A literature review on the causal relationship between Occlusal Factors (OF) and Temporomandibular Disorders (TMD) II: observational analytical epidemiological studies

Una revisión de la literatura sobre la relación causal entre los Factores Oclusales (FO) y los Desórdenes Temporomandibulares (DTM) II: estudios epidemiológicos analíticos de observación

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ABSTRACT

This is the second article in a series that aims to do a literature review about the causal relationship between occlusal factors (OF) and temporomandibular disorders (TMD). This article presents and analyzes analytic epidemiologic studies, which are positioned higher in the hierarchy of scientific evidence and may offer more concrete conclusions about possible relationships between OF and TMD. The analysis of the studies reported in this article did not find any causal relationship between OFs and TMD development. Although there was an association between some OFs and TMDs, many of them could be better seen as the consequence and not the cause of a TMD. Additionally, even though certain OFs were correlated to TMD signs or symptoms in the longitudinal studies, none of the OFs could be associated with the development of a TMD or any TMD diagnostic categories.

Keywords: *occlusion, temporomandibular disorders, etiology, occlusal factors, temporomandibular joint, epidemiological studies.*

RESUMEN

Este es el segundo de una serie de artículos que tienen como propósito presentar una revisión de la literatura acerca de la relación causal existente entre los factores oclusales (FO) y los desórdenes temporomandibulares (DTM). En este artículo se presentan y se analizan los estudios epidemiológicos analíticos de observación; los cuales tienen un grado más alto en la pirámide de la evidencia científica y por tanto pueden ofrecer conclusiones más concretas sobre la posible relación entre FO y DTM. El análisis de los estudios reportados en este artículo no encontró ninguna relación causal entre los FO y el desarrollo de DTM. Aunque sí hubo la asociación de ciertos FO a los DTM, muchos de ellos pueden interpretarse mejor como la consecuencia y no la causa de un DTM. Adicionalmente, aunque en los estudios longitudinales ciertos FO fueron correlacionados con signos o síntomas de DTM, ninguno de los FO se pudo asociar con el desarrollo de un DTM o con alguna categoría diagnóstica entre los DTM.

Palabras clave: *oclusión, desórdenes temporomandibulares, etiología, factores oclusales, articulación temporomandibular, estudios epidemiológicos.*

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INTRODUCTION

This is the second article in a series that aims to review different epidemiological studies on the possible causal relationship between occlusal factors (OF) and temporomandibular disorders (TMD).[1] This article presents and analyzes observational analytical epidemiological studies. These are positioned higher in the hierarchy of scientific evidence and can therefore offer more concrete conclusions about the possible relationship between OFs and TMDs. These studies include case-control studies (CCS) and cohort studies (retrospective and prospective or longitudinal (LS)).[2]

METHODS

The literature review was performed using diverse sources of information:

1. The Ovid database from 1966 to 2005. We reviewed the abstracts of articles in English, and whose titles suggested the relationship between OFs and TMDs was studied. In order to narrow the search, the different occlusal factors and the relevant terms under the heading occlusion/malocclusion were used as keywords. These were cross-referenced with the relevant terms under the TMD heading (temporomandibular joint (TMJ), TMJ disorders).
2. The bibliography of the articles initially found in the Ovid database search.
3. The bibliography of different books on the TMD and occlusion domain.
4. The bibliography of several literature reviews on the subject matter from the Ovid database.

This first article[1] included only descriptive studies in which an association can be established at an individual level: case-series analysis and cross-sectional studies. This second article presents observational analytical studies, which include CCS and LS. The validity of the studies was evaluated following the parameters recommended by Mohl[3] and displayed in Table 1. The first eight parameters were described and applied in the first article.[1] Additional parameters applicable to more complex studies are described and explained in this section:

1. Using matched control groups. Using a control group provides a basis for comparing and interpreting factors that differ from the group of diseased persons (in the case of CCS) or the experimental group receiving an intervention (in the case of randomized clinical trials).[2] In order to control potentially confounding variables such as age, gender, socioeconomic status, or duration of the disorder, among others, the control group should be matched, or preferably should be as similar as possible to the experimental

group. This similarity should be established for all factors that may confound the analysis and interpretation of the results, except, of course, for the factor being analyzed.

