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Craniomandibular Disorders and Burning Mouth Syndrome in Removable Denture Wearers

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Authors' contributions

This work was carried out in collaboration between all authors. Authors MC, DDV, FP and MP designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author AD managed the literature searches and author ST managed the statistical analysis process. All authors read and approved the final manuscript.

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ABSTRACT

Objectives: The frequent finding of craniomandibular disorders (CMD) in burning mouth syndrome (BMS) patients has led the scientific community to hypothesize that the two diseases have common aspects that require further examination. Some authors have evaluated the presence of CMD in patients with BMS. No studies have limited the investigation to denture patients affected by BMS. The aim of the study is to estimate signs and symptoms of Craniomandibular Disorders (CMD) in patients with BMS and to investigate for the existence of a possible association between CMD and BMS in removable denture wearers.
Materials and Methods: From April 2010 to March 2012 we enrolled forty-eight patients affected by BMS, of which 24 wearing removable denture and 24 without denture, in accordance with the inclusion/exclusion criteria. A clinical-gnathological evaluation and a prosthodontic examination were performed and the results were compared.

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Results and Discussion: Nineteen patients of the sample showed disorders classified as primary signs and symptoms of CMD on the basis of Research Diagnostic Criteria of Temporomandibular Disorders (RDC/TDM), compared with ten patients of the control group. Most common disorders were disc displacement and muscle pain. The chi-square test was statistically significant ($p < .05$) for 6 of the 10 relationships studied.
Conclusion: A higher number of CMD cases was observed in the original sample compared with the control group. In BMS patients therefore being a denture-wearer may contribute to the onset of CMD.

Keywords: *Craniomandibular disorders; burning mouth syndrome; prosthetic rehabilitation; neuropathy; old age.*

1. INTRODUCTION

Burning Mouth Syndrome (BMS) is a chronic pain syndrome that mainly affects middle-aged/old women with hormonal changes or psychological disorders [1-4].

The International Association for the Study of Pain (IASP) has identified BMS as a "distinctive nosological entity" characterized by "unremitting oral burning or similar pain in the absence of detectable oral mucosa changes" [5]. BMS often affects the tongue, lips and hard and soft palate. The intensity of burning ranges from moderate to severe and it is usually less severe in the morning and during the mastication [1].

Lamey and Lewis [6] classified BMS into three different types: type I, with symptoms not present upon awakening in the morning but starting during the day; type II, with burning present upon awakening in the morning and persisting throughout the day; and type III, with intermittent symptoms in the whole day (Table 1).

The etiopathogenesis of BMS remains still unclear and is probably of multifactorial origin [7].

Scala et al. distinguished two different types of BMS: the primary and the secondary one [8]. The primary BMS is the “true” idiopathic BMS while in the secondary BMS it is possible to relate the burning sensation to local conditions (infections, allergic reactions, galvanism, geographic tongue, dental treatment) or systemic diseases (menopausal disorders, diabetes mellitus thyroid dysfunctions, nutritional deficiencies).

Recent studies have elucidated that several neuropathic mechanisms act at different levels of the neuraxis and contribute to the pathophysiology of primary BMS [7,9-12].

Craniomandibular Disorders (CMD) are a group of diseases that involve the masticatory muscles, the temporomandibular joint (TMJ) or both [13,14].

The most common signs and symptoms of CMD are orofacial pain, several types of temporomandibular joint (TMJ) sounds, tenderness of the muscles of mastication and the TMJ, restricted range of mandibular motion [13].

The Research Diagnostic Criteria of Temporomandibular Disorders (RDC/TDM) in Axis I divided the clinical CMD conditions into three groups: muscle diagnoses (myofascial pain with or without limited opening), disc displacements (with reduction, without reductions with limited openings, without reduction without limited opening) and arthralgia, arthritis and arthrosis [13].

The correlation between BMS and CMD has already been a subject of interest for several authors [2,15-18]. No studies have limited the investigation of correlations between BMS and CMD to denture patients.

