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Original Article

A Systematic Review of the Literature on the Connection Between Cervical Spine Abnormalities and Internal Disorders of the Temporomandibular Join

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ABSTRACT

Alterations in neck and head posture can affect jaw and masticatory muscle function, as well as the neck's range of motion and cervical muscle activity in patients with temporomandibular disorders (TMD). This review aimed to investigate the association between abnormalities in the cervical spine and temporomandibular joint (TMJ) dysfunctions. This systematic review was conducted following the guidelines set by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). A thorough search of the literature was performed using the databases ResearchGate, PubMed, Scopus, Cochrane Library, and Google Scholar. The search strategy used the terms "temporomandibular joint," "Cervical spine," and "pain." Initially, 273 articles were considered during the title and abstract screening process. After further evaluation, 52 studies were identified, and the full texts of these studies were reviewed. Finally, 6 studies met all inclusion criteria for this review. The studies included 417 patients from TMD-related clinical trials, with 302 patients participating in the intervention groups. Key findings included reduced side flexion, increased pain intensity associated with TMD, a greater number of active trigger points in masticatory and cervical muscles, and a reduction in the C0-C1 distance, all of which significantly affect cervical abnormalities related to the temporomandibular joint (TMJ).

Keywords: Craniocervical mandibular system, Temporomandibular joint, Cervical spine abnormalities, Internal disorders, Relationship.

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Introduction

Temporomandibular disorders (TMDs) refer to a collection of conditions impacting the muscles responsible for chewing, the temporomandibular joints (TMJs), and adjacent structures [1]. The "craniocervical-mandibular system" that involves the TMJ, masticatory muscles, and ligaments connecting the TMJ to the cervical region, is a functional unit that has not been completely understood yet [2]. This biomechanical relationship could influence how the cervical and masticatory systems depend on each other [3]. Several studies have pointed out the strong connection between TMD and cervical issues [4, 5]. Modifications in neck and head posture can affect jaw function, masticatory muscle performance, neck mobility, and cervical muscle activity in those with TMD [4]. It is also common for TMD symptoms to coincide with conditions like shoulder and neck pain and headaches [5].

Back pain, one of the most widespread medical concerns, can arise from numerous underlying causes and disorders [6]. Research suggests that 43% of women and 30% of men experience neck pain at some stage in their lives, with pain intensity worsening as individuals age [7]. When it comes to TMD, the likelihood is more than double for women than men. Additionally, other important factors have been identified in the literature, such as self-reported health, general chronic pain, age, study location, ethnicity, psychosocial conditions, and genetic predispositions [8]. Chronic TMD prevalence is reported at 1.6%, affecting 1.3% of men and 1.8% of women, with lasting effects on quality of life [9].

To evaluate the dysfunctional and functional aspects of the craniocervical mandibular system, the anatomical connections between the structures involved are studied, as capturing these functions in real time is not feasible [10]. Several studies have highlighted the relationship between the cranial region, temporomandibular joint, cervical spine, and hyoid bone, focusing on both their morphological and functional interconnections [11, 12]. Headaches and Neck pain often coexist with temporomandibular disorders [5]. The relationship between TMD and changes in neck and head posture remains a subject of ongoing debate, which is why the association between cervical spine abnormalities and TMJ dysfunction was examined in this study [13].

Materials and Methods

This systematic review was conducted in alignment with the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines [14]. The protocol for the review was registered with the International Prospective Register of Systematic Reviews, under the registration number CRD42022330126. The following PICO framework was developed:

- The participants (P): individuals with TMJ dysfunction;
- the intervention (I): not present;
- the comparison (C): cervical spine abnormalities and TMJ dysfunction;
- the outcomes (O): pain intensity, TMJ functionality, and range of motion in the cervical spine.

The guiding PICO question for this review was: “Is there a connection between abnormalities in the cervical spine and dysfunctions of the temporomandibular joint (TMJ)?”