2. Random assignment of patients and subjects to the control group. Random assignment ensures that the measured phenomenon is not influenced by variables other than the one intended to be measured. In addition, the possible confounding variables are evenly or similarly distributed across the two evaluated groups.

Table 1. Parameters for assessing the validity of scientific studies

1. Definition of the gold standard.
2. Establishment of an acceptable system of diagnostic classification.
3. Use of clearly defined measures
4. Intra- and inter-examinators acceptable reliability
5. Use of suitable samples
6. Data collection by "blind" examiners.
7. Study replicability
8. Consideration of alternative hypotheses
9. Using matched groups
10. Random assignment of patients and subjects to the control group.

Source: by the authors

RESULTS

Observational analytical studies included 34 CCS in adults [4-37] (table 2) and 19 LS [38-57] (table 3).

Analysis of the factors guaranteeing the validity of the collected observational analytical studies:

1. **Definition of the gold standard**. In most studies, TMDs were defined by the presence or absence of one or more generally isolated signs or symptoms. Only a few studies attempted an analysis based on the presence or absence of the TMD diagnosis or TMD subgroups. [9, 10, 12, 22, 25-33, 37]
2. **Diagnostic classification system**. Only a few reviewed studies attempted to use a systematic diagnostic classification that would allow a differential diagnosis between the different TMDs. [9, 10, 12, 19,20, 25-29, 32, 37]
3. **Use of clearly defined measures.** Although most of the criteria for identifying TMD signs were described similarly throughout the studies, the techniques used during the physical examination to establish its presence were different.
4. **Intra- and inter-examinators acceptable reliability.** Some studies did not report the number of examiners, while others used two or more. Some studies reported high

reliability, while others only reported it as acceptable. In a few studies examiners were trained prior to data collection.[11,15, 33, 42, 45, 51]

5. **Use of suitable samples.** In the CCS, samples varied widely in both the number of patients and the number of subjects in the control group. In general, patients belonged to university hospitals specializing in TMD, and the control subjects were mostly dental school students or patients. When patients were examined, the intensity, duration, or frequency of TMD signs and symptoms was generally not determined. Similarly, LS samples varied widely, and only in a few studies, subjects were chosen randomly. Thus, it can be observed that the samples do not conduct to obtaining an adequate representativeness that would allow the generalization of the results obtained in these reports.
6. **Data collection by "blind" examiners**. Most studies did not report using "blind" examiners, and only a few reported some form of control of this bias variable. [9, 29, 30, 35, 36] As a measure to control this aspect, some studies reported different examiners: some to evaluate symptoms and others to evaluate the signs. Alternatively, other studies prevented the examiners from knowing the patient's clinical condition or the patients' responses when questionnaires were used during the clinical evaluation.
7. **Study replicability.** There was a tendency to repeatedly associate some OFs with TMDs in studies reporting some correlation between them. Angle's II malocclusion, posterior crossbite, open bite, overjet > 6 mm, posterior tooth loss > 5, and displacement in centric > 2-4 mm were repeatedly reported in at least two of the CCS (Table 2). At least two LS repeatedly reported posterior crossbite, deep bite, overjet, and interference on the non-working side (Table 3). Although it was found that these OFs might be associated with TMDs, it was also notable that for many of the evaluated OFs, no correlation was reported.
8. **Consideration of alternative hypotheses**. The association of certain OFs to TMDs reported in CCS, and LS does not necessarily indicate a cause-effect relationship. The following are the alternative hypotheses to consider: are OFs the consequence but not the cause of TMDs? Could OFs cause TMDs when experimentally induced in asymptomatic individuals? Is there any proportional relationship between the OF size or dimension and the TMD degree of severity?
9. **Using matched control groups.** Only a few studies managed potential confounding variables using subject matching. Generally, age and sex were the most commonly controlled factors.[7, 9, 17, 18, 25, 32, 35, 36]
10. **Random assignment of patients and subjects to the control group.** Only a few studies randomized the assignment of subjects or patients. [51, 57]