The aim of the study is to estimate signs and symptoms of Craniomandibular Disorders (CMD) in patients with BMS and to investigate for the existence of a possible association between CMD and BMS in removable denture wearers.

2. MATERIALS AND METHODS

This was a case-control study carried out at the Oral Pathology Unit, (Dental School, University of Bari) from April 2010 to March 2012. The Oral Pathology Unit is a tertiary care center where patients are referred by primary physicians as well as by private dentists and other specialty clinics. All participants gave written consent and the study was approved by the local Ethics

Committee of the Odontostomatology Department of the University of Bari.

We enrolled forty-eight patients affected by BMS, of which 24 wearing removable denture and 24 without denture, in accordance with the inclusion/exclusion criteria. Both group were frequency-matched for sex, age and the proportion between the three BMS clinical types reported in the original sample.

The Inclusion Criteria Were as Follows

- A diagnosis of primary BMS
- Being a removable denture wearer

The Exclusion Criteria Were as Follows

- A previous treatment for BMS and/or TMD
- Presence of an allergic contact stomatitis to prosthetic materials.

2.1 BMS Diagnosis

Patients received a diagnosis of primary BMS after clinical and laboratory examination:

- Presence of a persistent idiopathic mucosal oral burning sensation for at least 4-6 months, in absence of any oral mucosal macroscopic lesions.
- Normal salivary flow rates and absence of bacterial or fungal infections.
- Laboratory analyses included hematological assessment of nutritional deficiencies, blood glucose levels, patch testing for specific allergies.

Then patients have been classified by Lamey's classification (6) in BMS type I, type II or type III. Oral symptoms were registered using a 10-cm visual analogue scale (VAS; 0 = no pain to 10 = extreme pain).

2.2 CMD Evaluation

A clinical TMJ evaluation was performed, according to the protocol of the European Academy of Craniomandibular Disorders (E.A.C.D.). This protocol consisted in (13):

- An anamnestic questionnaire
- A clinical examination recording subjective perception of pain by a Visual Analogue Scale (VAS). The site of pain was indicated by patient using the hand and was reported in the clinical folder. The presence of self-reported parafunctional habits (such as tongue indentations) was investigated.
- Orthopedic tests to investigate dysfunctions during mandibular dynamics, pain during jaw movements or post palpation on masticatory muscles and/or TMJ, TMJ noises, wear facets.

Restricted opening was considered to be any distance less than 40 mm between the incisal edges of the maxillary and mandibular anterior teeth (present/absent).

Deviation during opening was evaluated considering the path taken by the midline of the mandible during maximum opening (present/absent).

The "*end feel* " describes the characteristics of the joint when an attempt is made to increase mouth opening passively by gently placing downward force on the mandibular incisors with the fingers to increase the interincisal distance. If the end feel is "soft", increased opening can be achieved and we can suspect muscle-induced restriction. If no increase in opening can be achieved, the end feel is said to be "hard". Hard end feels are likely associated with intracapsular sources, such as a disc dislocation.

Joint muscle test (or static pain test): evaluation of the masticatory muscles during mandibular movements performed against resistance. The muscles that coordinate the respective movement were evaluated for pain (+ if pain was present).

Joint play test: various tensile loads(toward caudal, toward ventro-caudal, toward medial and toward lateral) were applied to the TMJ (+ if pain was present).

Compression test: different compressive loads were applied to the TMJ (+ if pain was present).

Masseter, anterior, middle and posterior parts of temporalis, medial and lateral pterygoid, neck, shoulder and submandibular region were palpated bidigitally (pain present/absent).

Pain or tenderness of the TMJ was determined by digital palpation of the joints, both when the mandible was stationary and during dynamic movement. The fingertips were placed over the lateral aspects of both joint areas simultaneously and the patient was asked to open and close a

few time and to report any symptoms (pain present/absent).

