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Temporomandibular Disorder: relationship between otologic and orofacial symptoms

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Key words: temporomandibular joint, otologic symptoms, stomatognathic system.

Summary

The otologic symptoms are frequents in temporomandibular disorder patients, and studies are needed to elucidate the involved mechanisms. Aim: The objective of the present study was to investigate the association of otology symptoms (otalgia, tinnitus, ear fullness) with otologic findings, the other temporomandibular disorder signs and symptoms, and parafunctional habits. Study Design: Clinical prospective. Material and Methods: 27 temporomandibular patients from Occlusion Clinic of the Dental School of Ribeirão Preto – University of Sao Paulo, answered a questionnaire which included questions about signs and symptoms of temporomandibular disorder and parafunctional habits; they were submitted to otorhinolaryngological and audiologic examination. The data obtained were analyzed through Binomial Test, Exact Test of Fisher and Pearson Correlation, with p value < 0.05. Results: Otologic symptoms were presented in 88.88% of the patients (59.26% presented otalgia, 74.07 tinnitus and 74.07% ear fullness). There was no significance between the otologic symptoms and audiologic findings. There was significant association between otologic symptoms and jaw movements or functions (speaking, opening, closing the mouth). There was significant correlation between grade of otologic symptoms and grade of other temporomandibular disorder signs/symptoms, and between the symptom ear fullness and number of the parafunctional habits. Conclusion: The results provide additional support for the notion that a relationship between temporomandibular disorder and otologic symptoms does exist. In temporomandibular disorder patients, the stomatognathic system alterations, such as orofacial pain and functional difficulties, were statically associated with otologic symptoms.

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INTRODUCTION

Otological symptoms are frequent in patients with temporomandibular joint disorders (TMJD)[1-9], and dental treatment contributes to their remission [10-15]. However, the origin and possible correlations between otological symptoms and other manifestations of the problem are not completely explained.

Costen[16] suggested that lack of posterior dental support and the consequent alteration to mandible condyle positioning could result in a set of symptoms, among which some are otological.

Since then, the origin of otological symptoms in patients with TMJD, such as ear fullness, tinnitus, otalgia, vertigo, external ear pruritus, and hearing loss, have been based on anatomical-functional considerations between TMJ, muscles innervated by trigeminal nerve and ear structures [11, 17-21]. However, electromyography does not always confirm this correlation [22, 23].

In addition to etiology, there is controversy considering audiological findings in patients with TMJD. Decrease of pure tone thresholds in specific frequencies was referred by some authors [21, 24, 25], but not by them all [2, 10]. Some studies have suggested that pure tone thresholds may be improved after occlusal treatment, even in patients with normal audiogram [14, 15, 26]. Another possibility is the coexistence of auditory pathologies and TMJD in some cases, without cause-effect correlation [26,27].

The risk of otological symptoms is considered greater in patients with pain upon palpation of TMJ, mastication and neck muscles, as well as pain during mouth opening [8,28].

The purpose of the present study was, after characterizing the sample concerning frequency and severity of signs and symptoms of TMJD, to investigate the association between auditory symptoms - otalgia, tinnitus and ear fullness - and audiological findings, with other signals and symptoms related to TMJD, including functional limitations and oral parafunctional habits.

MATERIAL AND METHOD

The study included 27 consecutive patients diagnosed as having temporomandibular joint disorder in the Division of Occlusion II, Department of Restorative Occlusion, School of Dental Science, Ribeirão Preto, University of Sao Paulo (FORP-USP). There were 25 female patients and 2 male patients, ages ranging from 13 to 52 years (mean age of 32.8 years). They all signed the informed free consent term, as provided by the approval of the protocol by the Research Ethics Committee, University of Ribeirão Preto – SP.

The inclusion criteria was clinical examination conducted by specialized dentist, signs and symptoms that led to the diagnosis of TMJD, such as presence of pain in mastication muscles and/or TMJ during mandible function and palpation of structures, limitation or deviation of mandible movements, TMJ noise, and abnormal static or dynamic occlusal relation [29].