Table 2. Case-control studies

First author & year	Patients	Controls	Method for TMD clinical evaluation	Evaluated occlusal factors		Occlusal risk factors (OR) associated with TMD (diagnosis, signs, or symptoms)	
				Morphological	Functional	Occlusal factor	TMD
Thompson, 1959	100 (74/26) patients from a TMD university clinic	100 (65/35) asymptomatic workers from the same institution	Interview and physical examination	Tooth wear, posterior occlusal support	NR	None	TMD signs and symptoms
Geering, 1974	139 dental patients with TMD symptoms	139 dental patients without TMD symptoms	Interview and physical examination	NR	Displacement in centric, non-working interference	Anterior or lateral displacement in centric (non-vertical)	TMD
Magnusson, 1978	100 (74/26) patients from a TMD university clinic	80 dental clinic patients	Questionnaire and physical examination*	Posterior occlusal support	NR	None	Headaches Ai Di
Pullinger, 1984	128 (NR) patients from a TMD university clinic	71 asymptomatic subjects	Interview (NR) and physical examination MS	Occlusal support and stability (NR contacts distribution)	NR	Lack of posterior stability	TMD signs and symptoms
Mohlin, 1984	56 (39/17) patients from a TMD university clinic	(272/389) general population	Interview and physical examination*	Midline discrepancy, crossbite, overjet, overbite, deep bite, Angle's classes	Premature contacts, displacement in centric, non-working interference	Crossbite, open bite	Hello Di
Stringert, 1986	62 (57/5) private practice and TMD university clinic patients with internal derangement	103 (94/9) general population	Interview, physical examination, and arthrography in patients. *	Angle's classification, overjet, and overbite, class II incisor relationship, and absence of molars	NR	None	TMJ internal derangement
Seligman, 1989	196 (157/39) TMD private practice patients assessed by diagnostic subgroups	222 (102/120) hygiene and dentistry students	Interview, physical examination, and dental models	Angle's classes, overjet, overbite, crossbite, deep bite	Premature contacts, displacement in centric	Angle's class II division 1, asymmetrical displacement in centric and > 1 mm, anterior open bite	DDR Osteoarthritis. Osteoarthritis and myalgia
Dworkin, 1990	220 (NR) patients and 123 (NR) symptomatic subjects from the general population	264 (NR) asymptomatic subjects from the general population	Interview and physical examination ^	Angle's classification, crossbite, open bite	Displacement in centric	None	TMD signs and symptoms
Pullinger, 1991	213 (169/44) TMD clinic and private practice patients assessed by diagnostic subgroups	107 (47/60) asymptomatic dentistry patients and hygiene and dentistry students	Interview and physical examination	Overjet and overbite, and Angle's classes	NR	Angle's class II division 1, anterior open bite, deep bite	Osteoarthritis. Osteoarthritis and myalgia Osteoarthritis
Steele, 1991	72 (51/21) patients with migraine from an oral medicine clinic	31 (22/9) dental patients with no history of migraines	Interview and physical examination BS, MS	Angle's classes, posterior occlusal support	Displacement in centric, non-working interference, protrusive interference, disocclusion type	None	TMD signs and symptoms
Takenoshita, 1991	35 (22/13) TMD patients taken from a dental school	44 (20/24) asymptomatic dental patients for TMD	Interview, physical examination, wax bite registrations	Number of occlusal contacts	NR	None	TMD signs and symptoms
Cacchiotti, 1991	41 (27/14) TMD patients from a clinic	40 (21/19) dentistry students	Questionnaire, examination, and dental models^	Overjet and overbite, crossbite	Displacement in centric, anterior guidance, non-working interference, group function	None	TMD signs and symptoms