TMJ noises was perceived placing the fingertips on the lateral surfaces of the joint and having the patient open and close. Click is defined as a single sound of short duration (clicking present/absent), crepitation is a multiple gravel-like sound commonly associated with osteoarthritic changes of the articular surfaces of the joint (click present/absent).

2.3 Prosthodontic Examination

Denture typology (complete/skeletal), presence of decubitus (yes/no), occlusal errors (yes/no), denture base extension (correct/incorrect) and denture hygiene (good/poor) were examined. The vertical dimension of dentures and free-way space were measured as the distance between ink marked points on the tip of the nose and on the chin. The subjects were asked to stand in a normal, relaxed position with the lower jaw in the intercuspal position and in a natural resting position following swallowing of water.

Stability test evaluated the resistance to horizontal movement; *phonetic tests* (test of random speech, test of specific speech sounds, test of reading of a paragraph) evaluated the denture design affecting speech: denture thickness, vertical dimension, occlusal plane, postdam area, anterior-posterior positioning of teeth, width of dental arch.

Lastly patients have been classified by Dworkin and LeResche RDC / TMD criteria (13) in one of the following categories:

Group 1: Muscular disorders

- 1a: Myofascial pain
- 1b: Myofascial pain with limited opening

Group 2: Disc displacements

- 2a: Disc displacement with reduction
- 2b: Disc displacement without reduction, with limited opening
- 2c: Disc displacement without reduction, without limited opening

Group 3: Other joint conditions

- 3a: Arthralgia
- 3b: Osteoarthritis of the TMJ
- 3c: Osteoarthrosis of the TMJ

A prosthodontic examination was performed by an experienced dentist.

The control group was subjected to the same diagnostic protocol (BMS diagnosis, CMD evaluation) and compared with the original sample in order to determine if and how removable dentures could affect the onset of CMD in patients with BMS.

2.4 Statistical Analysis

Collected data were reported in standardized forms; forms were computerized using a database created by FileMaker pro, data were analysed using Stata MP11 software. Means were compared using t-student test for unpaired samples; proportions were compared using chi-square test.

A bivariate analysis using the chi-squared test in order to determine the association between the independent variable and each of the dichotomous dependent variables. For all test, a $p<0.05$ was considered as significant.

3. RESULTS

The overall sample was composed by 12 males and 36 females; the distribution of patients per sex did not differ between the two groups (Table 1; chi-square=0; p=1.000). The mean age was 65.2±12 years, lower in non denture wearer group (51.2±6) than in denture wearer group (75.2±6; t=13.8; $p<0.0001$).

The distribution of enrolled patient per BMS type group did not show any difference (chi-square=0; p=1.0). The average value of the VAS was of 5.1±2.2, without any difference between the two groups (Table 2; t=0.31; p=0.75).

In the group of denture wearer, 56.2% reported a complete denture typology and 43.8 a skeletal denture tipology; 56.2% presented decubitus. The stability test was correct for 50%; the phonetic test was correct for 68.7%; 31,3% reported occlusal errors; 31,3% had O.V.D. correct. A correct denture base extension was reached into 43,8%; good hygiene in 62,5%. The time from the last dental visit was of 1-2 years for 25% and >2 years for the restant 75%.

The average VAS score, the distribution of parafunctional habits and of the site of pain

Table 1. Lamey's classification of BMS subtypes

Type1	Symptoms not present upon awakening but starting during the day. Unrelated to psychiatric condition
Type 2	Persistent pain. Chronic anxiety
Type 3	Intermittent pain in the whole day in unusual sites (floor of the mouth). Allergic contact stomatitis

Table 2. Characteristics of the studied sample

	Total sample (N=48)	**Denture wearer group (N=24)**	**Non-denture wearer group (N=24)**
Mean age (years)	65,2±12	75,2±6	51,2±6
Sex			
male	12	6	6
female	36	18	18
BMS type			
I	15	7	7
II	16	9	9
III	15	8	8
VAS	5,1±2,2	5,2±2,4	5±2

Data are reported as mean±standard deviation

(except the frequency of the persons who reported the head as site of pain) did not differ between the two group (Table 3). Table 4 showed the Statistical analysis between BMS and dependent variables for CMD.