Exclusion criteria were to present history of central neurological or peripheral disorders, or tumors or traumas of the head and neck, as well as to have previously conducted some kind of TMJ treatment.

Subjects underwent exams and interviews with the same professionals, before any treatment approach, as follows: (1) clinical examination of stomatognathic system; (2) protocol for TMJ and parafunctional habits signs and symptoms; (3) ENT history and clinical examination, and (4) audiological tests.

We used the following devices: dental clinical instruments; otoscopy brand Welch Allyn; audiometer Interacoustics AC40; immittanciometer Interacoustics AZ7R; soundproof booth; clinical history protocol and routine audiological assessment, containing questions on risk factors to hearing loss; investigation protocol of signs and symptoms of TMJ [30], modified by the inclusion of questions about parafunctional habits and/or pain during swallowing and speech.

After the diagnosis of TMJD, patients answered the protocol about signs and symptoms to TMJD and parafunctional habits. The first part had yes/no questions. In the second part they were asked to indicate the severity of signs and symptoms when waking up, when masticating, speaking and at rest using an 11-point scale, supported by a graduated printed scale in which zero was considered complete absence of symptom or sign, and 10 was highest severity possible (Annex A).

Next, subjects were referred to audiological anamnesis, ENT examination to define otological conditions and diagnose other pathologies; audiological tests that included meatoscopy, pure tone bone and air audiometry, speech recognition index (monosyllables) and acoustic immittance measures (tympanometry and acoustic reflex investigation).

The used criteria to define abnormality in audiological exams were: Air pure tone thresholds (in frequencies of 250Hz, 500Hz, 1000Hz, 2000Hz, 3000Hz, 4000Hz and 8000Hz) and bone pure tone (in frequencies of 500Hz, 1000Hz, 2000Hz, 300Hz e 4000hz) higher than 20 dBHL; air-bone GAP greater than 10 dBHL; speech recognition index (IRF – monosyllables) lower than 92%; tympanometric curve deviated as of – 100 dapa; contralateral acoustic reflexes higher than 115 dBHL (absent); the difference between air pure tone and reflex below 60 dBHL, suggestive of recruitment.

To better specify alterations found in air pure tone thresholds, they were grouped in frequency ranges as follows (250 and 500 and 1000 Hz), (1000, 2000 and 40000 Hz), (3000, 4000, 6000 and 8000 Hz), and we calculated the mean.

After collection, data were digitalized in Microsoft® Excel. Severity of each signal or symptom was determined

Chart 1. Protocol of Investigation of Signs and Symptoms of TMJD and Habits

Name: _____
Age: _____ Date of Birth: _____/_____/_____ Gender: F ( ) M ( )
Onset of Problem: _____
History of other problems: _____
Previous treatments: _____

SIGNALS AND SYMPTOMS	YES	NO	R	L	BIL
1) Do you have pain in the mastication muscles?					
2) Location of pain					
3) Do you have fatigue in the mastication muscles?					
4) Do you have TMJ noise?					
5) Type:					
6) Do you have headaches?					
7) Do you have auditory symptoms?					
7.1) Otalgia					
7.2) Ear fullness					
7.3) Tinnitus					
Type of tinnitus					
8) Do you have difficulty to move the mandible (mouth)?					
9) Open it					
10) Close it					
11) Masticate					
12) Yawn					
13) Swallow					
14) Speak					

R = right side, L = left side, Bil = Bilateral

PARAFUNCTIONAL HABITS	YES	NO	PAST
1) Chew gum			
2) Bite nails			
3) Bite objects			
4) Do you lock or move your teeth during sleep?			
5) Do you lock or move your teeth during the day?			
6) Others			

Severity judgment by the patient
Instruction: You should try to remember how you perceive the signals/symptoms in the specified situation and indicate in the scale how severe it is. Zero means absence of symptoms and 10 is the worst grade. The more severe the symptom is, the higher the score; the less severe the symptom is, the lower the score.

