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## THE ROLE OF OCCLUSAL FACTORS IN TEMPORO MANDIBULAR DISEASES – A SYSTEMATIC REVIEW

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### ABSTRACT

**PURPOSE:** The aim of this systematic review is to investigate the role of TMDs and offer a suggestion as to how best to manage them. **METHODOLOGY:** Databases including Google Scholar, Embase, Scopus, and Medline were accessed between October 1975 to May 2018. Only English language articles were selected. No additional sources were accessed, including gray literature. The topic addressed was the following: interaction between occlusion and TMD. 41 articles were sourced relevant to the research question under discussion. None of the articles were duplicates, while four were discarded after reading the abstract, and 15 articles were excluded after reading the articles in full text for studying other factors along with occlusion in their study. A total, therefore, 22 articles were finally selected and included based on their relevance in addressing the proposed research topic. All of them were full text accessed and qualitatively analyzed results. **RESULTS:** The articles selected demonstrated that there were three streams of studies. While two of the streams were diametrically opposite to each other regarding their conclusions, the third stream pointed out that the methodological flaws in the studies implied that further studies might be needed to arrive at a definite conclusion. **CONCLUSION:** This systematic review arrived at the following conclusions: 1. A majority of studies do not find occlusion as an aetiologic role in TMD; 2. there are a few studies which, however, find an association, and it is the duty of the clinician to differentiate and diagnose the different entities of temporomandibular disorders and adjust the treatment modality accordingly.

**KEYWORDS:** Occlusion, Temporo-mandibular disorders (TMD), Cranio-mandibular disorders.

## INTRODUCTION:

Temporomandibular disorders (TMDs) have been and continues to be a subject of controversy<sup>1</sup> even today; this can be attributed to two reasons. One lack of clarity with regards to the functioning of the Temporomandibular joint (TMJ) and the other to the inability to pinpoint a definite etiology for the condition the latter is, however, not due to shortage of aetiologies for the condition but rather due to the plethora of such aetiologies but among the many aetiologies, one has been a significant source of dissonance.<sup>1,2</sup> It is the role of occlusion in TMDs. This one cause has been investigated by many over a long period of time, but the conclusions have not been conclusive divergent results have emerged, which, rather than offering clarity, have often served to cloud the picture. Reviews, including systematic reviews, have also not helped because they usually end up either confirming or denying the role of occlusion in TMDs.

