

**Review**  
**by**  
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**on a dissertation for the award of a  
educational and scientific degree “Doctor“**

**Author: Dr. Boris Yankov Borisov**

**Topic: „Tinnitus and auditory changes in patients with temporomandibular joint dysfunction“**

The thesis presented to me for review contains 173 standard typewritten pages with a bibliography consisting of 325 authors, of which 20 in Cyrillic script and 305 in Latin script, and 4 appendices. It is illustrated with 89 figures and 4 photos. The dissertation is well structured, which facilitated the review preparation.

The **Introduction** emphasizes the fact that Tinnitus is the perception of noise, which can be generated by pathological changes in various levels of the acoustic system, changes in the vascular or velo-palatal muscles, as well as changes in the temporomandibular joint (TMJ). For this reason, tinnitus is not considered a separate disease, but only a symptom with many etiological factors

The global prevalence of tinnitus reaches 14 - 32%.

The US Public Health Agency discussed the condition, described as tinnitus, in 1984 and 1985 as the third most uncomfortable condition that has a negative impact on lifestyle.

As the etiology of temporomandibular joint disorders is multifactorial, collaboration between different health professionals and the application of an interdisciplinary approach to alleviate tinnitus and other otological symptoms associated with temporomandibular joint disorders are needed.

The entire diagnostic process in patients with tinnitus should be accompanied by multidisciplinary timely consultation, including with a dentist.

The above facts give grounds for the candidate to formulate:

**The aim** of the dissertation is to study and evaluate the correlation between problems in the temporomandibular joint and tinnitus in patients with audiovestibular diseases

In order to meet the set aim, **5 tasks** have been formulated and completed.

1. To systematize demographic and clinical information for patients undergoing prosthetic treatment in connection with temporomandibular dysfunction (TMD).
2. To examine patients with tinnitus:
  - to assess tinnitus;
  - to investigate TMJ dysfunction.
3. To investigate and evaluate the relation between tinnitus and TMJ dysfunction.
4. To assess a risk profile of patients with tinnitus and TMJ dysfunction.
5. To create an algorithm for the diagnosis of patients with tinnitus and TMJ dysfunction enriched with a closely specialized diagnostic protocol for TMD in collaboration with an ENT specialist.

**The materials and methods** of the study are correctly and adequately selected, the use of a sufficient number of modern **statistical methods** for processing the obtained data ensures that reliable and objective **results** are attained.

#### **Material and methods**

The object of the study on the first task are 152 patients who have passed through the clinical halls of the FDM - Varna for a period of two years (2019 - 2020).

The object of the study on the other tasks are 150 patients who passed through the clinical halls of the Faculty of Dental Medicine - Varna, University Medical and Dental Center and the audiovestibular laboratory at the Faculty of Dental Medicine - Varna. The selection of participants is based on well-defined criteria.

#### **a) Inclusion criteria**

- Persons over 18 years of age;
- With tinnitus;
- With complaints in the area of the temporomandibular joint;
- With audiovestibular diseases;
- With completed informed consent.

#### **b) Exclusion criteria**

- Persons under 18 years of age;
- Without audiovestibular diseases;
- Without tinnitus;
- Without complaints in the area of the temporomandibular joint;
- Persons who have not filled in an informed consent.



All participants in the study had a history, dental examination and examination by an otolaryngologist.

In addition, the patients underwent two functional examinations - tympanometry and audiometry by an ENT specialist.

#### **Statistical methods - for all tasks**

The results were processed with SPSS v. 20.0, using the following analyzes:

- ❖ Dispersion analysis (ANOVA);
- ❖ Variation analysis - arithmetic mean  $\pm$  standard deviation (mean $\pm$ SD);
- ❖ Correlation analysis - Pearson's ratio and Spearman's ratio
- ❖ Regression analysis - univariate linear regression
- ❖ Risk analysis - Odds Ratio (OR)
- ❖ Comparative analysis (hypothesis evaluation)–  $\chi^2$ , F and t-test.
- ❖ Graphic and tabular method of displaying the obtained results

In all analyzes performed, an acceptable level of significance  $p < 0.05$  is assumed.

