = Moderate, 3 = Moderately Severe, 4 = Severe)	As quantitative data (0–4)
Age	Quantitative data (y)	Quantitative data (y)
Gender	Binary 0 = Female; 1 = Male	Binary 0 = Female; 1 = Male

Abbreviations; TMD; temporomandibular disorder, DC-TMD; Diagnostic Criteria-Temporomandibular Disorders; PHQ-15, Patient Health Questionnaire-15; PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder-7.

anxiety (GAD-7). Gender ("male", "female"), orofacial trauma ("presence", "absence"), dental trauma ("presence", "absence"), myalgia ("presence", "absence"), arthralgia ("presence", "absence"), TMD-related headache ("presence", "absence"), and TMD-function diagnosis ("presence", "absence") were included as categorical variables. Age, somatic symptoms, depression, and anxiety were included as continuous variables. Since the data set contained both categorical and continuous variables, the mixed graphical model (MGM) was used. The least absolute shrinkage and selection operator (LASSO) regularization was used to estimate the model. The LASSO regularization was adjusted by the Extended Bayesian Information Criterion (EBIC) using a gamma hyperparameter (γ) [14]. The hyperparameter is usually set between 0 and 0.5 [14]; the hyperparameter was set to 0 in this study to increase the network's sensitivity and its associations. The result from the network analysis was visualized in a network model containing nodes and edges. The different variables were visualized as nodes; the conditional dependence associations between variables were presented as edges. Blue edges represent positive associations; red edges are negative ones. Thicker and darker edges indicate stronger associations compared to thinner and paler edges. Last, the nonparametric bootstrapping with 1,000 bootstrap samples was used to investigate the network's accuracy. The bootstrapped confidence intervals plot of the network model can be found in the Appendix, Figure A1. The network analysis and checking of the network's accuracy was performed using the "bootnet" package (version 1.5.6), and the outcome of the network analysis was visualized with the "qgraph" package (version 1.9.8) in R (v.4.1.2: R Core Team 2021).

Results

The database consisted of 659 patients, of which 487 were females. Ages ranged between 18 and 86 years old, with a mean age of 43 years and a standard deviation of 16 years. Myalgia was diagnosed in 381 patients, arthralgia in 203 patients, TMD-related headache in 113 patients, and in 355 patients, a TMD-function diagnosis was established. Patients could suffer from more than one diagnosis. Orofacial trauma was reported by 83 out of 659 patients, and dental trauma by only 39. Different causes of orofacial trauma were mentioned, amongst others falls, assaults, motor vehicle accidents, and bicycle accidents. Information on the type of trauma and the timeline of the trauma was inconsistent. The interval between trauma and TMD diagnosis ranged from one year to 50 years. An overview of all descriptive statistics is shown in Table 2.

In the binary logistic regression analysis, no significant associations were found between TMD and orofacial trauma in this tertiary referral clinic. An overview of these outcomes is shown in Table 3; all four TMD diagnoses are listed, and none of them show an association with orofacial trauma, nor with dental trauma, in both univariable and multivariable regression analyses. As shown in Table 3, the TMD diagnoses of myalgia and TMD-related headache were significantly associated with somatic symptoms (both $p < .001$). Patients with a higher score on the PHQ15 were more likely to have myalgia and TMD-related headache. Furthermore, a TMD-function diagnosis was significantly positively associated with higher age ($p = .02$). Patients with older ages are more likely to have a TMD-function diagnosis. No associations were found between the dependent variable arthralgia and any of the independent or co-variables.

