Chapter 29
The Dentist

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Keypoints

1. Patients with tinnitus are *prima facie* beyond the responsibility of dentists.
2. Studies of the prevalence of tinnitus in people with temporomandibular disorders (TMD) (give values from 2 to 59%) and the prevalence of TMD in patients with tinnitus ranging from 7 to 95%. Evidence about the relationship between TMD and tinnitus is conflicting and it is not known if it is causal or coincidental.
3. Patients with TMD-related tinnitus can benefit from TMD therapy but TMD therapy in patients with tinnitus without any signs of TMD is not recommended.

Keywords TMD • Tinnitus • Dentist

Abbreviations

CMD	Craniomandibular disorder(s)
MPD	Myofascial pain dysfunction
TMD	Temporomandibular disorder(s)
TMJ	Temporomandibular joint

Introduction

Tinnitus is generally regarded as a symptom of the ear or an auditory disorder. Therefore, patients with tinnitus are *prima facie* beyond the responsibility of dentists or maxillofacial surgeons. Additionally, patients suffering from tinnitus do not primarily consult a dentist, and most patients will not relate their "ear symptoms" to possible stomatognathic or temporomandibular disorders. The understanding of tinnitus symptoms and knowledge on the pathophysiology of different forms of tinnitus has, however, changed in recent years. Tinnitus researchers have benefited from learning from other fields of medicine, from cooperating with other disciplines, and from "thinking outside the box" [1]. Today, tinnitus is seen as a symptom presenting in many forms, and the contribution of dental science to a better understanding of tinnitus is appreciated by "traditional tinnitus therapists", such as otolaryngologists, audiologists, psychologists, and psychiatrists.

Temporomandibular Disorders

Dentists and maxillofacial surgeons have long known that tinnitus symptoms are not uncommon in patients with temporomandibular joint (TMJ) and masticatory muscle disorders – also referred to as Costen's syndrome – [2], craniomandibular disorders (CMD), myofascial pain dysfunction (MPD), temporomandibular dysfunction, or temporomandibular joint syndrome [3]. Nowadays, these terms are summarized under the heading "temporomandibular disorders" (TMD) [4, 5]. TMD are considered as a cluster of various joint and muscle disorders and a subgroup of general musculoskeletal and rheumatologic disorders, but should be regarded as a distinct group of diseases and symptoms [6]. The complex signs and symptoms of TMD are generally described as pain or tenderness in the

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region of the TMJ or the masticatory muscles (myofascial pain), limitation or disturbance of mandibular movements, joint sound (clicking and crepitation), locking, oral parafunction, masticatory muscle hyperactivities (bruxism, clenching, and rocking of teeth), and fatigue in the jaws [3, 6]. Unfortunately, since the classification of the different forms of TMD is still not agreed upon, numerous ways of categorizing TMD have been proposed [7]. In general, TMD can be classified as a joint disorder (including structural deviations, mechanical derangements, and inflammatory disorder or arthritis), muscle disorder, and a combination of both [4, 6]. Clinicians who treated patients with TMD as a main complaint have noted that these patients often present with ear symptoms as a secondary complaint. Therefore, related conditions such as tinnitus were improved and often eliminated after treatment of their TMJ problems [8–11]. Tinnitus and TMD symptoms show many parallels in their clinical appearance. Knowledge of the etiology of both symptoms and disorders is limited. Thus, valid and reproducible diagnostic criteria are lacking. As a result, conflicting opinions exist on therapeutic proceedings for patients with tinnitus and TMD. Success rates of specific therapies remain unpredictable, which in turn transforms patients of both groups into an "unpopular" group of patients.

Prevalence of Temporomandibular Joint Disorders

The literature contains conflicting evidence about the prevalence of tinnitus in individuals with TMD as a main complaint (ranging from 2 to 59%), but most studies report a much higher prevalence of tinnitus in patients with TMD than in the general population. Unfortunately, most of the presented studies are mainly descriptive and have not been designed to compare between patients with symptoms and a reference group (Table 29.1). Studies of the general population showed prevalence of tinnitus from 14.2 to 20.1% (please see Chap. 5). Vice versa, information on the prevalence of TMD in patients with tinnitus is also incongruent (ranging from 7 to 95%) (Table 29.2). However, incidence of TMD was found to be higher in patients with tinnitus than in the general population, where tinnitus occurred in 16–59% for reported symptoms and in 33–86% for clinical signs [12].

Relation Between TMD and Ear Problems

Many different manifestations lead to the diagnosis of TMD, and a discrepancy exists between reported

Table 29.1 Studies reporting tinnitus in patients with TMD as the main complaint

	Prevalence of tinnitus, no (%)	
Source	Patients with TMD	General population
Bernstein et al. [35]	36/86 (42%)	–
Bush [8]	35/105 (33%)	–
Bürgers (unpublished)	30/82 (37%)	68/951 (7%)
Camparis et al. [36]	54/100 (54%)	–
Cooper et al. [37]	301/837 (36%)	–
Dolowitz et al. [38]	200/338 (59%)	46/326 (14%) and 121/368 (33%)
Gelb et al. [39]	311/742 (42%)	–
Gelb et al. [40]	71/200 (36%)	–
Goodfriend [31]	24/168 (14%)	–
Hankey [41]	6/68 (9%)	–
Koskinen et al. [42]	9/47 (19%)	–
Myrhaug [32]	436/1,391 (31%)	–
Parker et al. [9] and Chole et al. [28]	199/338 (59%)	45/326 (14%) and 118/365 (33%)
Rubinstein et al. [43]	93/376 (25%)	–
Tuz et al. [10]	91/200 (46%)	13/50 (26%)
Upton et al. [44]	72/989 (7%)	–
Wedel et al. [45]	8/350 (2%)	–
Wright et al. [46]	101/267 (38%)	–

