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# Prevalence of New-Onset Otological Symptoms in Patients with Temporomandibular Disorders

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**Abstract:** The aim of this retrospective study was to evaluate the prevalence of new-onset otological symptoms and the possible associations between tinnitus and oral parafunctional habits among patients with temporomandibular disorders (TMD) who attended a Craniofacial Pain Outpatient and a Dentistry Clinic. The medical reports and charts of patients who experienced TMD between 1 February 2016 and 31 December 2017 were reviewed, in order to evaluate the prevalence of new-onset aural fullness, vertigo and tinnitus. Tinnitus was also analyzed in more detail to evaluate possible associations with parafunctional habits. A total of 400 patients (301 females, 99 males) met the inclusion criteria, with a median age of  $39.6 \pm 15.6$  years. Overall, new-onset otological symptoms were reported by 304 (76%) subjects with TMD. Among otological symptoms, aural fullness was the most common ( $n = 133$ , 33.3%), followed by tinnitus ( $n = 92$ , 23%) and vertigo ( $n = 79$ , 19.8%). No significant correlations were found between tinnitus and bruxism ( $p = 0.28$ ), clenching ( $p = 0.11$ ), nail-biting ( $p = 0.96$ ), sleeping prone ( $p = 0.27$ ), chewing gum ( $p = 0.99$ ) and talking for a long time ( $p = 0.42$ ). The present study suggests that all patients with TMD should be investigated for new-onset otological symptoms, regardless of oral parafunctional habits. Early diagnosis would allow to plan personalized and appropriate therapeutic and rehabilitative pathways, minimizing the negative impact due to TMD.

**Keywords:** temporomandibular disorders; parafunctional habits; tinnitus; aural fullness; vertigo

## 1. Introduction

Temporomandibular disorders (TMDs) are a heterogeneous group of disorders characterized by structural or functional alterations of the masticatory system, mainly involving the muscles of mastication and temporomandibular joints (TMJ) [1,2]. TMDs represent the leading cause of pain in the orofacial region and one of most common musculoskeletal conditions, negatively affecting quality of life [1,2]. Although the etiology of TMDs is considered multifactorial, oral parafunctional habits, such as clenching and bruxism, seem to play an important role [3,4]. Yadav et al. have found that the degree of TMD symptoms increases in patients with parafunctional habits and with higher anxiety and depression scores [5]. Parafunctional habits could contribute to the onset and progression of painful TMD due to the great sensitization of afferent nociceptors caused by persistent mechanical

stimuli [6]. Some studies have also shown a significant relationship between TMD and otological symptoms [7–9], possibly due to excessive mechanical forces on the discomalleolar ligament or direct pressure on the auriculotemporal nerve [10]. In particular, TMDs have been suggested to be a risk factor for the development of severe tinnitus [11].

The aim of this study is to evaluate the prevalence of new-onset otological symptoms and the possible associations between tinnitus and oral parafunctional habits among patients with TMD who attended a Craniofacial Pain Outpatient and a Dentistry Clinic.

## 2. Materials and Methods

The present retrospective study was conducted at the Craniofacial Pain Outpatient of the Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico and at the Neuromuscular Dentistry Clinic of Istituto Stomatologico Italiano (Milan, Italy). The medical reports and charts of patients who experienced TMD between 1 February 2016 and 31 December 2017 were reviewed.

All patients underwent medical history and physical examination, assessing TMJ pain (spontaneous or exacerbated by finger pressure), TMJ noises, difficulty chewing, and limited mouth opening.

Listening carefully to the patients' descriptions of their symptoms and gathering additional information from questionnaires and clinical examination based on "Diagnostic Criteria for Temporomandibular Disorders Axis I (DC/TMD)" allowed physicians to confirm the diagnosis of TMD [2]. Clinical examinations included assessment of joint sounds during superior joint loading and with stethoscope, joint-play tests (traction, translation, and compression), joint and myofascial palpation, clench test and bite stick test. Furthermore, all subjects underwent instrumental tests, such as kinesiographic and electromyographic examinations of the masticatory muscles.

All patients also completed a questionnaire aimed at detecting the presence of otological symptoms; in particular, the authors evaluated the prevalence of new-onset aural fullness, vertigo and tinnitus (self-reported), defined as follows:

- Aural fullness: ear pressure or a "clogging sensation" of the ear;
- Vertigo: illusion of spinning motion;
- Tinnitus: perception of sound in absence of an external source.

Tinnitus was also analyzed in more detail to evaluate possible associations with self-reported parafunctional habits, including bruxism ("involuntary, unconscious, and excessive grinding of teeth"), clenching ("teeth pressed tightly together"), nail-biting ("onychophagia"), sleeping prone ("face down"), chewing gum (>3 times/day) and talking for a long time (>6 h/day).

The study included patients over 8 years of age diagnosed with TMD.

Otological symptoms prior to the diagnosis of TMD or clearly caused by medications, surgical intervention, acute cochlear and/or vestibular disorders were removed from the study.

The chi-squared test was performed to assess the relationship between tinnitus and bruxism, clenching, nail-biting, sleeping prone, chewing gum and talking for a long time.

Statistical analysis was performed with Stata 16 software (StataCorp. 2019, College Station, TX, USA). A *p* value of <0.05 was accepted as statistically significant.

The study was conducted according to the World Medical Association's Declaration of Helsinki and approved by the ethical committee (Area 2, Milano, Italy) of the Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico (protocol code 575\_2018bis, date of approval 11 September 2018). Written informed consent was obtained from all participants.