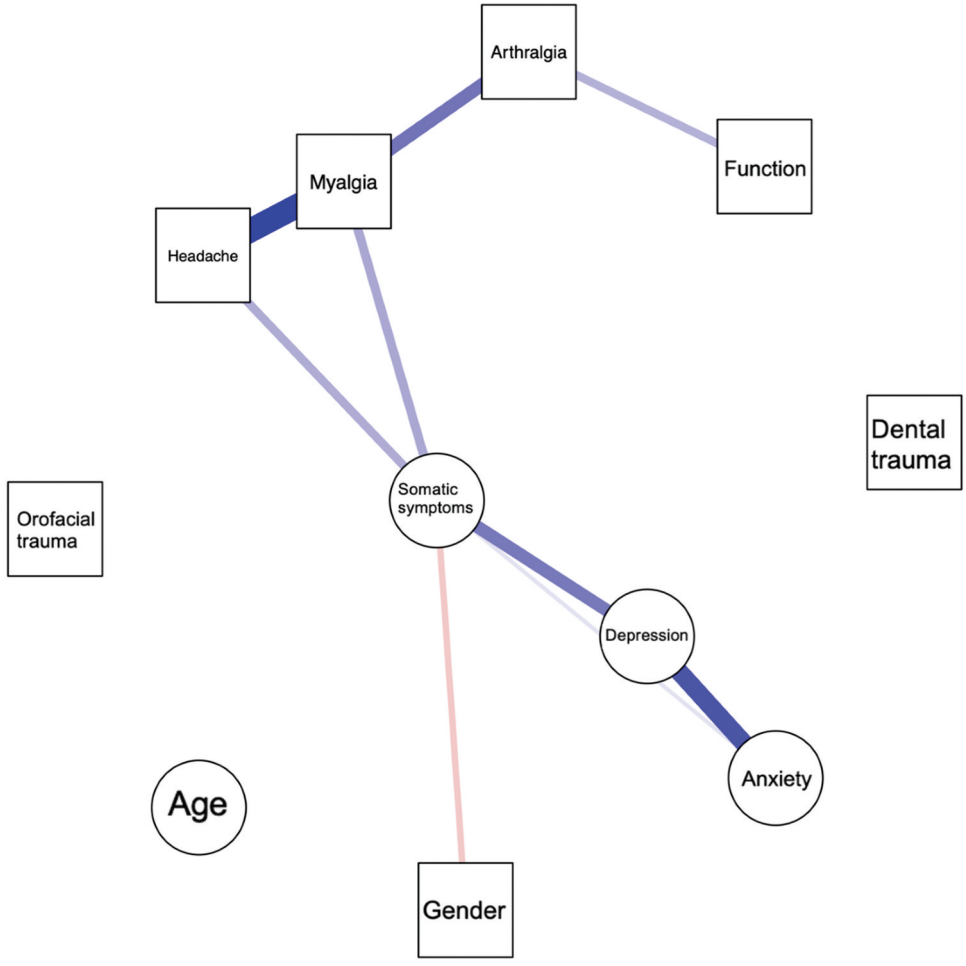

Figure 1. Network analysis of orofacial trauma and TMD in a tertiary clinic. Outcome network analysis. Four dependent variables: myalgia, arthralgia, Headache; Temporomandibular disorder-related headache, function; Temporomandibular dysfunction-function diagnosis. Independent variables: orofacial trauma. Co-variables: dental trauma, anxiety, somatic symptoms, depression, age, and gender. Nodes: numerical variables round; categorical variables square. Blue; positive association, red; negative association, viz: an association between somatic symptoms and female gender. A thicker line between variables means a more pronounced association.

In the network analysis, only 236 out of the 659 patients could be included due to missing variables. Figure 1 shows the outcome of the network analysis. No significant associations were found between the TMD diagnoses on the one hand and orofacial/dental trauma on the other hand. The different TMD diagnoses and the psychosocial variables, viz. somatic symptoms, anxiety, and depression, are associated in the network analysis. The strongest association is present between myalgia and TMD-related headache and between depression and anxiety, visible in Figure 1 with a thick dark-blue line. Gender is negatively associated with somatic symptoms, visible with the red line, which means that the female gender (defined as 0) is associated with somatic symptoms.

Discussion

No associations were found between the different TMD diagnoses and orofacial or dental trauma in a tertiary referral clinic. There were no direct associations in the binary logistic regression analyses nor indirect associations in the network analysis. None of the four different TMD diagnoses investigated were associated with orofacial or dental trauma. Therefore, the research question regarding the differentiation between type of trauma or type of TMD is not relevant within this population.