Search strategy

An extensive search of the literature was conducted utilizing the advanced search options of PubMed, Cochrane Library, ResearchGate, Scopus, and Google Scholar. The search terms employed included “Cervical spine,” “temporomandibular joint,” and “pain.” The search was limited to articles published in English between July 2017 and 2022. No restrictions were placed on the country of publication or the status of the articles.

Selection criteria

The studies considered for inclusion were randomized controlled trials, as well as comparative, observational, retrospective, single-blinded, split-mouth randomized trials, and controlled clinical trials involving adult participants. These studies examined the connection between cervical spine abnormalities and TMJ disorders. Only patients aged 18 and older who experienced chronic orofacial pain and had a diagnosis of TMDs were included.

Exclusion criteria

- Studies such as case reports, animal studies, systematic reviews, or meta-analyses;
- Research focusing on the relationship between TMJ disorders and other areas of the spine;
- Patients with a history of craniofacial or cervical trauma, or surgery involving the orofacial region;
- Individuals with immune diseases, systemic or localized inflammation, or infections;
- Patients who had previously undergone or were currently receiving orthodontic treatment;
- Those regularly use medications that could influence clinical outcomes.

Quality assessment

The quality of the selected studies was assessed using the Cochrane collaboration tool for risk of bias. Seven domains were examined: generation of random sequences, concealment of allocation, blinding of participants and staff, blinding of outcome evaluation, selective reporting, incomplete outcome data, and other potential validity risks. Each domain was rated as low risk, unclear risk, or high risk.

Results and Discussion

Study selection

A total of 317 articles were identified through both electronic and manual searches, with 41 duplicates removed. This left 273 articles for screening based on titles and abstracts. After applying the eligibility criteria, 52 full-text articles were reviewed. Ultimately, 6 studies met all inclusion requirements for this systematic review (**Figure 1**). Both quantitative and qualitative analyses were conducted on the selected studies. A summary of the key characteristics of these studies can be found in **Table 1**.

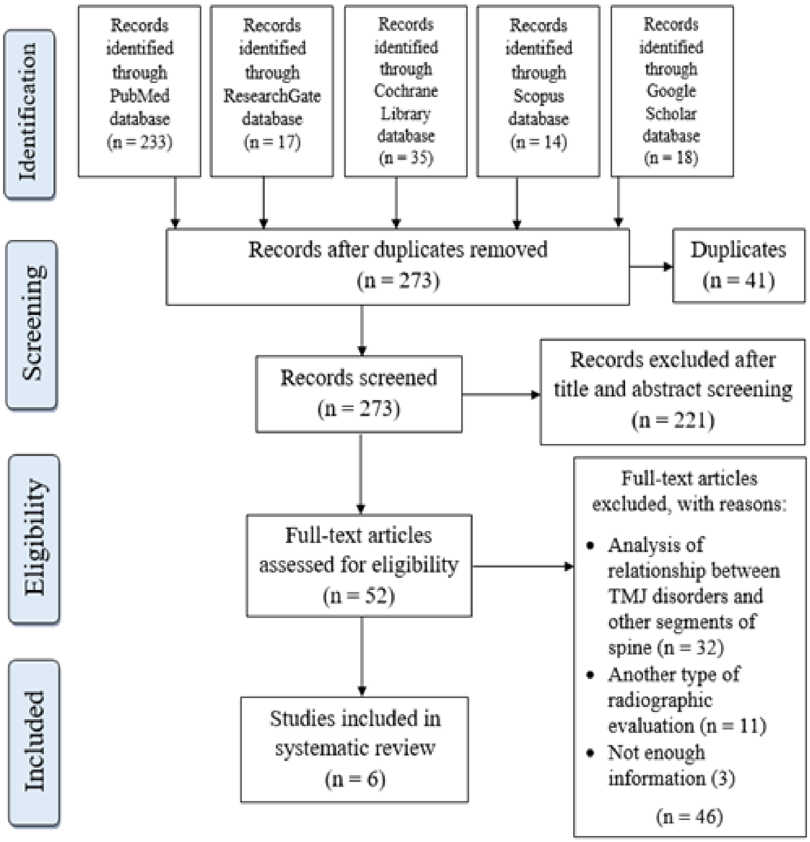


Figure 1. PRISMA flow chart.