The chi-square test was significant ($P < .05$) for six of the ten relationships studied. The BMS was the independent variable while limitation in mandibular movements, mandibular deviation, hard end feel, TMJ disorders in auscultation, pain during joint play test, TMJ palpation, joint muscle test, compression test, masticatory muscle palpation and wear facets were dependent variables. The strongest associations were found between BMS and hard end feel and between BMS and pain during the compression test ($F = 12.25$).

Fig. 1 shows the data obtained by clinical-gnathological evaluation in the denture wearer group and in the control group.

Fig. 2 summarizes the distribution of the sample according to the type of dysfunction found for each patient.

In nineteen patients of the denture wearer group it was possible to notice disorders classified as primary signs and/or symptoms of CMD on the basis of RDC/TMD criteria, while only ten patients of the control group developed CMD signs and/or symptoms.

In particular among the study group four patients were classified as "1a", thirteen patients were classified as "2a", one patient as "1a+2a" and one patient as "1a+3a". Then six patients had myofascial pain and fourteen patients had internal derangements, while one patients had degenerative joint diseases. Five patients showed no signs and / or symptoms of CMD.

In the control group fourteen patients showed no signs and/or symptoms of CMD, while four patients were classified as "1a", three patients were classified as "2a", one patient as "1a+2a", one patient as "2a+3a"and one patient as "3c". Then in control group five patients had myofascial pain, five patients had internal derangements, while two patients had degenerative joint diseases.

Fig. 3 summarizes the distribution of the sample according to the three typology of BMS.

4. DISCUSSION

The results of this observational study evidence that about two thirds of denture wearing BMS patients showed primary signs and symptoms of TMD according to the protocol of the European Academy of Craniomandibular Disorders.

Table 3. Data obtained by denture wearer sample's and control group's gnathological history

	Denture wearer group (N=24)	Non-denture wearer group (N=24)	Chi-square	p
Site of pain*	Neck= 9	Neck= 6	0.87	0.35
	Head= 9	Head= 3	4.00	0.04
	Masseters= 8	Masseters=5	0.95	0.33
	Pterigoids=0	Pterigoids=1	1.02	0.32
	TMJ=0	TMJ=1	1.02	0.32
	None= 6	None=8	0.40	0.52
VAS score	2.2±2.4	1.3±1.7	1.5	0.14
Parafunctional habits**	Bruxism=14	Bruxism=9	2.1	0.15
	Grinding=3	Grinding=2	0.22	0.64
	Biting of lips and cheeks=2	Biting of lips and cheeks=3	0.22	0.64
	None=9	None=15	3.00	0.08

**a person can present multiple site of pain; ** a person can present multiple parafunctional habits*

Table 4. Statistical analysis between BMS and dependent variables for CMD

	Limitation in mandibular movements	Mandibular deviation	Hard End feel	ATM auscultation	Joint play test	ATM palpation pain	Joint muscle test	Compression test	Muscular palpation pain	Wear facets
X^2 test	9,000	9,000	12,250	,000	6,250	9,000	9,000	12,250	,250	,250
Df	1	1	1	1	1	1	1	1	1	1
Sig. Asint.	p<.05	p<.05	p<.05	p>.05	p>.05	p<.05	p<.05	p<.05	p>.05	p>.05