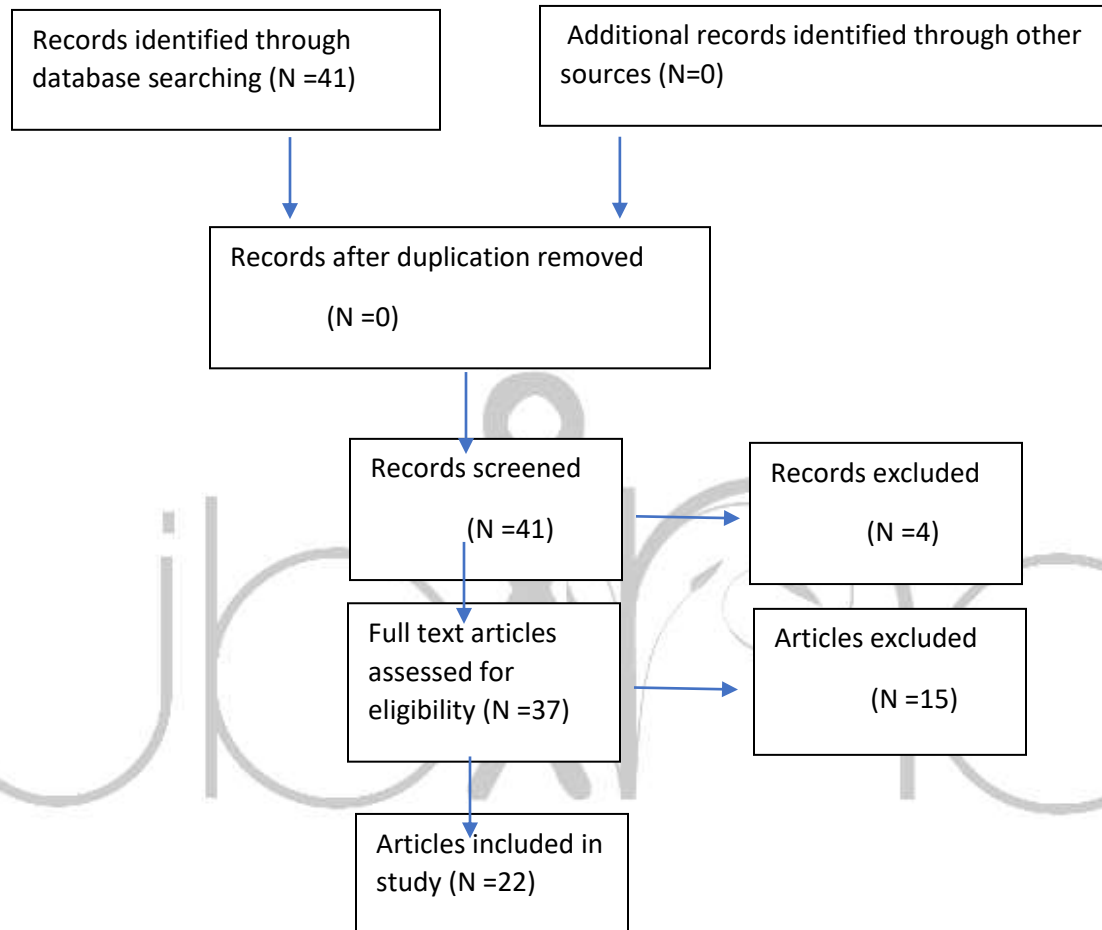
This review is, therefore, an attempt to present both the divergent viewpoints as well as a third one which is that further studies are required since many of the studies are flawed methodologically. This systematic review will, therefore, present all three aspects, thus enabling the reader to get a balanced view and help promote further investigation into the topic. A hand search was initiated by the third author, and the keywords used in the hand search

were occlusion, Temporo-mandibular disorders (TMD), Cranio-mandibular disorders.

## DATA SOURCES:

Databases including Google Scholar, Embase, Scopus, and Medline were accessed between October 1975 to May 2018, using the keywords Occlusion, Temporo-mandibular disorders (TMD), and Cranio-mandibular disorders. Only English language articles were selected. No additional sources were accessed, including gray literature. The question addressed was the following: what is the association between occlusion and TMD? 41 articles were sourced relevant to the research question under discussion. None of the articles were duplicates, while four were discarded after reading the abstract, and 15 articles were excluded after reading the articles in full text for studying other factors along with occlusion in their study. A total, therefore, 22 articles were finally selected and included based on their relevance in addressing the proposed research question. All of them were full text accessed and qualitatively analyzed results. The chosen articles demonstrated that there were three streams of studies. While two of the streams were diametrically opposite to each other regarding their conclusions, the third stream pointed out that the methodological flaws in the studies implied that further studies might be needed to arrive at a definite conclusion.

**FLOW CHART 1: PRISMA flowchart for selection of the article**



**Table 1 excluded articles and the reasons for exclusion :**

S.NO	FIRST AUTHOR & YEAR	REASONS FOR EXCLUDING
1	Iger .egermartx <sup>3</sup> 1992	Not relevant to the research question as it examined the relationship between orthodontic patients and TMD
2	Peter Fuchs <sup>4</sup> 1975	The study investigated the nocturnal muscle activity of the stomatognathic system. Hence unrelated to the research question