Huggare, 1992	16 (14/2) TMD patients	16 (14/2) students and workers of a dentistry school	Interview and physical examination*	Overjet and overbite	NR	None	TMD signs and symptoms
Kononen, 1992	52 (M) patients diagnosed with Reiter's syndrome	52 (M) asymptomatic subjects matched by age and uni/bilateral molar support	Interview and physical examination MS*	Anterior open bite, number of occlusal contacts and unreplaced teeth	Premature contacts, displacement in centric, laterality interference	Decrease in the number of contacts	TMD signs and symptoms Di
Kononen, 1992	61 (54/7) patients with rheumatoid arthritis; 61 (24/37) with psoriatic arthritis; 61 (15/46) with ankylosing spondylitis	61 asymptomatic dental patients for skin and inflammatory diseases	Interview and examination MS*	Clinical posterior occlusal support	Premature contacts, displacement in centric, laterality interference	NR	TMD signs and symptoms Di Ai
Pullinger, 1993	270 (239/31) TMD clinic and private practice patients assessed by diagnostic subgroups	148 (48/100) asymptomatic dentistry patients and hygiene and dentistry students	Interview, physical examination and dental models	Attrition (previous, later, mediotrusive and laterotrusive)	NR	None Exception with lower mediotrusive attrition	TMD diagnostic groups Myalgia
Pullinger, 1993	413 (NR) TMD clinic and private practice patients assessed by diagnostic subgroups	147 (47/100) asymptomatic dentistry patients and hygiene and dentistry students	Interview, physical examination, and dental models	Molar relationship, anterior open bite, unilateral lingual crossbite, overjet and overbite, midline discrepancy, number of teeth, and anteroposterior molar relationship	Displacement in centric and asymmetry	Anterior open bite, overjet > 6-7 mm, displacement in centric > 4 mm unilateral lingual crossbite, anterior tooth loss > 5-6. Retrusive molar relationship	Osteoarthritis Myalgia DDR, DDwoR Osteoarthritis
Tsolka, 1994	35 (F) patients from a TMD clinic	26 (H) dentistry students, dentists, and dental technologists	Interview, index, and physical examination*	Overjet and overbite	Premature contacts, occlusal interference, and disocclusion type	Overjet	TMD signs and symptoms
Tsolka, 1995	64 (54/10) patients from a TMD clinic	28 (26/2) asymptomatic university students and workers	Interview, physical examination, and dental models	Angle's classes, overjet, overbite, crossbite, tooth crowding, tooth wear	Premature contact, occlusal interference, and group or canine protection	Class II division 2	TMD signs and symptoms Myofascial pain
Mauro, 1995	73 (NR) patients from a TMD clinic	52 (NR) patients without TMD	Interview and physical examination	Angle's classes	Premature contacts and displacement in centric	None	TMD signs and symptoms
Raustia, 1995	21 patients from a TMD clinic	28 asymptomatic university students and workers	Interview, physical examination, and dental models	Canine relationship, overjet, overbite, and midline discrepancy	Premature contacts and occlusal interference	Displacement in centric, overbite, midline discrepancy	TMD signs and symptoms, HI
Seligman, 1996	270 (239/31) TMD clinic and private practice patients assessed by diagnostic subgroups for internal derangement	52 (F) asymptomatic dentistry patients and hygiene and dentistry students	Interview, physical examination, and dental models MS	Dental attrition, anterior open bite, unilateral crossbite, overjet and overbite, midline discrepancy, number of unreplaced teeth, and anteroposterior molar relationship	Displacement in centric and asymmetry	Anterior open bite, lack of posterior teeth, overjet, displacement in centric	Osteoarthritis
Kahn, 1998	263 (233/30) TMD clinic patients with internal derangement	82 (41/41) asymptomatic volunteers	Interview and physical examination	Overjet and overbite	NR	Overjet > 4 mm	DDR, DDwoR
Kahn, 1999	263 (233/30) TMD clinic patients with internal derangement	82 (41/41) asymptomatic volunteers	Interview and physical examination	Angle's classification	Lateral guidance, non-working contacts	Class II, less frequency of canine guidance	DDR, DDwoR
Pulinger, 2000	381 (F) TMD clinic and private practice patients assessed by diagnostic subgroups for internal derangement	98 (F) asymptomatic dentistry patients and hygiene and dentistry students	Interview, physical examination, and dental models	Anteroposterior molar relationship, anterior open bite, unilateral lingual crossbite, displacement in centric and asymmetry, overjet and overbite, midline discrepancy, number of teeth	Displacement in centric and asymmetry	Anterior open bite, unilateral crossbite, displacement in centric	DDR, DDwoR Osteoarthritis