Table to record answers

Intensity of Signals and Symptoms ***Situation***											
1) Pain in mastication muscles (face)	0	1	2	3	4	5	6	7	8	9	10
2) TMJ pain	0	1	2	3	4	5	6	7	8	9	10
3) Neck pain	0	1	2	3	4	5	6	7	8	9	10
4) Otalgia	0	1	2	3	4	5	6	7	8	9	10
5) Tinnitus	0	1	2	3	4	5	6	7	8	9	10
6) Ear fullness	0	1	2	3	4	5	6	7	8	9	10
7) Teeth sensitivity	0	1	2	3	4	5	6	7	8	9	10
8) Joint noise	0	1	2	3	4	5	6	7	8	9	10

Instruction for the application – the focused situations are: when waking up, masticating, speaking and at rest. All questions are asked for each of the situations: “when you wake up, do you have facial muscle pain... when you wake up, do you have neck pain”. When the first situation is covered, go to the next one: “When you masticate, do you have...”, up to the end. Therefore, you should have four final tables.

by sum of scores attributed to the four questioned situations and later they were classified concerning grade of severity as follows: Grade 0 (absent signal/symptom); Grade 1 (sum ranging from 1 to 10); Grade 2 (from 11 to 20); Grade 3 (from 21 to 30) and Grade 4 (from 31 to 40). For example, to a patient that reached score 10 in muscle pain symptom in the four questioned situations (when waking up, masticating, speaking and at rest), the sum was 40, and the symptom was classified as Grade 4, and then successively for each investigated signal/symptom.

The analysis was made using non-parametric statistics, owing to level of measurement of data relative to signals and symptoms, employing the software GMC[31]. Binomial test was employed to check whether the presence of signs/symptoms of TMJD and oral parafunctional habits was significant in the sample. Fisher's exact test was employed to analyze the possible associations of otological symptoms with results of otological exams, difficulty to make mandible movements, and difficulties in stomatognathic functions. Using the product-moment correlation test by Pearson, we analyzed the correlation between grade of otological symptoms and grade of other TMJD signs and symptoms, and the sum of oral parafunctional habits. The significance level adopted was $p<0.05$.

RESULTS

Using the Binominal test, we noticed that the studied sample was statistically significant in the presence of articular noise, muscle pain, TMJD pain, neck pain, teeth sensitivity ($P<0.01$), tinnitus and ear fullness ($p<0.05$). There was no statistically significant difference between number of subjects with and without otalgia. Considering the scores attributed by the patients to signs and symptoms, it was possible to describe their severity in the sample. In Table 1 we can see frequency of TMJD signs and symptoms and the respective levels of significance and distribution of the sample according to severity grade.

As to difficulty to make mandible movements and stomatognathic functions, presence of difficulty to open the mouth ($p<0.05$), yawn and masticate ($p<0.01$) was statistically significant. There was no statistically significant difference between presence and absence of difficulty to close the mouth, swallow and speak (relative frequencies can be observed in the first column of Table 4).

As to oral parafunctional habits, we noticed statistically significant differences in the sample for night bruxism, day bruxism ($p<0.01$) and biting objects or other habits ($p<0.05$), as well as the number of subjects with 3 habits or more ($p<0.01$). There was no statistically significant difference in the presence and absence of habits: chewing gum, biting nails and biting the cheeks (Table 2).

In ENT examination, we did not find otological abnormalities nor signs and symptoms that could prevent conduction of audiological tests. Upon analyzing the risk factors to hearing loss, their absence was significant compared to their presence, that is, exposure to noise ($p<0.05$), use of ototoxic drugs ($p<0.01$) and family history ($p<0.01$). When analyzed as a group, at least one risk factor per subject, 15 subjects out of 27 did not present any risk factor, leading to the conclusion that there was no significance ($p>0.05$).