3	Lotika Wadhwa <sup>5</sup> 1993	The study examined the role of orthodontics in TMD and hence unrelated to the research question
4	M.J Trenouth <sup>6</sup> 1979	The study was on the relationship between TMD and bruxism hence not relevant to the research question
5	PullingerAJ <sup>7</sup> 1993	The study was to find the role of attrition, TMD. occlusal factors were not taken into considerations
6	H.G. Stringert <sup>8</sup> 1986	Excluded because the study dealt with variations in skeletal and dental patterns in joints and co-relation with TMD not specific to the research question
7	Risse C <sup>9</sup> 1984	The study investigated occlusal interferences with certain muscle groups activity
8	Pullinger A <sup>10</sup> 1991	Studied overjet + bite relations with osteoarthritis and hence not relevant to the research question
9	Rugh <sup>11</sup> 1984	The study examined the role of experimental occlusal discrepancies on nocturnal bruxism and hence not relevant to the research question
10	Westling <sup>12</sup> L1995	The study was restricted to adolescents and hence was age limited in scope
11	Tsolka P <sup>13</sup> 1995	The study was to examine the occlusal variables and bruxism on TMD. Hence not specific to the research question
12	Suvinen <sup>14</sup> 2007	The study dealt with EMG studies, occlusal factors.
13	Luther F <sup>15</sup> 2007	This article addressed the role of orthodontics in TMD
14	TamneK <sup>16</sup> 1993	The study investigated the association between malocclusion and TMD in orthodontic patients
15	MarbachJJ <sup>17</sup> 1990	The study assessed the association between tooth grinding and TMD. So not relevant

**SYSTEMATIC ASSESSMENT OF PAPERS:**

The selected papers were analyzed by adhering to the PICOT format. i.e

P-population, I-intervention, C - comparison O- Outcome and T -time

Population - refers to the target population who were part of the study. viz. the users in the community

I -intervention refers to the parameters that were selected for investigation and /or the experimental parameters into the population studied

C - are the factors that were used as controls, e.g., placebos

O - outcome refers to the outcome of the study and whether the results led to rejection or acceptance of the investigator's hypothesis

T - the time frame within which the study was conducted

**TABLE 2: ARTICLES INCLUDED IN THE STUDY**

**1<sup>ST</sup>GROUP (POSITIVE ASSOCIATION- studies stating occlusion has a role in TMD )**

S.No	Author	Population (P)	Intervention (I)	Comparison (C)	Outcome (O)	Time (T)
1	Haralur SB et.al., <sup>18</sup>	N= 100 N=50 (asymptomatic), N= 50 (symptomatic)	Dynamic occlusal contacts evaluated by conventional and digital methods. Centric, lateral and protrusive interferences by a conventional method occlusion time and disclusion time by a digital method	N=50 asymptomatic individuals	There is Association between dynamic occlusal parameters( centric slide, balancing side interference)and TMD There is an association between prolonged occlusion and disclusion time and TMD	
2	kirveskari p et al., <sup>19</sup>	Total N = 62 Treatment group N= 33	Treatment group occlusal interferences like the elimination of slide in RCP- MI and posterior	Placebo group N= 32	Reduction in subjective symptoms followed modifications of occlusion;	2yrs

			contacts during lateral and protrusive movements Subjects in the placebo group had a mock adjustment, polishing of non-occluding fillings, i.e., no occlusal changes		ergo, there is an association between occlusal interferences and signs and symptoms of TMD	
3	Riolo ML et.al., <sup>20</sup>	N= 1342 Age 6-17	Analyzed for specific types of occlusion, subjective symptoms, and clinical signs of TMD		An association exists between specific features of occlusion, including open bite, increased overjet, sounds in older children with a buccal crossbite	
4	Forsell H et al., <sup>21</sup>	N= 91 patients with headaches and signs and symptoms of TMD	Occlusal adjustments on 48 patients and mock adjustment on 43 19 of the 48 patients had occlusal splints as well	N=43 (control group) patients had a mock adjustment	Significantly more reduction in signs and symptoms of treatment group independent of splint therapy	