Seligman, 2000	124 (F) TMD clinic and private practice patients with internal derangement	47 (F) asymptomatic dentistry patients and hygiene and dentistry students	Interview, physical examination, and dental models BS	Anteroposterior molar relationship, dental attrition, anterior open bite, unilateral crossbite, overjet and overbite, midline discrepancy, number of unreplaced teeth	Displacement in centric and asymmetry	Unilateral lingual crossbite, displacement in centric > 2, overjet > 5 mm, and anterior dental attrition	DDR, DDwoR Osteoarthritis
List, 2001	63 (42/21) symptomatic general population subjects with TMD	64 (47/17) asymptomatic subjects from the general population	Interview and physical examination BS	Crowding, anteroposterior molar relationship, open bite, crossbite, overjet and overbite, midline discrepancy, number of teeth, and number of tooth contacts	Premature contacts, displacement in centric, non-working interference	None	TMD signs and symptoms
Yamakawa, 2002	142 (F) patients with rheumatoid arthritis	143 (F) non-hospitalized subjects without rheumatoid arthritis	Interview and physical examination	Missing teeth		Missing teeth	TMD signs and symptoms
Tallents, 2002	263 (233/30) TMD clinic patients with internal derangement	82 (41/41) asymptomatic volunteers	Interview and physical examination MS	Posterior tooth loss	NR	Posterior tooth loss	DDR, DDwoR
John, 2002	154 (115/39) patients from a TMD university clinic	120 (76/44) dental patients without TMD	Interview, physical examination, and dental models^	Incisor tooth wear	NR	None	TMD signs and symptoms and TMD subgroups
Fujii, 2002	82 (63/19) dental patients with masticatory system pain after treatment with occlusal plaque	60 (29/31) asymptomatic dentistry students	Interview and physical examination	Number of occlusal contacts at maximum intercuspation	Premature contact, working, non-working interferences, and canine guidance	Lack of canine contact on the working side and lack of interference on the non-working side	TMD signs and symptoms
Ciancaglini, 2002	25 (13/12) Dental students with TMD signs or symptoms	25 (13/12) asymptomatic dentistry students	Interview and physical examination with wax bite registrations MS, BS	Distribution and number of occlusal contacts	NR	Bilateral asymmetry in the number of contacts and higher number of contacts on the symptomatic side	TMD signs and symptoms
Ciancaglini, 2003	15 (8/7) dental students with unilateral TMD signs and symptoms	15 (8/7) asymptomatic matched dentistry students	Interview and physical examination with wax bite registrations BS, MS	Distribution and number of occlusal contacts	NR	None	Unilateral signs and symptoms of TMD
Landi, 2004	81(M) subjects diagnosed with myofascial TMD	48 (F) asymptomatic subjects	Interview and physical examination	Overjet, overbite, unilateral lingual crossbite, anterior open bite, midline discrepancy	Displacement in centric, working, and non-working interference	Displacement > 2 mm and non-working interference	TMD signs and symptoms

***** Application of the Helkimo index (IH); ^ reported reliability of examiners; female (F); male (M); DDwoR (TMJ disc displacement); blind study (BS); matched study (MS).

