Clinical evaluation of tinnitus in patients with sleep bruxism: prevalence and characteristics

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SUMMARY Evaluation of the prevalence and characteristics of tinnitus in a Brazilian series of sleep bruxism patients. In this descriptive study, 100 patients (80 women and 20 men) were selected through the self-report of grinding teeth during sleep, confirmed by room mate or family member. They were evaluated according to a systematized approach: a questionnaire for orofacial pain and the Portuguese version of the Research Diagnostic Criteria for Temporomandibular Disorders. The patients were divided into two groups: group A, 54 patients with complaint of tinnitus and group B, 46 patients without tinnitus complaint. The mean age was 37.85 (13–66 years) and 34.02 years (20–59 years), respectively, for groups A and B ($P = 0.1164$). There was statistically significant difference between the two groups, with higher prevalence for the group A, in relation to: presence of chronic facial pain ($P = 0.0007$); number of areas painful to palpation in the masticatory and cervical muscles ($P = 0.0032$); myofascial pain in the masticatory muscles ($P = 0.0003$); absence of teeth without prosthetic replacement ($P = 0.0145$) and indices of depression ($P = 0.0234$). Structural alterations of the TMJ, like disc displacement and vertical dimension loss did not differ for the two groups. Tinnitus frequency was higher in patients with sleep bruxism and chronic facial pain. Myofascial pain, number of areas painful to palpation in the masticatory and cervical muscles, higher levels of depression and tooth absence without prosthetic replacement were more frequent in the group with tinnitus.

KEYWORDS: tinnitus, sleep bruxism, temporomandibular disorders, orofacial Pain, temporomandibular joint

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Introduction

Tinnitus is the perception of sound in the absence of an apparent acoustic stimulus and is not a specific disease entity, but rather a symptom, with many potential causes. Although there are several theories regarding the pathophysiology of tinnitus, the precise mechanism remains to be elucidated. Tinnitus may be related to otological, neurological and traumatic causes, adverse effects of drugs, nutritional deficiencies, metabolic disturbances, dietary, depression and temporomandibular disorders (TMD). Thus, the aetiology of tinnitus is diverse and may result from abnormal neural excitation of various levels of the auditory axis (1).

Aural symptoms like tinnitus are frequently related as symptom of TMD (2, 3) and many patients report improvement of tinnitus after dental and TMD therapy (4, 5). There are suggestions of clinical criteria for identifying the characteristics of the masticatory origin of tinnitus (6). Recent epidemiological studies relate complaints of tinnitus and masticatory and cervical muscle pain in patients with TMD diagnosis (7, 8).

The observation that aural symptoms such as tinnitus, otalgia, impaired hearing, dizziness and vertigo are
common complaints among patients suffering from TMD, has prompted a number of authors to look for a causal relation between TMD and these symptoms.

Costen (9) assumed that loss of vertical dimension can lead to an overclosure and retro-displacement of the condyles, causing compression of the auditory structures like the auriculotemporal and chorda tympani nerves and the Eustachian tube. Myrhaug (10) suggested that neuromuscular dysfunction of the masticatory muscles may trigger alterations in the sound-conducting apparatus because, phylogenetically, the middle ear bones are interpreted as jaw bones, and the temporal and palatine tensor muscles are thought to have originated as masticatory muscles and both are supplied by the trigeminal nerve. Because of this common nerve supply, bite anomalies and clenching could not only result in states of tension and contraction in the masticatory muscles, but they could also trigger a secondary reflex contraction in the tympanic and palatine tensor muscles. Increase in tympanic membrane tension and disturbance of the Eustachian tube function could consequently cause fluctuating ear symptoms. Pinto (11) found that the temporomandibular joint (TMJ) structures were connected to the malleus and that the excursion of the disc and condyle during mandibular movement could induce mobility of the malleus and alter the tension of the tympanic membrane. Though the relationship between tinnitus and TMD has attracted great interest during the past several years, theories attempting to explain this association are still inconsistent. More recently, studies involving functional neuroanatomy and neuroplasticity of the central auditory system could assist with clarifying this question.