According to audiometry results, on the right ear mean of air thresholds in frequencies of 250, 500 and 1000 Hz in the sample ranged from 3.33 to 16.67 dBHL, in frequencies of 1000, 2000 and 4000 Hz from 3.33 to 21.67 and in 3000, 4000, 6000 and 8000 Hz from 2.5 to 28.75 dBHL, and in only 3 subjects means were higher than 20dB HL. On the left ear, mean of pure tone thresholds of 250, 500 and 1000 Hz in the sample ranged from 0 to 18.33 dBHL, in frequencies of 1000, 2000 and 4000 Hz from -3.33 to 21.67, and 3000, 4000, 6000 and 8000 Hz from 0 to 40 dBHL. Only one subject presented means above 20 dBHL.

On the right ear, means of bone thresholds in frequencies of 250 and 500 Hz ranged from –10 to 15 dBHL, from 1000 to 2000 it was –7.5 to 12.5, and 3000 and 4000Hz, from –5 to 15 dBHL. On the left ear, the mean of bone

Table 1. Frequency of signs and symptoms of TMD and distribution of the sample according to grade of signs and symptoms severity.

Signs/Symptoms			Severity of signs and symptoms				
			Grade 0	Grade 1	Grade 2	Grade3	Grade 4
	f	f%	f	f	f	f	f
Muscle pain	25**	92,59	02	07	10	07	01
TMJ pain	25**	92,59	02	06	12	06	01
Neck pain	24**	88,89	03	10	06	07	01
Otalgia	16	59,26	11	04	05	03	04
Tinnitus	20*	74,07	07	09	03	05	03
Ear fullness	20*	74,07	07	12	02	04	02
Teeth sensitivity	21*	77,78	06	07	09	04	01
Joint noise	26**	96,29	01	13	08	04	01

Absolute frequency: f, relative frequency: f%, significant at level 5%: *, 1%: **

thresholds in frequencies of 250 and 500 Hz ranged from –10 to 15dB, in 1000 and 2000 from –10 to 12.5, and in 3000 and 4000Hz, from –5 to 42.5 dBHL. None of the subjects presented speech recognition index below 92%.

At tympanometry, we noticed curve type A in 48 ears, type Ad in 3 right ears and 2 left ears, and type C in one left ear. Therefore, type A curve was the most prevalent in the sample ($p<0.01$). Ipsilateral and contralateral acoustic reflexes were significantly present in the sample in all analyzed frequencies and in both ears, that is, in 22 out of 27 subjects.

The prevalence of normal audiological results did not require the application of statistical tests for analysis of association.

The severity of symptoms of otalgia, tinnitus and ear fullness was considered positive in most of the signs/symptoms of TMJD. Pearson correlation coefficient (r) and significance levels are presented in Table 3.

To better understand the correlation between difficulties in mandible movements and stomatognathic function and otological symptoms, we conducted an individualized analysis by Fisher exact test. There was significant association between presence/absence of difficulty to open the mouth and otalgia ($p<0.01$), difficulty to close the mouth and otalgia ($p<0.01$). Difficulty to speak was significantly associated with otalgia and ear fullness ($p<0.05$). In Table 4, we could observe frequencies relative to difficulty of making mandible movements and stomatognathic functions, as well as absolute frequencies according to presence or absence of otological symptoms.

As to oral parafunctional habits, we detected significant correlation between number per patient and grade of ear fullness symptom ($r = 0.45$, $p<0.05$).

DISCUSSION

The objectives of the present study were: to analyze the association between otological and audiological symptoms in patients with TMJD, or in other words, to define whether the complaints patients had reflected their otological conditions and to investigate the association and correlation between otological symptoms and other TMJD signs and symptoms relative to the stomatognathic system, as well as oral parafunctional habits.

In the studied sample, as expected in cases of TMJD, there were more female patients than male patients [2,5,10,13,15,26-28].

Predominant signs and symptoms were: joint noise, muscle pain and pain on the TMJ area, which coincided with previous findings [10,11,30]. Other symptoms that presented significant frequency in our study were neck pain [3, 4] and teeth sensitivity [28, 30]. The high incidence of otological symptoms in the present sample was in agreement with the literature [4,5,6,8,9,27,28], in which ear fullness prevailed over the symptom of otalgia [2,12,30]. Tinnitus was as frequent as ear fullness. Other studies indicated prevalence of otalgia [10,13,32].