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#### **for the first task it is established that:**

- ⊕ Of the patients studied, only 5.9% were diagnosed with bruxism, with a predominance of women (66.7%).
- ⊕ TMJ dysfunction was found in 27.6% of patients, mostly women (66.7%).
- ⊕ There was a significant difference in the type of prosthetic treatment and complaints related to TMJ dysfunction ( $p = 0.030$ ), finding that the likelihood of TMJ dysfunction in patients with complete dentures increased more than twice (OR = 2.124 (1,030-4,381);  $p < 0.05$ )
- ⊕ It was found a directly proportional moderate relation between bruxism and TMJ dysfunction ( $r = 0.344$ ;  $p < 0.001$ ), with bruxism being responsible for 19.0% of TMJ dysfunction cases in the present study.
- ⊕ 11.2% of the examined patients have joint diseases, and a proportionally weak dependence with TMJ dysfunction was found ( $r = 0.201$ ;  $p = 0.013$ ).

#### **After the research on the second task, it became clear that:**

- ⊕ The most common noise is similar to whistling (36.4%), followed by buzzing (22.8%). On the other hand, 87 (58.0%) patients reported that tinnitus is unilateral only in the left or right ear, and in the others the noise is in both ears.

- ✚ About 2/3 (65.3%) of the patients state that they are more irritable in their relations with family and friends due to tinnitus.
- ✚ About 62% said they found it difficult to rest because of tinnitus, with a significant difference and moderate gender dependence ( $r = 0.358$ ;  $p < 0.001$ ), with gender finding that women had a harder time falling asleep than men. (88.5% for women and 58.2% for men, respectively;  $p < 0.001$ )

**After the research on the third task, it became clear that:**

- ✚ 28.7% of the studied patients with tinnitus were diagnosed with TMD dysfunction.
- ✚ The main complaints of patients that may be associated with TMJ dysfunction. The most common are pain in speech (16.00%), followed by clicking of the TMJ (15.3%) and pain in chewing (14.00%).
- ✚ A significant gender difference was found with regard to the clicking of the TMJ, which is more frequent in women (10.2% for men and 25.0% for women, respectively;  $p = 0.017$ ).
- ✚ The clicking of the TMJ is another factor that is influenced by the prosthetic treatment, as its frequency is 21.7% among the patients who did not receive treatment, but needed it. The incidence was 9.9% in those treated ( $p = 0.037$ ).
- ✚ The lack of prosthetic treatment was found to increase the risk of TMJ clicking by 2.54 times ( $OR = 2.54$  (1.003-6.407);  $p < 0.05$ ).
- ✚ The pain in p. 4 is associated with compression of the TMJ as a result of night clenching of teeth in patients with bruxism and bruxomania.
- ✚ The pain in p. 2 is indicative of increased tone of the m.pterygoideus lateralis, which is activated by parafunctional movements in the temporomandibular joint.
- ✚ Morning rigidity correlates most strongly with pain in p. 4 (0.367), followed by pain in p. 2 (0.339).
- ✚ Pain during speech has the strongest relation with pain in p. 2 (0.447), followed by that in p. 5 (0.301).
- ✚ The clicking of the TMJ correlates with almost all points except for p. 5., as in p. 2 and p. 3 the dependence is the strongest (0.461).
- ✚ Trismus shows a strong dependence on pain in p. 3 (0.437) and p. 5 (0.431).



- ✦ The third degree of severity of tinnitus correlates with the pain found in p. 4 ( $r = 0.238$ ;  $p = 0.020$ ). No connection with gender and prosthetic treatment done was found.
- ✦ There was no significant difference in tympanogram results according to the presence of TMJ dysfunction, but there was a moderate relation between tympanogram results and the severity of tinnitus in patients with TMS dysfunction ( $r = -0.419$ ;  $p = 0.012$ ).