This outcome is contradictory to a recent review on orofacial trauma and TMD, in which an association between TMD and orofacial trauma was found [11]. In that review, no studies on tertiary referral clinics for TMD were included. Therefore, a possible explanation for this discrepancy may be a difference between TMD diagnoses in general dental practice and those in a tertiary referral clinic. The tertiary referral clinic at ACTA might have a larger proportion of more complex or therapy-resistant TMD problems that are harder to solve since most of the patients have a chronic TMD complaint and have

Table 2. Descriptive statistics of dependent variables; TMD diagnoses, independent variables; orofacial and dental trauma, and co-variables; psychological, and demographic variables.

		Total ($N = 659$)
Dependent variables		
Myalgia (N, %)		381 (57.8%)
Arthralgia (N, %)		203 (30.8%)
TMD-related headache (N, %)		113 (17.1%)
TMD-function diagnosis (N, %)		355 (53.9%)
Independent variables		
Trauma variables		
Orofacial trauma (N, %)		83 (12.6%)
Dental trauma (N, %)		39 (5.9%)
Co-variables		
Psychological variables		
Somatic symptoms (PHQ-15) (N, %)	None	116 (17.6%)
	Low	176 (26.7%)
	Medium	120 (18.2%)
	High	80 (12.1%)
Depression (PHQ-9) (N, %)	None	235 (35.7%)
	Mild	148 (22.5%)
	Moderate	72 (10.9%)
	Moderately Severe	19 (2.9%)
	Severe	18 (2.7%)
Anxiety (GAD-7) (N, %)	None	285 (43.2%)
	Mild	137 (20.8%)
	Moderate	48 (7.3%)
	Severe	21 (3.2%)
Stress (N, %)	None	48 (7.3%)
	Mild	216 (32.8%)
	Moderate	178 (27.0%)
	Moderately Severe	48 (7.3%)
	Severe	2 (0.3%)
Age y, median [IQR]		42.9 (29–55)
Female gender (N, %)		487 (73.9%)

Abbreviations; TMD; temporomandibular disorder; PHQ-15, Patient Health Questionnaire-15; PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder-7.

already been seen by different caretakers before their referral to the tertiary referral clinic. In line with this theory, the present results could also indicate that most TMD complaints are successfully resolved in general dental practice, which in turn aids in preventing the chronicity of the complaint. Alternatively, TMD caused by orofacial trauma may not be severe enough to seek help in a tertiary referral clinic. For example, patients may end up with a slightly limited mouth opening after condylar fracture, but for the patient, this might not be debilitating enough to seek treatment for, while in the review on orofacial trauma and TMD, this may have been addressed as a TMD, complaint [11].

Psychological factors play a big role in TMD; within the DC-TMD an entire axis is dedicated to these factors [4]. Lee et al. (2019) found elevated psychological scores in adolescents after macrotrauma [15]. In addition, a recent review showed that orofacial trauma patients suffer from PTSD and anxiety disorders significantly more often than the general population, especially victims of assault [16]. Tertiary referral clinics are known to include TMD patients with more mental health issues than the general population. A recent study on TMD patients in a tertiary referral clinic showed that psychiatric diagnoses were present in around half of the patients [17,18]. Possibly, in the tertiary referral clinic, patients more often have one or several life events that have a larger impact than an orofacial trauma and contribute more to the development of the TMD. Also, although not found in this study, the type of TMD could make a difference, as psychological risk factors play a role in some TMDs, but not in all [19]. Maybe the question should not be if the patient has experienced an orofacial trauma, but rather if that orofacial trauma was significant enough to develop a psychological trauma. A fall, for example, might be different from an assault in terms of psychological damage. In future studies, the focus should be on how the orofacial trauma was experienced versus the tissue damage that it caused.