5	Kirveskari et al., <sup>22</sup>	Treatment group N=53	Elimination of interferences annually in the treatment group N = 53	Control group N = 46 underwent placebo treatment	A significant association between the number of interferences and signs of CM disorders	
6	Pullinger et al., <sup>23</sup>	N=147 asymptomatic	11 occlusal features anterior open bite; unilateral maxillary lingual crossbite; RCP-ICP slide; unilateral RCP contact; overbite; overjet; dental midline discrepancy; the number of missing teeth; the greater of the mesiodistal intermaxillary relationship discrepancies at the first molar intermaxillary relationship (right vs. left asymmetry).	Disc displacement with reduction (n=81), disc displacement without reduction (n=48), osteoarthritis with disc displacement history (n=75), primary osteoarthritis (n=85), and myalgia only (n=124).	Significant associations exist for each disease.	

**2<sup>ND</sup> GROUP (NEGATIVE ASSOCIATION- studies stating there is no relation between occlusion and TMD )**

S.No	Author	Population (P)	Intervention (I)	Comparison (C)	Outcome (O)	Time (T)
7	AlhajjMN et al., <sup>24</sup>	N= 625 (75% female ) age 34.1 +/- 6.7 (divided into 4groups)	Examination of Static occlusal features evaluated posterior crossbite, excessive overbite, anterior open bite, excessive overjet and molar, and canine asymmetry  Examination of Dynamic occlusal features were Medio-laterotrusive interferences, slide length from RCP- MI, Ø correlation coefficient assessed the strength of correlation between each occlusal feature	Data on malocclusion in the General population	In adult subjects with or without signs and symptoms of TMD, static and dynamic malocclusion were comparably present  No association of occlusion with TMD	
8	Droukas B et al., <sup>25</sup>	N= 50 37 female , 13male	Recording of occlusal contacts in ICP, type of contact – unilateral or bilateral in RCP, RCP- ICP distance in the sagittal, vertical and lateral direction, types of occlusion – contacts in		Even though occlusal conditions varied considerable and, no association could be established with signs and symptoms of mandibular dysfunction	3 month period



			laterotrusion and protrusion and occlusal interferences			
9	Takenoshita Y et al., <sup>26</sup>	N= 79 N=44 control group N= 35 treatment group	Wax bite was taken in ICP and analyzed electrophotometrically	N=44 control group	No association of occlusal contact area with signs and symptoms of TMD	
10	De Boever JA et al., <sup>27</sup>	N= 135 patients ( 33 male , 102 female)	Reassurance, occlusal splint and muscle exercise, occlusal adjustment, occlusal rehabilitation	Intergroup comparison	No association between the number of occluding molars and premolars and the severity of the symptoms and signs	12 months
11	V a n d e r a s AP <sup>28</sup>	N= 386 children age 6-10 yrs With or without unpleasant life events, both females n males N= 250 calm group N=105 subjects with unpleasant life events	Questionnaire to the parents and followed by clinical examination	N=250 calm group ( subjects without unpleasant life events)	No statistically significant correlation between each clinical sign and each type of morphological malocclusion in both groups No association/correlation between malocclusion and CMD	

		(tense, anxious) (not calm ) N=25 subjects with dentofacial injuries either with or without unpleasant life events			
12	Szentpetery et al. <sup>29</sup>	N= 600 N= 285 (male) N= 315 (female )	Assessed morphological occlusion viz., angle classification of inter-arch occlusal relations, crowding, deep bite, edge to edge bite, open bite, crossbite, tilting, and over the eruption. Functional occlusion, balance, and hyper balance		No association of TMD with morphological or functional occlusion
13	Mohlin et al., <sup>30</sup>	N= 505 women age range : 20-45 yrs	Clinical assessment of TMJ movements, pain on movement, TMJ sounds, muscle tenderness, TMJ tenderness, and cuspal interferences		No association between any variable malocclusion and severity of clinical signs