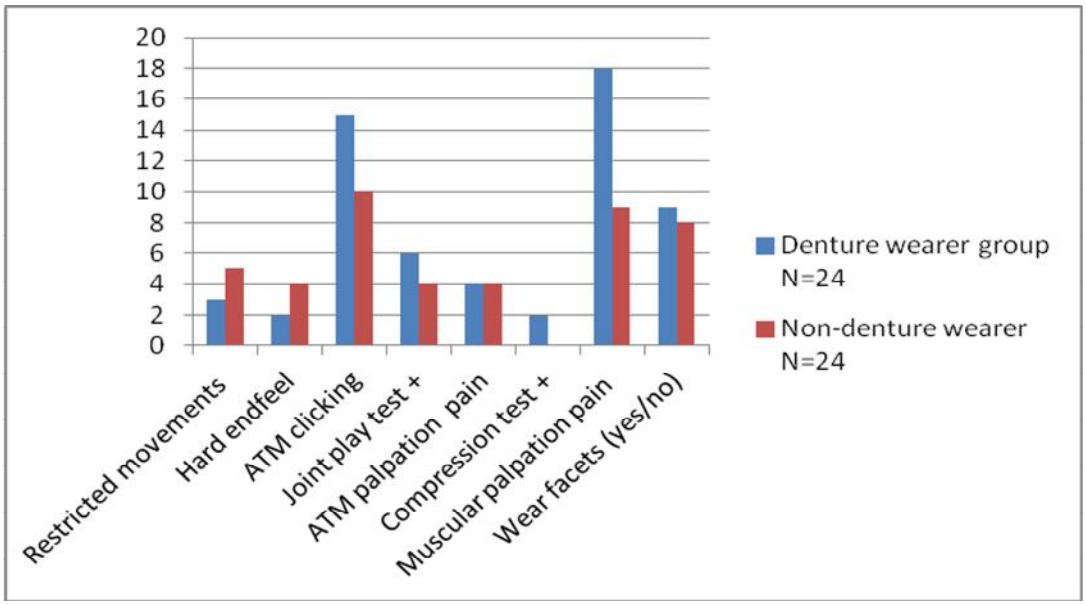


Fig. 1. Data obtained by clinical-gnathological evaluation in the denture wearer group and in the control group

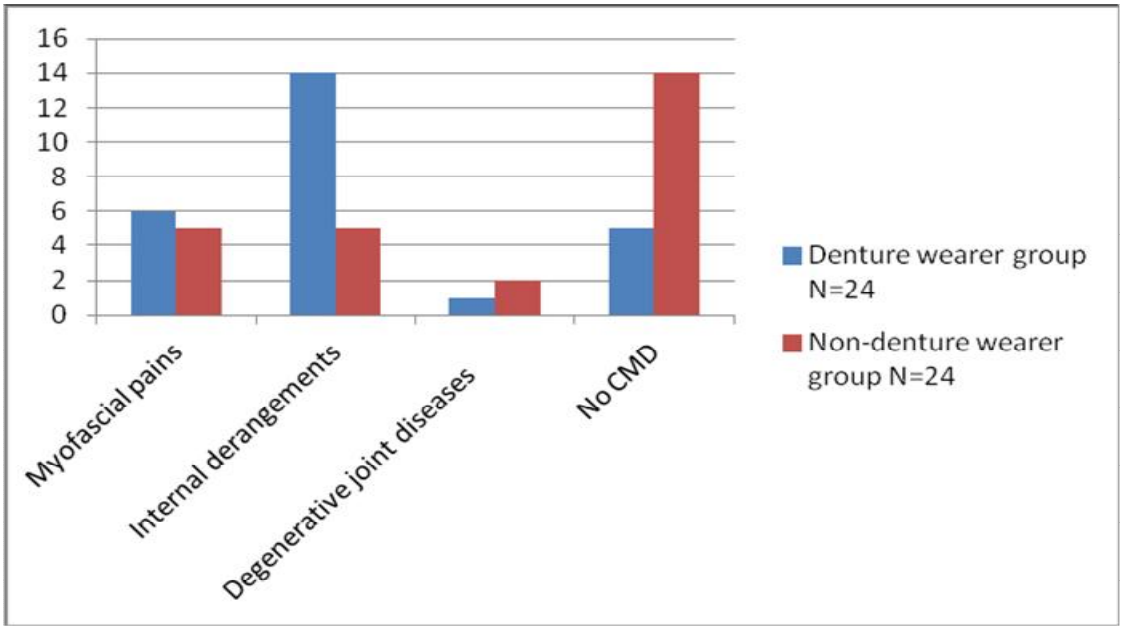


Fig. 2. Distribution of the sample according to the type of dysfunction found for each patient