Another variable that could influence the association between orofacial trauma and TMD is time. Kumaran and Soh (2020) found that the negative physical effects of trauma stabilize after six months [20]. If pain lasts longer than 1 or 2 years and becomes chronic, psychological symptoms start to play a larger role than physical symptoms [21]. Therefore, the time interval between an orofacial trauma and a TMD diagnosis could contribute to the association between both variables but also to the mechanism behind this association. In case of a relatively short interval, i.e., under six months, one would expect the physical consequences of the trauma to be the instigator in the development of a TMD. In case of a longer interval, one would expect psychosocial aspects of the orofacial trauma to be responsible for the TMD. A review of differentiating factors between acute and chronic TMD found psychological factors to be more present in chronic TMD. However, these factors did not increase the transition risk to chronicity [22]. In the present study, information on the time interval between orofacial trauma and TMD was unavailable for most participants. Also, no information was available on TMD complaints before the orofacial trauma. In future studies, it would be an important addition to take the timeline and prior TMD complaints into account.

The binary logistic regression analyses yielded significant associations between myalgia and TMD-related headaches on the one hand and somatic symptoms on the other hand. This was confirmed by the network analysis results, where all TMD diagnoses and psychological variables were directly or indirectly associated. This is in line with the literature, as TMD patients, especially those with a myogenous complaint, are known to have higher scores on psychosocial assessment [23,24]. The network analysis showed associations between all TMD diagnoses and between the TMD diagnoses and the psychological variables.

Table 3. Binary logistic regression model using four TMD diagnoses as dependent variables, orofacial and dental trauma as independent variables and psychological, and demographic variables as co-variables.

	Univariable regressions		Multivariable regressions	
	OR (95% CI)	p Value	OR (95% CI)	p Value
Dependent variable: Myalgia				
Independent variables				
Orofacial trauma	1.48 (0.91–2.41)	0.12	1.50 (0.84–2.69)	0.18
Dental trauma	1.23 (0.62–2.44)	0.55	1.02 (0.47–2.19)	0.97
Co-variables				
Anxiety (GAD7)			0.88 (0.63–1.23)	0.44
Stress			1.03 (0.77–1.38)	0.86
Somatic symptoms (PHQ15)			1.87 (1.44–2.42)	**<0.01**
Depression (PHQ9)			1.17 (0.87–1.57)	0.31
Gender			1.25 (0.79–1.99)	0.34
Age			0.99 (0.98–1.00)	0.08
Dependent variable: Arthralgia				
Independent variables				
Orofacial trauma	1.14 (0.69–1.88)	0.60	1.05 (0.6–1.84)	0.86
Dental trauma	0.64 (0.30–1.39)	0.26	0.66 (0.29–1.51)	0.32
Co-variables				
Anxiety (GAD7)			1.04 (0.75–1.44)	0.81
Stress			0.84 (0.63–1.13)	0.25
Somatic symptoms (PHQ15)			1.23 (0.96–1.57)	0.1
Depression (PHQ9)			0.97 (0.73–1.29)	0.84
Gender			1.62 (0.98–2.69)	0.06
Age			0.99 (0.98–1.00)	0.09
Dependent variable: TMD-related headache				
Independent variables				
Orofacial trauma	1.31 (0.74–2.33)	0.36	1.09 (0.55–2.17)	0.8
Dental trauma	1.90 (0.90–3.96)	0.09	2.06 (0.87–4.85)	0.1
Co-variables				
Anxiety (GAD7)			0.81 (0.55–1.20)	0.3
Stress			1.30 (0.89–1.91)	0.17
Somatic symptoms (PHQ15)			2.19 (1.59–3.01)	**<.01**
Depression (PHQ9)			0.87 (0.62–1.22)	0.43
Gender			1.56 (0.76–3.17)	0.22
Age			0.98 (0.97–1.00)	0.06
Dependent variable: TMD-function diagnosis				
Independent variables				
Orofacial trauma	1.21 (0.74–1.97)	0.44	1.10 (0.64–1.91)	0.73
Dental trauma	0.79 (0.41–1.53)	0.48	0.74 (0.35–1.53)	0.41
Co-variables				
Anxiety (GAD7)			0.79 (0.57–1.09)	0.15
Stress			0.96 (0.72–1.27)	0.78
Somatic symptoms (PHQ15)			1.10 (0.87–1.41)	0.43
Depression (PHQ9)			1.16 (0.88–1.54)	0.29
Gender			1.10 (0.70–1.74)	0.67
Age			0.99 (0.97–0.10)	**0.02**