Table 3. Longitudinal studies

First author/Year	Sample (F/M)	Follow-up time	Occlusal factors studied		Risk factors for TMD signs or symptoms	
			Morphological	Functional	Occlusal	TMD
Rasmussen, 1981	119 TMD patients, mainly concerning TMJ	3, 6, 12 months	Tooth loss	NR	Lack of occlusal stability	Less prompt remission of symptoms
Mejersjo, 1984	154 (F) patients from a TMD university clinic*	7 years	Number of teeth in occlusion	Displacement in centric, non-working interference	Lateral displacement in centric Non-working interferences	TMD signs and symptoms
Kampe, 1987	16 subjects with and 16 without restored dentitions with an average age of 14 years old	3 years	NR	Premature contacts, displacement in centric, non-working interference, dental attrition	Premature contacts and displacement in centric	Di TMJ noises
Keikinheimo, 1990	167 (84/83) adolescents assessed at age 12	3 years	NR	Premature contacts, displacement in centric, non-working interference, and protrusive interference	NC	TMD signs and symptoms
Egermark-Eriksson, 1990	238 (116/122) population* ^	4-5 years	Angle's classes, crossbite, open bite, deep bite, overbite, overjet	Premature contacts, displacement in centric, non-working interference	Unilateral crossbite, deep bite, scissor bite, overjet > 6 mm, Angle's class 2 and 3, open bite	Subjective symptoms TMJ tenderness Pain on mandibular movement Headaches Di
Wanman, 1990	285 (139/146)	2 years	Overbite and overjet	Premature contacts, displacement in centric, non-working interference	NC	TMJ noises
Kampe, 1991	16 subjects with and 16 without restored dentitions with an average age of 14 years old	5 years	NR	Premature contacts, displacement in centric, non-working interference, dental attrition	NC	TMD signs and symptoms Ai Di
Pilley, 1992	791 (398/393) with malocclusion^	3 years	Overjet, overbite, crossbite, tooth crowding	Premature contacts, displacement in centric, non-working interference, dental attrition	NC	TMD signs and symptoms Di
Magnusson, 1994	135 subjects aged 15 years followed for 10 years	10 years	Dental attrition	Premature contacts, displacement in centric, non-working interference	Tooth wear Non-working interferences	TMJ tenderness to palpation, difficulty opening jaw, Di and other TMD symptoms
Kononen, 1993	131 adolescents with an average age of 14 years old	4 years	NR	Premature contacts, displacement in centric, non-working interference, dental attrition	NC	TMD signs and symptoms Di

Witter, 1994	107 (NR) patients with shortened dental arches, complete dentition, and using partial dentures	6 years	Posterior support Tooth wear	NR	NC	TMD signs and symptoms
Kampe, 1996	18 subjects with and 11 without restored dentitions with an average age of 25 years old	10 years	NR	NR	NC	TMD signs and symptoms Ai Di
Panula, 2000	60 (49/11) patients with orthognathic surgery and 20 (16/4) with similar anomalies without treatment*	4 years	Angle's classes, overjet, overbite, number of contacts	Premature contacts, displacement in centric, non-working interference	NC	TMD signs and symptoms Ai Di
Pahkala, 2002	187 (91/96) school children with and without speech problems	8 years	Angle's class, overjet, overbite, open bite, crossbite	Premature contacts, displacement in centric, occlusal interference	Angle's class III, open bite, crossbite, non-working interference, protrusive interference	Muscle tenderness, movement deviation, TMJ noises
Carlsson, 2002	320 (167/153) randomly chosen children from the general population* ^	20 years	Angle's class, overjet, overbite, open bite, crossbite, dental attrition	Premature contacts, displacement in centric, non-working interference	Tooth wear, deep bite	Articular noises TMD symptoms
Pahkala, 2004	97 (54/43) school children with and without speech problems	12 years	Angle's class, overjet, overbite, open bite, crossbite	Premature contacts, displacement in centric, occlusal interference	Large overjet, Angle's class III, open bite, crossbite, non-working interference, protrusive interference	Muscle tenderness, movement deviation, TMJ noises
Mohlin, 2004	337 (NR) subjects from the general population	19 years	Angle's class, overjet, overbite, open bite, crossbite, tooth crowding	Premature contacts, displacement in centric, occlusal interference	Crowding, non-working interference, crossbite, lack of deep and open bite (inverse association)	Severe TMD signs and symptoms
Magnusson, 2005	420 (194/208) randomly chosen children from the general population* ^	20 years	Angle's class, overjet, overbite, open bite, crossbite, dental attrition	Premature contacts, displacement in centric, non-working interference	Tooth wear, deep bite, displacement in centric, crossbite	TMD symptoms Signs of TMD, Di TMJ noises TMJ pain