It is possible that the way we asked about symptoms of ear fullness and tinnitus have contributed to patients' understanding, and consequently, to their positive answer about these symptoms, respectively "sensation that you ear is blocked, clogged, as if when you go to the beach", and "quick high noise, something that comes and goes". As previously characterized, tinnitus in TMJD is normally of high frequency, moderate intensity and sporadic, different from most types of tinnitus associated with otoneurological affections [5].

We did not include in the present study the investigation of dizziness or vertigo, which are sometimes associated with TMJD, since differential diagnosis of vestibular pathology would require otoneurological exams, which were not included in the method.

The exact correlation between TMJD and otological symptoms is still unknown. This issue has been explained based on embryological, anatomical and functional correlation of the region that comprises the TMJs, the muscles innervated by the trigeminal nerve and middle ear structures [21]. Among other things, it has been suggested that muscle affections in patients with TMJD, such as lateral pterygoid muscle spasm, may lead to tympanic tensor muscle hypertony, causing alterations in the opening cycle of auditory tube and consequent reduction

Table 2. Frequency of parafunctional habits.

Habits	f	f%
Chewing gum	16	59.26
Biting nails	12	44.44
Bite the cheeks	14	51.85
Night Bruxism	21**	77.78
Day Bruxism	21**	77.78
Bite objects/others	19*	70.37
At least 3 habits	23**	85.18

Absolute frequency: f: , relative frequency: f%, Significant at level 5%: *, 1%: **

Table 3. Pearson's correlation coefficient between otological and orofacial symptoms.

	Otological Symptoms		
Orofacial Symptoms	Otalgia	Tinnitus	Ear fullness
Muscle pain	0.50**	0.54**	0.17
TMJ pain	0.72**	0.60**	0.22
Neck pain	0.49**	0.67**	0.80**
Joint noise	0.36	0.74**	0.27
Teeth sensitivity	0.40*	0.58**	0.54**
Functional difficulties	0.49**	0.46*	0.58**

Significant at level 5%: *, 1%: **

Table 4. Frequency of auditory symptoms according to difficulty to make mandible movements and functions.

Movements and Functions		Otalgia		Tinnitus		Ear fullness	
	f%	A	P	A	P	A	P
Open the mouth							
W/out difficulty	33.33	07	02	03	06	04	05
W/ difficulty	66.66	04	14	04	14	03	15
Close the mouth							
W/out difficulty	66.66	10	08	06	11	06	12
W/ difficulty	33.33	01	08	00	09	01	08
Masticate							
W/out difficulty	18.51	03	02	02	03	02	03
W/ difficulty	81.48	08	14	05	17	05	17
Yawn							
W/out difficulty	22.22	04	02	02	04	03	03
W/ difficulty	77.77	07	14	05	16	04	17
Swallow							
W/out difficulty	55.55	08	07	05	10	06	09
W/ difficulty	44.44	03	09	02	10	01	11
Speak							
W/out difficulty	55.55	08	04	05	07	06	06
W/ difficulty	44.44	03	12	02	13	01	14

Relative Frequency: f%, symptom present = P, symptom absent = A

in middle ear ventilation [17,20]. Nevertheless, some authors do not confirm this hypothesis [22,23].

Interferences in the petrotympanic fissure region, through which we have tympanic corda nerve, tympanic artery and disk-malleolus ligament, which is originated from the malleolus anterior process and inserted in the TMJ capsule and disk, could also cause otological symptoms [19].

In some cases, it is considered that flat configuration of joint eminence would lead to mandible condyle displacement against the sphenomandibular ligament, triggering neuromuscular system dysfunction and causing abnormalities to the protective reflex during swallowing, which would inhibit the opening of auditory tube and reduce middle ear ventilation [18].