Outcome binary logistic regression analysis SPSS. Four dependent variables: myalgia, arthralgia, TMD-related headache, TMD-function diagnosis. Independent variables: orofacial trauma, overall trauma. Co-variables: dental trauma, anxiety, stress, somatic symptom, depression, age, gender. OR; odds ratio, p-value significant below 0.05. Bold: statistically significant outcome.

Abbreviations; TMD; temporomandibular disorder, DC-TMD; Diagnostic Criteria-Temporomandibular Disorders; PHQ-15, Patient Health Questionnaire-15; PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder-7.

The associations between the different TMD diagnoses are also reported in the literature, as it is common for TMD patients to suffer from more than one diagnosis [25]. The association between the TMD diagnoses with pain and somatic symptoms is also substantiated in the literature [26]. The network analysis also found an association between somatic symptoms and female gender. This is contrary to the binary logistic regression analysis results, where no associations with gender were found. However, the binary logistic regression analysis yielded a significant positive association between a TMD-function diagnosis and higher age. In such TMD patients, in general, an association with gender is observed: most of the TMD patients are generally female [25,27,28]. A recent retrospective study on 3362 patients also found that females are more likely to have limitations in their jaw movements and that prevalence of these limitations increases with age [28], as did a TMD-function diagnosis in the present study. Qin et al. (2024) also found that pain symptoms increased with age [28]; an association not found in the present study.

This study has several limitations. Although a large group of patients was included in this study, less than 300 participants could be included in the network analysis, as the database needs to be

complete for such an analysis. Ideally, the network analysis would have been performed with a larger group of participants. However, a larger number of participants in the network analysis would not necessarily have led to a different outcome, although the sensitivity of the network analysis does increase with sample size [12]. Another limitation of this study is the low number of dental traumas, with only 39 out of 659 participants, probably because that variable is largely underreported in the present study. Indeed, the literature shows that around one-fifth of the adult population sustained a dental injury [29]. The reason for the probable underreporting of dental trauma is unknown. This study did not include information on the severity of the orofacial trauma or the burden for the patient, while both variables could be relevant in the association between orofacial trauma and TMD.

This study also has several strong aspects. To the authors' best knowledge, this study is the first attempt to investigate the association between orofacial and dental trauma and TMD in a tertiary referral clinic for TMD. One of the advantages of this study is the use of a reliable and prominent tool for diagnosing TMD, viz. the DC-TMD. With the use of both regular statistics in binary logistic regression analyses and the more recently developed network analysis, direct and indirect associations have been explored. Thus, the outcomes of the present study provide a reliable basis for further exploration of the association between orofacial trauma and TMD.

As the previous review did find an association between orofacial trauma and TMD [11], recommendations for future research would be to investigate a more general TMD population instead of patients in a tertiary referral clinic. In this review, no association between orofacial trauma and TMD in children was found [11]. Therefore, children were excluded from the present study. In addition, it is suggested to take the time interval between the orofacial trauma and TMD onset into consideration to better understand underlying mechanisms. Possibly, the focus should lay more on how the orofacial trauma was experienced versus what physical damage the patient endured. In a recent study on orofacial trauma, a large number of these patients suffered mental illnesses such as PTSD, anxiety, and depression, possibly due to the orofacial trauma [30]. Treatment of these mental aspects of orofacial trauma should be studied in future research. In that context, adding dental trauma could prove value despite the smaller physical damage. Also, it would be of additional value to know the origin of the orofacial trauma, for example, assault versus fall.

Conclusion

To conclude, no direct or indirect associations between orofacial trauma and TMD were found in the tertiary referral clinic investigated.