Microtrauma associated with repetitive activities such as bruxism, is considered a risk factor for the onset and perpetuation of pain in the TMD and could be directly related to the symptom of tinnitus. Patients with longstanding bruxism behaviour have common symptoms of TMD such as facial pain, AM stiffness of the jaw, TMJ sounds, muscle fatigue during chewing and muscle tenderness to palpation (12) and patients with TMD symptoms have high frequency of bruxism (13). However, the cause-and-effect relationship between bruxism and TMD is still not clear because many people who grind the teeth do not have TMD symptoms (14).

Sleep bruxism has been defined by the American Sleep Disorders Association (ASDA) (15) as a stereotyped movement disorder characterized by grinding or clenching of the teeth during sleep. Most data regarding the aetiology of bruxism come from studies of sleep bruxism and taking all the evidence together, bruxism appears mainly to be regulated centrally, not peripherally (16). Bruxism is the third most frequent sleep disorder and is generally associated with obstructive apnea and snoring (17).

Epidemiological studies on the relationship between tinnitus and TMD have not considered the presence or absence of bruxism in patients and the diagnostic criteria for TMD should be standardized for obtaining more reliable results about this issue.

Considering the muscle hyperactivity of sleep bruxism and its potential role in the onset and perpetuation of TMD and the symptom of tinnitus, this study aimed to verify the prevalence of tinnitus and to evaluate the characteristics of a sample of patients with sleep bruxism, as well as the relationship between tinnitus and TMD.

Methods

A total of 100 patients were selected from 500 subjects referred to the Orofacial Pain Clinic at the Hospital das Clínicas of São Paulo University (EDOF-HC) over a period of 18 months. All patients were evaluated initially using a questionnaire that identify the chief complaint, pain history and presence of sleep bruxism. The inclusion criterion for the sample was the statement that they often made tooth grinding sounds during sleep, confirmed by room mate or family member.

The patients referred to the Orofacial Pain Clinic presented with several kinds of complaints. The major complaints of the 100 patients that were selected by the confirmation of sleep bruxism were: facial pain ($n = 46$), headache ($n = 18$), tired jaws ($n = 8$), bruxism ($n = 12$), tooth ache ($n = 4$), tooth wear ($n = 6$), dental failure ($n = 2$), difficult mouth opening ($n = 2$) and tinnitus ($n = 2$).

A standardized diagnostic protocol was applied to all patients equally by only one experienced and trained dentist. It consisted of an interview and systematic evaluation of cervical, cranial, facial, dental and other oral structures according the following instruments or specialized exams:

2. The EDOF-HC protocol (19), a standardized orofacial pain questionnaire to detail: (a) the chief complaint, (b) the general pain characteristics, (c) the presence of headache or body pain complaints, (d) the medical history, and (e) the dental condition and occlusion. 3. Ortopanthomography of the jaw.

The RDC/TMD questionnaire allowed to obtainment of the self-report characteristics and the level of depression. The self-report of ear noises was obtained by the question: ‘Do you have noises or ringing in your ears?’. The diagnostic criteria of RDC/TMD allowed the patients to be classified into diagnostic categories of TMD. The physical examination was performed according to the RDC/TMD directions and allowed the number of areas painful to palpation of the muscles and TMJ to be evaluated. The chief complaint and the occlusal condition were obtained through the EDOF-HC protocol that was used as a complementary diagnostic tool.

The statistical analysis was performed using a non-parametric test (chi-square test) for qualitative variables. It was possible to compare the number of areas painful on palpation and the average age of groups using a parametric test (Student’s t-test). For age, the data were not distributed normally, therefore the logarithms of the data were used, as the variances were equal and there was a sufficient number of subjects in both groups. The data were analysed in the SPSS 11.0 for Windows program.

All subjects gave informed consent to procedures approved by the Ethics Committee of the Medical School.

Results

One hundred patients (80 men and 20 women) with ages varying from 13 to 66 years (average of 36.09 years) were evaluated. Through the findings of RDC/TMD self-report, the patients were divided into two groups in accordance with the report of the presence or absence of tinnitus: (i) group A, with sleep bruxism and complaints of tinnitus; (ii) group B, with sleep bruxism and without complaints of tinnitus.