As to perception of functional limitations and difficulty to make mandible movements, we can point out reports of difficulties to masticate, yawn and open the mouth, as previously detected [30].

Mastication suffers influence from the morphology of stomatognathic system, as well as other factors, such as pain and lack of posterior occlusal support, which causes changes and compensations and can become pathological [9]. Functional analyses of the mastication system of patients with TMJD have evidenced reduction in mandible movements when opening the mouth [3,10], which could result in sensation of difficulty to perform stomatognathic functions, such as masticate and speak. Even though it was not significant, difficulty to speak has also had considerable incidence (55.55%).

Considering ENT and audiological findings, most of the patients were within the normal range. Therefore, otological symptoms in the present sample did not reflect ear conditions, which were normal. Thus, despite the symptoms, no other auditory pathologies have been evidenced in cases of TMJD [1,2,8,10,27]. However, it has also been detected that despite being within the normal range, pure tone air thresholds may improve after mouth rehabilitation [14] or use of stabilizing splint [26], especially in cases of extra-articular TMJD [15].

Conversely, healthcare professionals should bear in mind the possible occurrence of TMJD and concomitant hearing pathologies without cause-effect correlation [26,27]; the differential diagnosis is always a requirement.

In the present study, we detected significant correlations between otological symptom severity and orofacial sign/symptom severity. Subjects with more severe/intense pain in the muscles and TMJ were more prone to otalgia [12] and tinnitus [3], which normally require active treatment of TMJ [6]. Neck pain was also positively correlated with otological symptoms [28].

Otological symptoms have been significantly associated with difficulty in mandible movement and stomatognathic functions. More specifically, otalgia was associated with difficulty to speak, open the mouth and close the mouth. Ear fullness was associated with difficulty to speak.

Similarly to otological symptoms, disorders of stomatognathic functions are frequent in patients with TMJD [9,25]. Subjects with otological signals presented higher likelihood of feeling pain during mouth opening [28]. Electromyography studies in humans demonstrated that periorbital muscle contraction during facial movement caused tympanic tensor muscle activity. Moreover, tympanic tensor

muscle activity was detected during speech and swallowing and stapedial muscle activity during the conduction of mandible and speech movements [11].

Facial innervation - motor and sensorial - involves many different cranial nerves and innervation is not shared. In subjects with TMJD, rather than harmonic functioning of face, mouth and pharynx, there is gradual modification of movements that the joints make when masticating, swallowing and speaking in the process of muscle and joint disorganization of the disease[8].

We can add that parafunctional habits may predispose to rupture of the harmony of the stomatognathic system, leading to imbalance. In subjects with TMJD they are frequent [3,9,25], as detected in the present study, and they have been considered significant in the etiology and in progression of muscle and intra-articular disorder [33]. In the studied sample, there was significant correlation between number of parafunctional habits per subject and grade of ear fullness; however, other investigations will be necessary to clarify whether parafunctional habits participate as etiological agents, simple participants or guiders of the process.

CONCLUSION

Based on the results, we could conclude that the studied sample presented high incidence of otological symptoms, with prevalence of ear fullness and tinnitus in relation to otalgia, in addition to other signs and symptoms related to TMJD.

The prevalence of results within the normal range in otological and audiological exams suggested that otological symptoms do not reflect ear conditions, detected in the clinical ENT and audiological exam.

Otological symptoms were correlated with severity of one or more investigated symptoms, which included muscle pain, TMJ pain, neck pain, teeth sensitivity, joint noise and general, functional difficulties.

There was significant association between otological symptoms and those directly related to stomatognathic functions. Otalgia presented association with sensation of difficulty to speak, open the mouth and close it. Ear fullness was associated with difficulty to speak.

The presence of parafunctional habits was also significant in the sample and there was significant correlation between number of habits per subject and ear fullness.

Thus, lack of harmony in the stomatognathic system, which was manifested as orofacial pain, and difficulty in functional activities were significantly associated with otological symptoms in cases of TMJD.

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