Table 29.2 Studies reporting TMD in patients with tinnitus as the main complaint

	Prevalence of TMD, no (%)	
Source	Patients with tinnitus	General population
Bernhardt et al. [47]	18/30 (60%) >2 TMD symptoms	697/1,907(37%)
Bosel et al. [17]	129/340 (38%)	–
Kempf et al. [48]	110/138[a] (80%)	–
Linsen et al. [49]	17/22 (77%)	–
Morgan [23]	19/20 (95%)	–
Peroz [13]	TMJ sounds 9/40 (23%)	1/35 (3%)
	Muscle tenderness 27/40 (93%)	8/35 (23%)
	Bruxism 25/40 (63%)	13/35 (37%)
Rubinstein et al. [43]	47/102 (46%)	–
Tullberg et al. [50]	101/120 (84%)	–
Upton et al. [44]	72/989 (7%)	–
Vernon et al. [18]	69/1,002 (7%)	–

[a]Patients with inner ear dysfunction

symptoms and clinical findings. Therefore, epidemiological studies on TMD (as well as on tinnitus) should not be compared without restrictions. Nevertheless, the simultaneous occurrence of tinnitus and TMD has led to the assumption that there may be a relationship between the two conditions. The initial claim relating tinnitus symptoms, temporomandibular joint, and masticatory muscle disorders was made by Costen in 1934, who described a syndrome of ear and sinus symptoms relating to disturbed TMJ function [2]. Although Costen's structural and mechanical theories on the correlation of TMD and tinnitus have now been discarded, his considerations started numerous scientific efforts to reveal the linkage between both symptoms [13–16]. At this point, many questions on this topic remain unexplained. We still do not know whether ear symptoms (such as tinnitus and TMD) are coexistent, independent, or unrelated [8, 17–22] or whether both diseases have a causal connection [23–30]. Since TMD and tinnitus occur frequently in humans, their coincidence may not mean these two diseases have common causes or common risk factors. Authors reporting causal associations between tinnitus and TMD have based their conclusions mainly on clinical, epidemiological, anatomical, and histological investigations [23–27].

For example, the simultaneous occurrence of bruxism (grinding of teeth) as a symptom of TMD and tinnitus may be explained by two different ways: patients with bruxism (TMD as a main complaint, shifting therapeutic responsibilities toward dentists) generate tinnitus symptoms through overloading their masticatory muscles and the temporomandibular joint or patients with tinnitus (tinnitus as a main complaint, shifting therapeutic responsibilities toward otorhinolaryngologists, audiologists, psychiatrists, etc.) process ear symptoms through grinding their teeth nightly. In addition to these causal explanations, these symptoms may occur without any causal relationship, or the presence of a third "disease" such as mental pressure, physic stress, or specific medication can act as a shared reason or a collective trigger causing TMD and tinnitus as secondary complaints [9, 19, 20]. Parker and Chole assumed that the relationship between TMD and tinnitus may be that both are responses to emotional stress [9]. However, attempts to find such a specific collective trigger for tinnitus and TMD symptoms remain speculative [21]. TMD-related tinnitus has been classified as objective tinnitus in most studies [26, 31, 32]. In contrast, Shulman and co-workers considered TMD-related tinnitus as subjective idiopathic tinnitus that was thought to directly or indirectly extend from a temporomandibular joint dysfunction on the auditory system [33, 34].

Besides epidemiological studies on TMD-related tinnitus and the steric adjacency of the *Porus acusticus* and the TMJ, a causal relationship between both symptoms has been observed. Ren and Isberg, for example, stated that in 53 patients with unilateral tinnitus and anterior disk displacement, disk displacement was found to be present in the ipsilateral joints in all patients, whereas the contralateral joint was asymptomatic in 50 patients (94%) [27]. In some patients, the intensity and quality of tinnitus can be altered (in most cases an enhancement) by mandibular movements, by pressure applied to the TMJ, or by biting [3, 13, 18, 24]. These alterations may indicate that increased activity of the masticatory muscles

or pressure on the TMJ increases or even causes the perception of tinnitus, which in turn corroborates the theory that TMD is the causal trigger of tinnitus [3]. Nevertheless, up to now, no conclusive explanation exists for this phenomenon. It should be mentioned that some authors could not find any epidemiological correlation between TMD and tinnitus symptoms [8, 18, 22]. It should also be mentioned that the innervations of the TMJ and adjacent tissue project to cells in the upper part of the spinal cord and the trigeminal nucleus, which in turn project to cochlear nucleus (see Chaps. 8 and 9). This may explain why some individuals with TMD also have tinnitus.

From a dental perspective, tinnitus is possibly a secondary complaint of TMD or vice versa. Therefore, evaluation of possible involvement of the TMJ and masticatory muscle disorders seems feasible in all patients with tinnitus, as well as using TMD therapy in patients with TMD symptoms (TMD-related tinnitus). In contrast, TMD therapy in patients with tinnitus but without any signs of TMD is not based on scientific evidence.

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