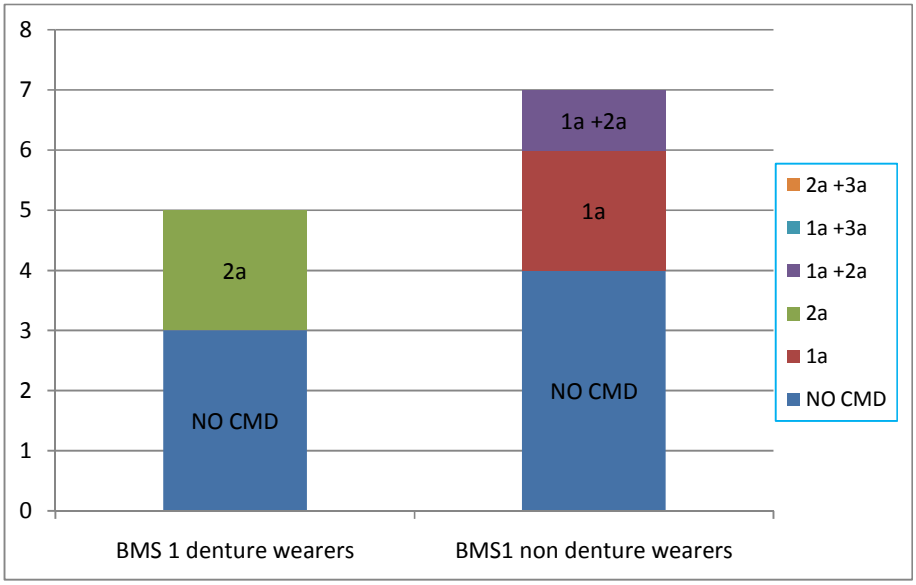
The prosthodontic examination of our patients revealed that about half of our patients presented incongruous prosthesis (unstable or with incorrect denture base extension), with occlusal errors in one third of cases. It is possible that CMD could be secondary to pain/burning sensation through mechanisms that are not yet fully understood and that incongruous prosthesis could significantly contribute to increasing the prevalence of CMD in patients with BMS. A correlation between denture design errors and either local physical trauma or parafunctional habits has been suggested by some authors [19,20,21]. Svensson and Kaaber studying denture function in patients with burning mouth syndrome observed a higher frequency of pain/

weakness in masticatory, neck, shoulder, and suprahyoid muscles in patients with BMS as compared with not affected subjects [21]. They hypothesized that prosthesis could significantly contribute to increasing the prevalence of CMD in patients with BMS. Occlusal errors and the increase of OVD may cause masticatory stress and support soft tissue overload [21]. Flanges structural defects may reduce tongue space and violate cheeks and lips muscles, thereby accentuating the patient's discomfort [21]. Inadequate denture base extension may be partially responsible for a burning sensation localized to denture-supporting soft tissues and may contribute to its instability [21]. Frequent tongue efforts to stabilize the upper denture can lead to excessive frictions on the lingual mucosa and burning sensation [21]. The prosthetic devices, especially if incongruous, can significantly increase the functional stress level of the entire stomatognathic system, promoting the onset of parafunctional habits, contributing factors to CMD [22]. In fact, some studies (8 - 9) demonstrated that during the parafunctions there are "eccentric" muscular contractions (that is, associated to lengthening of the muscle), which would cause inflammatory processes. This condition is responsible of alterations of muscular nociceptors: there is so a "sensitization" (lowering of the stimulus threshold), with consequent painful symptomatology. According to Lund's model of "adaptation to pain" [23] the convergence in the central nervous system of nociceptive afferents from the orofacial region may influence motor control in the masticatory muscles, thereby altering their useful performance.