The self-report of tinnitus (group A) was observed in 54% of the evaluated patients (45 women and nine men), with ages that varied between 13 and 66 years (average of 37.85 years). There were not statistically significant differences for age (P = 0.1164) and gender (P = 0.367) between the two groups (Table 1).

Data from EDOF protocol revealed that facial pain was the main complaint of 70 patients, 46 (85.18%) of group A and 24 (52.17%) of group B. The patients with tinnitus presented significantly higher frequency of facial pain (P = 0.0007), with facial pain duration ranging from 1 to 27 years (mean 6.92 years) and the intensity of pain [Visual Analogue Scale (VAS)] ranging from 1 to 10 (mean 4.33). In accordance with the self-report characteristics of the RDC/TMD, the patients with tinnitus presented significantly higher frequency of complaints about uncomfortable bite (P = 0.0000) and AM stiffness (P = 0.0003), but there was no difference between the two groups with regard to the self-report of diurnal tooth grinding/clenching (Table 2).

The physical examination performed according to axis I of RDC/TMD, showed a higher number of areas painful to palpation in the masticatory and cervical muscles (P = 0.0032) for the group with tinnitus complaint. Axis I of RDC/TMD revealed statistically significant difference for the presence of myofascial pain of the masticatory muscles (P = 0.0003) and arthralgia (P = 0.0033) in the patients with tinnitus, the same not occurring in relation to TMJ disc displacements (Table 3).

There was an indication of increased levels of depression in the patients with tinnitus, that was statistically significant (P = 0.0234) when compared with the patients without tinnitus (Table 4).

Table 1. Demographic characteristics of the sample

<table>
<thead>
<tr>
<th>Gender*</th>
<th>Group A</th>
<th>Group B</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>men</td>
<td>n = 9</td>
<td>n = 11</td>
<td>n = 20</td>
</tr>
<tr>
<td>women</td>
<td>n = 45</td>
<td>n = 35</td>
<td>n = 80</td>
</tr>
<tr>
<td>Mean age† (range)</td>
<td>37.85 (13–66 years)</td>
<td>34.02 (20–59 years)</td>
<td>36.09 (13–66 years)</td>
</tr>
<tr>
<td>Total</td>
<td>n = 54</td>
<td>n = 46</td>
<td>n = 100</td>
</tr>
</tbody>
</table>

*Not statistically significant (chi-square test: P = 0.367).
†Not statistically significant (Student’s t-test: P = 0.1164).

Table 2. Self-report characteristics according the RDC/TMD (%)

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>P-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial pain complaint</td>
<td>85.18</td>
<td>52.17</td>
<td>0.0007*</td>
</tr>
<tr>
<td>Diurnal teeth grinding/clenching</td>
<td>81.48</td>
<td>69.56</td>
<td>0.164</td>
</tr>
<tr>
<td>Uncomfortable/unusual bite</td>
<td>81.48</td>
<td>36.96</td>
<td>0.0000*</td>
</tr>
<tr>
<td>AM stiffness</td>
<td>88.88</td>
<td>54.35</td>
<td>0.0003*</td>
</tr>
</tbody>
</table>

*Significance of chi-square test.
Table 3. Areas painful to palpation and TMD diagnosis, according RDC/TMD axis I

<table>
<thead>
<tr>
<th>Area</th>
<th>Group A</th>
<th>Group B</th>
<th>P-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areas painful to palpation (%)</td>
<td>17.74</td>
<td>12.41</td>
<td>0.0032*</td>
</tr>
<tr>
<td>Myofascial pain (%)</td>
<td>85.18</td>
<td>47.83</td>
<td>0.0003†</td>
</tr>
<tr>
<td>Disc displacement (%)</td>
<td>20.37</td>
<td>17.39</td>
<td>0.705</td>
</tr>
<tr>
<td>Arthralgia (%)</td>
<td>70.37</td>
<td>39.13</td>
<td>0.0033†</td>
</tr>
</tbody>
</table>

*Significance of Student’s t-test. †Significance of chi-square test.