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ORCID

Loreine M.L. Helmer DDS https://orcid.org/0000-0002-8767-5590
Thiprawee Chattrattrai DDS PhD https://orcid.org/0000-0002-3715-1211

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Appendix

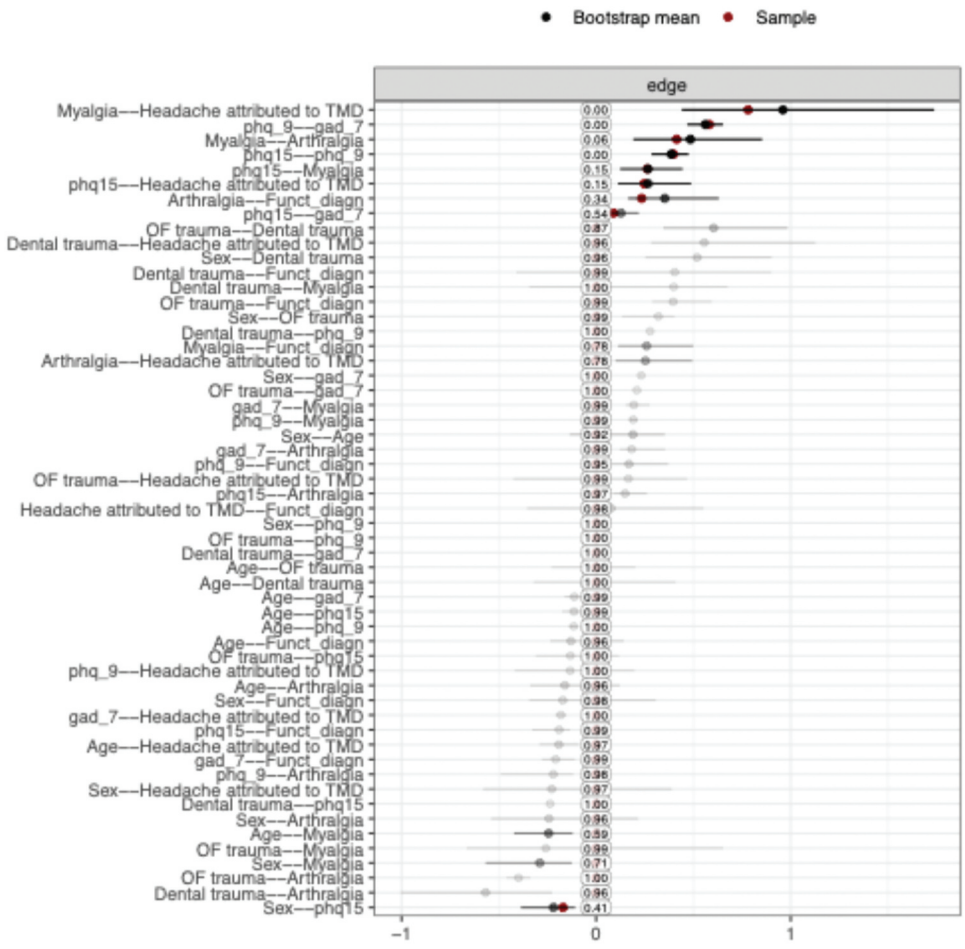

Figure A1. Bootstrap confidence intervals of network model on trauma and TMD.
The precision of the edges in the network model are visualized in the bootstrapped confidence intervals (CIs). The edges visible in the network model are black in the bootstrap, the grey CIs do not appear in the network model, as these are the non-significant edges. On the top and bottom of the plot are the strongest edges, in the middle the weakest. Positive edges are situated at the right side of the y-axis, negative ones at the left side.
The network analysis was performed with four dependent variables: myalgia, arthralgia, Headache; Temporomandibular disorder-related headache, function; Temporomandibular dysfunction-function diagnosis. Two independent variables: orofacial trauma, dental trauma. And several co-variables: anxiety (GAD-7), somatic symptoms (PHQ-15), depression (PHQ-9), age, gender. Nodes: numerical variables round; categorical variables square. Blue; positive association, red; negative association, viz: an association between somatic symptom and female gender. A thicker line between variables means a more pronounced association.