Previous studies have considered the prevalence of parafunctional habits in patients with BMS: Lamey and Lamb [15] found the presence of parafunctional habits in 20.6% of the patients examined, this percentage rising to 61% in a Paterson' study [16]. In the present study oral parafunctional habits were found in 62,5% of the patients. Among the habits, bruxism was observed in nine cases, grinding in two cases, biting of lips and cheeks in one cases.

It is not to exclude, moreover, that in BMS the parafunctional activity can be secondary to the feeling of oral burning/pain. The high percentage of CMD founded in BMS patients could be due to an overload of the masticatory system: anxiety and restlessness were frequently referred in the anamnestic interview and wear facets were often observed during the clinical evaluation of these patients as an effect of the stress associated to the primary disease. Probably, the stress condition associated to the primary disease could explain in these patients the onset of parafunctional habits, main causes of CMD.

BMS type 1



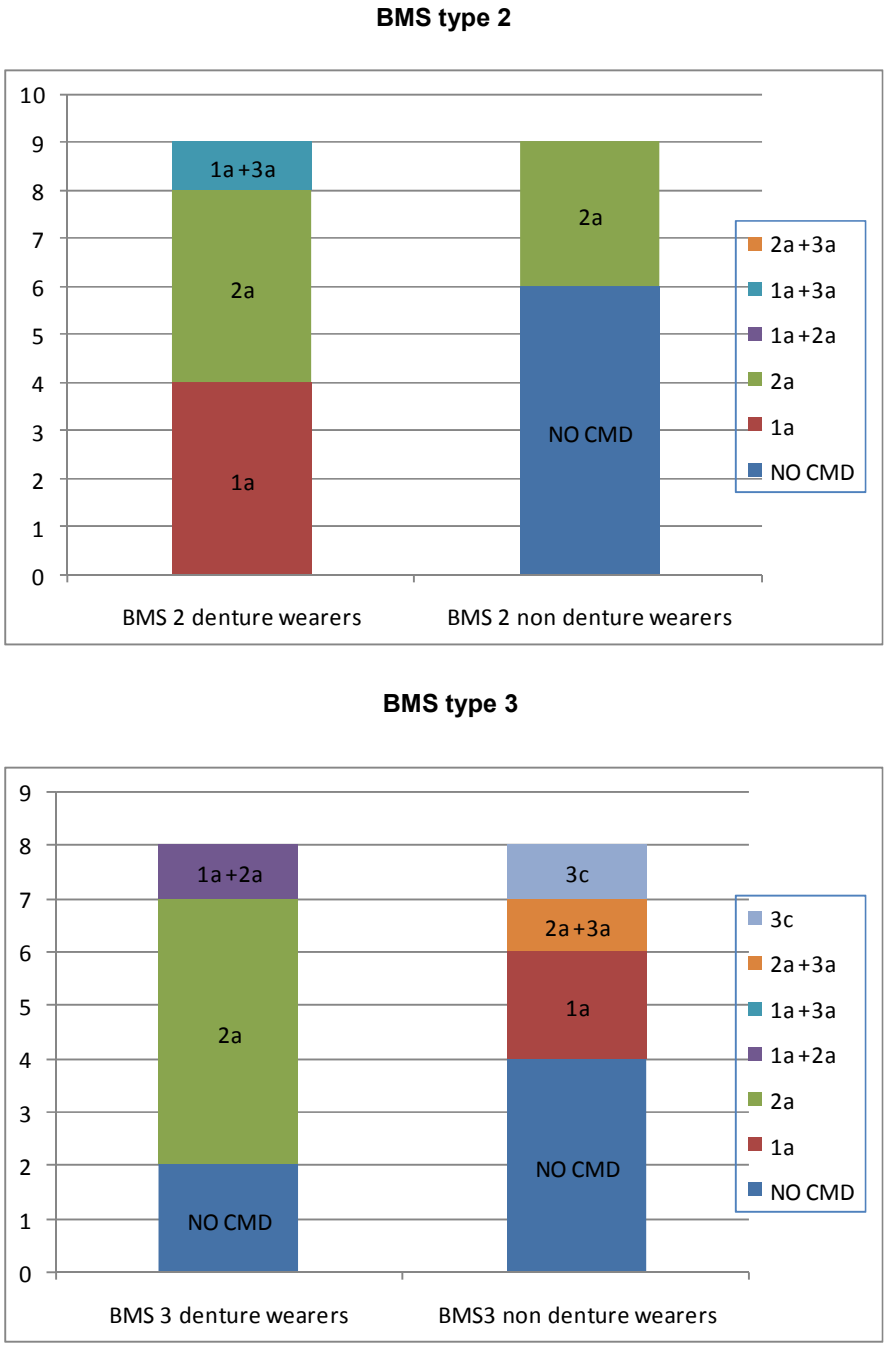


Fig. 3. Distribution of the sample according to the three typology of BMS and the type of dysfunction founded for each patient

However it is also possible that the same neuropathic alterations assumed for the BMS, could be engaged in parafunctional habits too. Lauria [9] showed a device trigeminal sensory neuropathy in patients affected by BMS.

This neuropathy results from a nigrostriatal dopaminergic system dysfunction that affects nociception regulation, causing a complete loss of inhibition of the trigeminal system. This would consist of a sensory and motor hyperfunction and

then a masticatory muscles hyperactivity with onset of CMD.

There is also an unifying hypothesis that explores the possibility that BMS and TMD and other neuropathic oral conditions can be related through hyperactivity of both the sensory and motor components of the trigeminal nerve following loss of central inhibition as a result of taste damage in the chorda tympani and/or the glossopharyngeal nerves. It is possible that loss or alteration of taste in the chorda tympani and/or glossopharyngeal nerves may result in a central loss of inhibition of the trigeminal nerve with subsequent hyperactivity of both the sensory and motor function, which may result in increased activity in the muscles of mastication and the intrinsic muscles of the tongue [24].