Table 4. Depression levels, according RDC/TMD axis II (%)

<table>
<thead>
<tr>
<th>Depression levels</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>16.67</td>
<td>41.30</td>
</tr>
<tr>
<td>Moderate</td>
<td>38.89</td>
<td>26.09</td>
</tr>
<tr>
<td>Severe</td>
<td>44.44</td>
<td>32.61</td>
</tr>
</tbody>
</table>

*Significance of chi-square test: P = 0.0234.

Table 5. Tooth loss and prosthetic replacement, according EDOF protocol data (%)

<table>
<thead>
<tr>
<th>Dental condition</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Totally dentate</td>
<td>38.89</td>
<td>67.39</td>
</tr>
<tr>
<td>Partially edentulous without prostheses</td>
<td>38.89</td>
<td>23.91</td>
</tr>
<tr>
<td>Partial fixed, removable and complete prostheses</td>
<td>22.22</td>
<td>8.70</td>
</tr>
</tbody>
</table>

*Significance of chi-square test: P = 0.0145.

Considering the tooth loss and prosthetic replacement of the sample (Table 5), there was significantly lower frequency of totally dentate patients and higher frequency of partially missing teeth without prosthetic replacement for the group with tinnitus (P = 0.0145). For group A, 12.96% of patients had vertical dimension loss and for group B, 8.70%, which did not represent a statistically significant difference.

Discussion

The present study showed a prevalence of 54% of tinnitus complaint in patients with confirmed history of sleep bruxism. The subjects with tinnitus presented significantly higher frequency of facial pain complaint, higher mean number of painful masticatory muscle areas on palpation and higher frequency of arthralgia than those without tinnitus complaint. Bernhardt et al. (7) found 60% of the tinnitus patients and 36.5% of the control subjects without tinnitus exhibited more than two symptoms of TMD and the tinnitus patients had significantly more muscle and TMJ palpation pain. Kuttila et al. (20) found the number of subjects with pain in masticatory muscles is significantly higher in a population with tinnitus than in a population without tinnitus. Lam et al. (21) found 64.1% of subjects with tinnitus had TMD. Moreover, epidemiological comparative studies showed that patients with TMD presented significantly higher frequency of tinnitus than the general population (21, 22).

For a long time, the complaint of tinnitus was related with morphological alterations of the TMJ (11), a fact that was still not confirmed by the studies of patients with mechanical abnormalities of the TMJ such as disc displacements, because they do not indicate higher prevalence of tinnitus in these patients. This study corroborates these data, therefore no statistically significant differences were found between the two groups of patients in relation to the presence of disc displacements, differently from the presence of myofascial pain or arthralgia. Ciancaglini et al. (23) found tinnitus and earache were not statistically significantly associated with the severity of the arthropathy, scored by the assessment of TMJ noise, spontaneous TMJ pain, and tenderness of TMJ to digital palpation.

With regard to arthralgia, the clinical evaluation data of the present study strengthens the idea that this pain was not related to structural alterations, like disc displacement, and could be characterized as capsulitis, synovitis or retrodiscitis. Pain in the pre-auricular area can have local or regional origin, as the referred dental, masticatory or cervical muscle pains, ear disease and other diseases of the head and neck region (19, 24) and our evaluation discharged these possibilities.

In this study, with regard to the sample of patients with chronic facial pain, some signs considered as being criteria for diagnosing myofascial pain because of sleep bruxism were identified such as uncomfortable bite and AM stiffness, clearly different from the data found in patients with sleep bruxism and without pain. The presence of the uncomfortable bite and pain complaint adds relevant aspects to the patients’ neural aspect, therefore when these complaints are present in chronic patients, as in the studied sample, it surely involves various biopsychosocial components. Differently from acute pains, chronic pain must be analysed, taking into consideration the possible modifications of the central nervous system such as central sensitization,
neuroplasticity and dysfunction of the pain suppression system. Tinnitus is a symptom of multifactorial origin, with peripheral and central contributory factors. It is possible that the higher frequency of patients with chronic facial pain in the group with tinnitus is a consequence of sensory-motor interactions, observed in patients with chronic pain as in patients with tinnitus (25, 26).