14	Jenni et al. <sup>31</sup>	N= 210 (both female and male ) Age between 20-69	Screening to evaluate signs of TMD in patients with and without occlusal interferences	Individuals without occlusal interferences	No significant association between occlusal interferences and TMD
15	Dworkin et al. <sup>32</sup>	N= 108 symptomatic patients	Screening field examination for signs and symptoms of TMD Field characteristic-pain report, morphologic occlusion	N= 210 controls in two age group strata 18-44 yrs, 45-75yrs	No association between any of the variables evaluated and signs and symptoms of TMD
16	Seligman DA et al., <sup>33</sup>	124 Female patients with intracapsular TMD	Nine occlusal factors were used for screening	N=47 asymptomatic female controls with an association to 9 occlusal factors N=3 attrition severity measures	Poor association between TMD patients and occlusal and attritional factors
17	Pullinger et al., 1988 <sup>34</sup>	N=220 Female N=102 Male N = 120	They were assessed for masticatory pain and dysfunction by questionnaire, clinical examination, and evaluation of dental casts. Assessment for vertical overlap,		No association of clicking with angle class, deep bite, length of RCP-ICP slide, or unilateral RCP contact.

			crossbite, ICP & RCP relationship unilateral molar contact in RCP			
18	McFarlane et al., <sup>35</sup>	N=196 healthy subjects aged 18-65 years	One occlusal feature missing posterior teeth	N=131 subjects with pain dysfunction syndrome	Multiple variables: no association.	
19	DeSousa et al., <sup>36</sup>	N=58 TMD free subjects aged > 15 years	Five occlusal features, anterior open bite; posterior crossbite; overbite>4mm; overjet>5mm; more than 5 posterior teeth were missing.	N=42 TMD subjects aged >15	Single variable: no association	
20	Manfredini et al., <sup>37</sup>	N=58 TMD free subjects (aged 20-40 years) without a history of orthodontics	Three occlusal features canine class, molar class, asymmetry.	N=96 TMD patients (aged 20-40 years) without a history of orthodontics	Single variable: no association.	

**3<sup>RD</sup> GROUP ( studies stating the requirement of further studies to assess the role of occlusion in TMD)**

S.No	Author	Population (P)	Intervention (I)	Comparison (C)	Outcome (O)	Time (T)
21	Le Bell Y et al., <sup>38</sup>	N= 26 healthy women N= 21 women with a previous history of TMD	Divided into treatment and placebo group Artificial interferences were created in the treatment groups and	Compared with placebo groups of each group	Patients with a previous history of TMD were more associated with signs and symptoms of	2-16 months

			<p>simulated in the placebo group, i.e., each of the 2 groups was subdivided into a treatment group and placebo group</p> <p>Patients without a history of TMD: N=14 placebo, N = 12 treatment group</p> <p>Patients with history of TMD : N = 11 placebo, N= 10 treatment group</p>		<p>TMD in the presence of occlusal interference</p> <p>Further studies required to know the association</p>	
22	Abd Al Hadi L <sup>39</sup>	<p>600 men and women</p> <p>Age:16-22 yrs</p> <p>N= 300</p> <p>symptomatic</p>	<p>Assessed 5 occlusal parameters angles class, type of eccentric occlusion, chewing side preference, and working and non-working interferences</p>	N= 300 asymptomatic patients	<p>Various levels of association and non-association</p>	

**RESULTS:**

The search (both physical and electronic) resulted in 41 citations, of which 19 were excluded based on the exclusion criteria mentioned elsewhere.

Thus 22articles were selected, which were in accordance with the objectives of the research question

A full-text retrieval was accomplished by 1<sup>st</sup> author of the included papers, and an agreement as regards their inclusion/exclusion was arrived at by

discussion among the 1<sup>st</sup>, 2<sup>nd</sup> authors. The study findings were categorized by 3<sup>rd</sup> and 4<sup>th</sup> author as follows:

**STUDY FINDINGS:**

The study findings could be categorized as under randomized control trials N= 2, Case-control studies N = 6, prevalence studies N=9.