DISCUSSION

Tables 2 and 3, which show CCS and LS, respectively, show that certain OFs were correlated with TMDs. However, the possible relationship between OFs and TMDs is not easy to analyze and interpret. The association between OFs and TMDs shown in CCS could be better interpreted as the consequence rather than the cause of TMDs. For example, OFs such as anterior open bite, Angle's class II, excessive overjet > 4-5 mm, or displacement in centric > 2-4 mm are present in degenerative TMJ diseases such as arthritis.10, 12, 20, 28, 29 These degenerative diseases, which commonly have autoimmune disorders in their pathophysiology, are reflected in occlusal changes and are not primarily caused by an occlusal instability discrepancy, imbalances or drastic changes in condylar morphology (which are caused by these types of systemic degenerative bone diseases). Other OFs —such as interference on the non-working side, posterior crossbite, deep bite— have also been reported in CCS but could not be clearly explained as a consequence of TMDS.

Interestingly, the OFs mentioned above maintain their association with the TMDs in the LS report. However, these OFs were correlated only with the presence of TMD signs and symptoms but not with the development of cases with clinical characteristics similar to that of TMD patients. This fact suggests that subjects with certain occlusal characteristics are more likely to show TMD signs or symptoms but not more likely to develop a TMD or to have a proper diagnosis.

It is also important to recognize the different methodological problems that were found in the analyzed studies, which are very similar to those discussed in the publication prior to this article. The divergence and inconsistency in the methodologies used in the different investigations (measurements poorly defined and made in different ways, trustworthiness of the examiners, etc.) put at risk the strength of the factors that assure the validity of the results. Few studies have used a TMD clinical diagnosis that has been reported to be reliable and valid. The evaluation and diagnostic criteria for the TMD research published by Dworkin (1992)58 were poorly applied. These criteria have high reliability and were proposed attempting to standardize the investigations and facilitate their comparison.59 Additionally, in many of the CCS, patients were evaluated in a large TMD group, and only a few reports considered the analysis by TMD subgroups. The results of the LS reports were not analyzed to check the presence of TMD subgroups or clinical characteristics similar to those displayed by TMD patients. Instead, the presence of signs and symptoms that occurred in isolation was analyzed, which is quite serious because isolated signs or symptoms do not constitute a disease state.

Likewise, as described in the previously analyzed descriptive studies, the criteria for identifying TMD signs and symptoms were not completely similar throughout different studies and the techniques used during the clinical examination were also different. In addition, among the studies, information regarding the presence of TMD symptoms was collected using several methods such as interviews or questionnaires (answered by mail or in person by the patient). Few studies reported examiner training and acceptable levels of intra- and inter-examiner reliability. In CCS, the subjects in the control group were chosen from different populations (students, dental patients, general non-randomly chosen population); therefore, attempting to extrapolate the results to all subjects is problematic. In addition, the TMD levels of severity (or their signs or symptoms regarding intensity, frequency, or duration) were not reported in most studies. When it came to establishing the severity of TDM cases, the Helkimo index60 was used; and as mentioned above, the diagnostic validity of this index is doubtful.

CONCLUSIONS

The analysis of the reported studies did not support the idea of any OF as a causal factor in TMD development. While some OFs were associated with TMDs, many can be better interpreted as a consequence and not the cause of TMDs. Additionally, while in longitudinal studies, certain OFs were correlated with TMD signs or symptoms, none of the OFs could be associated with the development of a TMD or with any TMD diagnostic category. Similarly, the results of these studies do not allow using some OFs as predictors of the need for TMD treatment. By analyzing the information obtained from the reviewed descriptive and analytic studies, it is not possible to conclude that OFs cause TMD development. Perhaps improving the research design will allow us to obtain significant results that may lead to a different interpretation and conclusion.

CONFLICT OF INTEREST

The authors state that they have no conflict of interest.

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