Several theories have been proposed to explain the tinnitus phenomenon, but the lack of consensus reflects the complex nature of this symptom. The observation that tinnitus occurs in those with complete resection of the eighth cranial nerve, supports the assertion that the central nervous system is involved in the generation and perception of abnormal sound. This central origin hypothesis has been attributed to increased neural activity, resulting in aberrant sound perception (1).

Tinnitus has been related to cervical myofascial pain and maneuvers of muscle contraction involving masticatory, head and neck muscles often modulate tinnitus intensity, suggesting the existence of anatomical and physiological connections between the auditory and somatic pathways. Although the definitive explanation for this modulation is still controversial, it has been suggested that somatic stimuli originating in the head and neck can generate excitatory neuronal activity in the auditory pathways (27). Other observations implicate the muscle spindle as initiating the neural activation that ultimately modulates the central auditory pathway, including the dorsal cochlear nucleus. Somatic influences upon auditory perception are not limited to tinnitus subjects but are a fundamental property of the auditory system (26).

Up to this moment, the present study is the first one to relate chronic musculo-skeletal facial pain, bruxism and tinnitus. No other study has focused the prevalence of tinnitus in bruxers and its relationship with TMD. The findings in this do not prove a causal relationship, but investigations of this association may improve the understanding of bruxism, TMD and otological symptoms of tinnitus.

Another interesting aspect of the present study was the depression indices, evaluated through axis II of the RDC/TMD, that were higher in the presence of tinnitus. These data strengthen the fact that depression is a common condition in patients with chronic pain, including facial pain. These data must be evaluated in the overall context of the patient with chronic pain for a better understanding of this condition. As chronic facial pain was statistically significant in the group of patients with tinnitus, its involvement in chronic alterations can be speculated. These conditions produce alterations in the peripheral and central nervous system, suggesting the presence of multiple sensitive, psychological, neurovegetative and motor alterations that could be involved in its maintenance.

It has been proposed that the limbic system plays a large role in the response to tinnitus and accounts for the emotional component of this symptom. Thus, the aetiology of tinnitus is diverse and may result from abnormal neural excitation of various levels of the auditory axis. It seems to be further complicated by patient’s emotional and psychological state (1).

It is speculated that tinnitus is related to the loss of the facial vertical dimension or to structural alterations of dental occlusion. The present study showed no statistically significant difference in the loss of vertical dimension for the patients with and without tinnitus. Considering the absence of teeth without prosthetic replacement, there was statistically significant difference between the two groups of patients, with higher frequency for those with tinnitus. Pascoal et al. (28) did not find a statistically significant correlation between symptoms of tinnitus and the total presence, partial or total absence of posterior teeth, in a sample of 126 TMD patients. This data could be relevant, considering that the alterations of the dental occlusion related to missing posterior teeth are a risk factor for TMD (29) and clinical studies show that alterations related to total prostheses are perpetuating factors for chronic musculoskeletal facial pain (30). Therefore, it is possible that the findings of dental condition in the present study have some correlation with myofascial pain but not with the tinnitus.

In this context, patients with sleep bruxism and complaints of chronic facial pain, and tinnitus should be evaluated through a complete examination of the cranial and cervical musculoskeletal system and occlusion conditions, not limited only to the TMJ. In any case, the dentist as well as the otorhinolaryngology specialist should bear in mind that the tinnitus symptom is not always because of ear disease. Detailed examination of such patients by both specialties leads to the correct diagnosis on which proper therapy can be based. Reports by both specialties on the symptomatology, diagnostic methods and therapeutic results in larger series of patients, will perhaps give definitive answers to the numerous questions related to this entity.
Conclusion
Through the employed methodology, it was observed that patients with sleep bruxism and tinnitus have more complaints of chronic facial pain than patients with sleep bruxism and without tinnitus. The findings of this study reinforce the data of scientific literature that indicate the probable relationship between tinnitus and myofascial pain. The depression indices were higher in the patients with tinnitus, results that must be analysed carefully, because these patients did not have psychiatric clinical diagnosis. The occlusion condition related to missing teeth without prosthetic replacement was more prevalent in the patients with tinnitus but this correlation was not clarified in this study.

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