The selected articles were discussed with the fifth author. He suggested that since the topic chosen for the review has high variable opinions and conclusions,

systematic quantitative analysis is not possible, and it has to be assessed qualitatively, where meta-analysis is not possible to attain mean and standard deviation values.

In summary, the pattern of associations could be divided into 3 groups.

G1(N = 6) studies which did find an association with occlusal features and TMD

G2, the major group( N=14), consisted of studies that failed to find any association between occlusal factors and TMD.

G3 (N= 2) questioned some of the findings of G1, stating a lack of methodological rigor in them.

#### DISCUSSION:

Temporomandibular disorders have a contentious history with regard to history. Among the many etiologic factors suggested, the one that was and still remains still unresolved despite decades of research has been the association between occlusal factors and temporomandibular joint disorders, and since the occlusion is of primary importance to the dental profession, it is essential that the role of occlusion be clearly defined in its relation to temporomandibular disorders—failing which the profession will have negligible if any role in the management of temporomandibular disorders. Ever since James B Costen first described a group of conditions that later was eponymously called Costen's syndrome, the dental fraternity has been intensely searching for an etiology for the condition.<sup>1,2</sup>

Despite the existence of huge literature about TMD and occlusion, there is still

controversy and contradictory opinions on the interaction of TMD and occlusion. Currently, the term temporomandibular disorders are the most frequently used term to represent disturbances and dysfunction of the stomatognathic system. Through a series of workshops and symposia, the term temporomandibular disorders became the "Gold standard" for the disorders' diagnostic criteria. In four different entities, the term occlusion is used in the dental literature: 1) the anatomic jaw relation (orthodontic): Angle classification, 2) static contact between the teeth of the upper and lower jaws, 3) dynamic contact between the teeth of the upper and lower jaws, and 4) the prosthetic classifications, more specifically, the complete/incomplete dentition versus complete dentitions and the presence of fixed/removable prosthesis.<sup>44</sup>

Table 2 summarizes in the PICOT format the results of the reviewing 22articles. The table reveals that while there is little to substantiate the role of occlusion in TMD, it is only a partial reflection of reality. This is in contradistinction to the conclusions of many authors because there are studies that do find the association of occlusal features with TMD and also articles which question the methodological rigor of studies in G2.

The conclusions drawn from the literature are: 1) the role of occlusion in the etiology "TMD" is not absolutely assessed. 2) occlusal interferences affect TMD, 3) "TMD" is multifactorial; subsequently, it will be affected by different treatment modalities ( the biopsychological model modalities of illness approach), 4) adaptation is an important quality of the

human being; it is more specific to the stomatognathic system.<sup>44</sup> This manuscript reviewed the literature on the association between features of dental occlusion and temporomandibular disorders. Based on findings, which support the absence of disease-specific association, there is no ground to hypothesize a significant role for dental association in the pathophysiology of TMDs. Dental clinicians are thus encouraged to move forward and abandon the old-fashioned gnathological paradigm. The authors are therefore of the opinion that since the majority of studies do not demonstrate a role for occlusion in TMD, it would be prudent for the clinician managing TMDs to adopt a conservative reversible approach, e.g., occlusal appliances, bio-feedback, etc. rather than adopt aggressive irreversible interventional strategies like orthodontics or extensive occlusal rehabilitation; till such time as

further studies definitely confirms the role of occlusion in TMD.

The main limitations of the study are the articles were assessed qualitatively, but quantitative analysis of the literature would have been helped in obtaining a perfect outcome with clinical significance.

#### CONCLUSION:

Due to the phenomenon of the multiple catch-all or container concepts of both temporomandibular disorders and occlusion, there are different options to research. This systematic review, therefore, arrives at the following conclusions:

1. A majority of studies do not find occlusion as an aetiologic role in TMD
2. there are a few studies that, however, find an association

This may enable the clinician and the researcher a springboard to do further study on the topic.

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