**After the research on the fourth task we can conclude that:**

- ✦ The risk of parafunction (bruxism, bruxomania) is the most important factor in the occurrence of tinnitus, followed by the presence of joint disease. Third is the lack of prosthetic treatment if necessary and complete edentulousness.
- ✦ The highest percentage of patients with tinnitus (55.8%) complain of greater irritability when they are in their social area. Complaints about difficulty concentrating (53.5%) followed, and an equal number said that the noise was so unpleasant that they could not ignore it and even linked it to a serious health problem (51.2%).
- ✦ According to 46.5% of patients, tinnitus could severely damage their physical health. 44.2% find it difficult to rest due to the presence of tinnitus. Many patients with tinnitus doubt whether this noise will ever disappear - 41.9%. According to 39.5%, tinnitus is the reason for their exhaustion. 32.6% reported sleep problems due to tinnitus. All-day tinnitus is typical for 16.3%. 14% feel like a victim of this noise.

**In connection with the fifth task, it can be concluded that:**

- ✦ The development of an algorithm for the diagnosis of patients with tinnitus is extremely important because the unclear etiology of the disease delays treatment and prolongs the discomfort of patients suffering from tinnitus

**The results** of the research give the doctor reason to draw the following important **implications:**

1. Some of the examined prosthetic patients suffer from bruxism and/or bruxomania related to dysfunctions in the temporomandibular joints.
2. The probability of developing TMJ dysfunction in completely edentulous patients is twice as high as in those who need partial prosthetics.

3. Tinnitus has a direct impact on the mood, habits and deteriorates the quality of life of patients, which is why timely diagnosis and treatment of this condition are a priority.
4. There is a direct link between tinnitus and temporomandibular dysfunction, which argues the importance of a detailed study of TMJ and the introduction of a diagnostic protocol in patients with tinnitus.
5. According to the established risk profile of patients with tinnitus and TMD, the most important etiological factors are bruxism, followed by the presence of joint disease and the lack of prosthetic treatment, if necessary, with complete edentulousness.
6. The need for timely diagnosis and treatment of patients with tinnitus requires the creation of an algorithm for the diagnosis of these patients and their referral to a specialist, emphasizing the role of the dentist in cases where there is TMD.
7. The detailed examination of TMS in the five described points assists dentists in diagnosing patients with tinnitus with regard to temporomandibular joint dysfunction as a risk factor.

The more important **contributions** of the dissertation can be grouped as:

**Original for the country:**

- ❖ For the first time in Bulgaria, the relation between temporomandibular dysfunction and tinnitus has been subjected to critical analysis and recommendations for dental practice have been made.

**With practical application:**

- ❖ Optimization of the interdisciplinary approach for diagnosis of patients with tinnitus through the algorithm created by us.
- ❖ A protocol for detailed examination of TMJ has been proposed, including objective and subjective criteria, which assists dentists in the differential diagnosis of patients with tinnitus.

**With theoretical application:**

- ❖ A detailed risk profile of patients with tinnitus has been developed.

**Confirmatory:**

- ❖ The correlation between tinnitus and temporomandibular joint dysfunction was confirmed.
  - ❖ It has been confirmed that tinnitus worsens the quality of life of patients.

**Assessment of publication activity**

In connection with the dissertation, Dr. Borisov presents 3 publications. This fact proves that the topic developed in the dissertation is his personal work.

**The author's summary** objectively reflects the dissertation. It is drawn up in accordance to the requirements of the law for the development of the academic staff.

I have no critical remarks on the reviewed thesis.

**Conclusion:**

The thesis of Dr. Boris Yankov Borisov is an depth study about tinnitus and auditory changes in patients with empromandibular joint dysfunction.

The obtained results are valuable for clinical practice and can serve as a basis for future research.

**I am confidently giving my positive vote for the award of the educational and scientific degree "Doctor" to Dr. Boris Yankov Borisov.**

Plovdiv  
21.03.2022



(Prof. Yavor Kalachev, DMD, PhD)