## 3. Results

A total of 400 patients (301 females, 99 males) met the inclusion criteria, with a median age of  $39.6 \pm 15.6$  years (range 9–82). Pediatric patients (<18 years of age) were 32 (8%), while adults represented the majority of the study sample (*n* = 368, 92%).

Overall, new-onset otological symptoms were reported by 304 (76%) subjects with TMD.

Among otological symptoms, aural fullness was the most common (n = 133, 33.3%), followed by tinnitus (n = 92, 23%) and vertigo (n = 79, 19.8%).

No significant relationships were found between tinnitus and any of the variables analyzed: bruxism (p = 0.28), clenching (p = 0.11), nail-biting (p = 0.96), sleeping prone (p = 0.27), chewing gum (p = 0.99) and talking for a long time (p = 0.42). (Table 1).

**Table 1.** Prevalence of tinnitus according to selected parafunctional habits in patients with temporomandibular disorders.

Variable	Patients N	Tinnitus N (%)	p-Value
Bruxism			
Yes	142	37 (26.1)	0.28
No	258	55 (21.3)	
Clenching			
Yes	219	57 (26.0)	0.11
No	181	35 (19.3)	
Nail-biting			
Yes	92	21 (23.1)	0.96
No	308	71 (22.8)	
Sleeping prone			
Yes	171	36 (21.1)	0.27
No	229	56 (24.5)	
Chewing gum			
Yes	174	40 (23.0)	0.99
No	226	52 (23.0)	
Talking for a long time			
Yes	171	36 (24.5)	0.42
No	229	56 (21.1)	

#### 4. Discussion

The present study confirms the importance of investigating otological symptoms in patients with TMD. Indeed, more than three out of four subjects who attended the clinics for TMD also complained of one among aural fullness, dizziness or tinnitus.

Unlike previous studies [12,13], aural fullness was the leading otological symptom in patients with TMD and it was reported by one third of the subjects. The relationship between TMD and aural fullness is still unclear, but it might be explained by the pathological hyperactivity of the masticatory muscles and the consequent excessive tonic contraction of the tensor tympani muscle, resulting in Eustachian Tube dysfunction [14]. Therefore, in case of nonspecific aural fullness, TMD should be investigated, also using the TMJ-MRI [15], in order to carry out the most appropriate treatment [16].

A relevant percentage of patients (19.8%) also reported new-onset vertigo, confirming that balance disorders are possible complications of TMD [8,17]. Although the pathophysiological mechanisms underlying the link between vertigo and TMD are poorly understood, possible hypotheses described in the literature include arterial constriction in the temporal region and irritation of the auriculotemporal nerve due to dysfunction of the masticatory muscles [8,18].

A systematic review by Manfredini found that the prevalence of tinnitus in patients with TMD was higher than in the general population, ranging from 3.7% to 70% [19]. In

the present study, tinnitus was reported by 23% of patients with TMD and it was the second most common new-onset otological symptom. Similarly to what suggested for aural fullness, hypertonia of the mandibular musculature due to inadequacies of dental occlusion might be responsible for an alteration in the function of the tensor tympani, whose tonic contraction would lead to the onset of tinnitus [14]. Furthermore, the increased tension of maxillary muscles could lead to an excessive stimulation of the structures within the petrotympanic fissure with subsequent changes in cochlear microcirculation, inducing degenerative processes which might be responsible for the occurrence of tinnitus [10]. In patients with TMD, the location and type of petrotympanic fissure could be a predisposing factor for tinnitus, and the nature of condylar displacement could also be essential for the induction of tinnitus [10]. Another possible cause of tinnitus in patients with TMD could be the hyperactivation of the dorsal cochlear nucleus due to abnormal trigeminal inputs [20].

Additional indications supporting the role of TMD in tinnitus include [21,22]: (a) the two conditions occur simultaneously; (b) worsening of tinnitus coincides with aggravation of TMD; (c) dental functional therapy can improve acute tinnitus; (d) tinnitus can be modulated by TMJ and head and neck maneuvers.

Parafunctional habits have been widely recognized as etiological factors for the development of TMD [3,4]; this study confirmed the high prevalence of bruxism, clenching, nail-biting, sleeping prone, chewing gum, and talking for a long time among patients with TMD. However, unlike previously described results [13,23], the results of this study suggest that parafunctional habits do not directly imply a higher risk of new-onset tinnitus in patients with TMD.

The present study has some limitations, including its retrospective nature, the relatively small number of patients and the lack of long-term follow-up.

Future developments of this research could involve (a) evaluation of tinnitus characteristics (such as pitch and loudness) in relation to oral parafunctional habits; (b) study of the association between TMD and otological symptoms according to other variables, such as age groups, gender, psychological and sleep impairments; (c) assessment of the duration and severity of otological symptoms through rigorous anamnestic, clinical and instrumental protocols.

## 5. Conclusions

On the basis of clinical findings, all patients with TMD should be investigated for new-onset otological symptoms, regardless of oral parafunctional habits. Early diagnosis would allow to plan personalized and appropriate therapeutic and rehabilitative pathways, minimizing the negative impact due to TMD.

Further studies, possibly multicentric and on a large population, are needed to confirm our findings.

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**Informed Consent Statement:** Written informed consent was obtained from all participants.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author. The data are not publicly available due to restricting privacy.

**Conflicts of Interest:** The authors declare no conflict of interest.

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