However, the parafunctions' role both in BMS and in CMD remains to define, and not all Authors agree in considering parafunctions as etiological agents of these pathologies [25].

To the best of our knowledge, this is the first observational study that utilizes the protocol of the European Academy of Craniomandibular Disorders in denture patients suffering from BMS.

In our previous study in a group of patients with BMS and CMD we found that myofascial pain was the most common observed CMD (2), while in the present study in denture wearing BMS patients the most common observed CMD are internal derangements. About half of our patients presented old and incongruous prosthesis, in sub-optimal condition and that require modifications or replacement. Some authors [26,27] found a strong association between CMD and age of dentures, without specifying the type of CMD according to the protocol of the European Academy of Craniomandibular. We can only hypothizes that an incorrect prosthesis could cause a change in mandibular position and a muscular imbalance which would be a contributing factor to internal derangement.

In addition, in our BMS denture wearer group nine patients present bruxism and/or grinding and wear facets that some authors associate with the presence of internal derangement [28].

It is also possible that the high mean age (75,2 years) of our study sample may have influenced the study results. Schimmer et al. [29], e Guarda-Nardini et al. [30] found that subjects of advanced aged exhibited objective symptoms of CMD (joint sounds on opening) compared to younger populations, which report more often the presence of subjective symptoms, such as pain.

5. STUDY LIMITATION

An important limitation of the study is that it was conducted in a small sample. Therefore, results must be taken cautiously. Besides, subjects were included regardless of the type of removable denture (complete or partial).

It would be of interest to develop future studies in BMS patients before and after prosthetic rehabilitation to evaluate the relationship between BMS and CMD.

6. CONCLUSION

A higher number of CMD cases was observed in the original sample compared with the control group. It would therefore seem that being a denture-wearer may contribute to the onset of CMD in BMS patients.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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