Table 1. Characteristics of included studies.

Article	Groups: Control	Groups: Study	Diagnostic method	Outcomes	Intervention	Treatment outcomes	Study groups P-value					
							Fusion abnormalities (with (n = 10) / without (n = 33))		Posterior arch deficiency (with (n=8) / without (n=35))		Presence of any abnormalities in TMJ (with (n=15) / without (n=28))	
							Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Kim *et al.* [15]		Patients with fusion, posterior arch defect, and the presence of both abnormalities	RDC/TMD	Pain intensity, CMO, MMO, MOL, pain on opening, pain on capsule palpation, pain on masticatory muscle palpation	Counseling, stress management, control of contributing factors, physical therapy (moist hot pack application, ultrasound, electric	Pain intensity	3.7 (SD = 2.9) / 4.0 (SD = 2.7)	0.3 (SD = 0.7) / 0.9 (SD = 1.6)	4.1 (SD = 3.6) / 3.9 (SD = 2.5)	1.0 (SD = 1.7) / 0.7 (SD = 1.4)	4.3 (SD = 3.2) / 3.9 (SD = 2.5)	0.7 (SD = 1.4) / 0.8 (SD = 1.5)
							P = 0.781	P = 0.096	P = 0.856	P = 0.645	P = 0.671	P = 0.806

Pain on capsule palpation [2]	P	Pain on opening [2]	P	Masticatory muscle palpation [2]	P	The MOL ranges [2]	P	The MMO ranges (mm) [1]	P	The CMO ranges (mm) [1]	P
5/10 (50.0%) / 13/33 0(39.4%)	P = 0.717	7/10 (70.0%) / 18/33 (54.5%)	P = 0.480	8/10 (80.0%) / 21/33 (63.6%)	P = 0.456	3/10 (30.0%) / 8/33 (24.2%)	P = 0.698	42.9 (SD 9.9) / 44.9 (SD = 7.8)	P = 0.513	35.8 (SD = 9.2) / 40.2 (SD = 9.4)	P = 0.217
1/10 (10.0%) / 5/32 (15.6%)	P = 0.657	2/10 (20.0%) / 5/33 (15.2%)	P = 0.656	3/10 (30.0%) / 12/33 (36.4%)	P = 0.711	3/10 (30.0%) / 5/33 (15.2%)	P = 0.362	45.5 (SD = 9.7) / 46.7 (SD = 7.0)	P = 0.676	44.9 (SD = 10.7) / 45.6 (SD = 7.3)	P = 0.828
3/8 (37.5%) / 15/35 (42.9%)	P = 0.782	5/8 (62.5%) / 20/35 (57.1%)	P = 0.782	6/8 (75.0%) / 23/35 (65.7%)	P = 0.613	3/8 (37.5%) / 8/35 (22.9%)	P = 0.401	39.8 (SD = 6.9) / 45.5 (SD = 8.2)	P = 0.075*	33.3 (SD = 9.1) / 40.7 (SD = 9.0)	P = 0.044*
1/7 (14.3%) / 5/35 (14.3%)	P = 1.000	2/8 (25.0%) / 5/35 (14.3%)	P = 0.597	6/8 (75.0%) / 9/35 (25.7%)	P = 0.014*	4/8 (50%) / 4/35 (11.4%)	P = 0.028*	40.9 (SD = 7.9) / 47.7 (SD = 7.1)	P = 0.021*	39.5 (SD = 9.4) / 46.7 (SD = 7.2)	P = 0.020*
7/15 (46.7%) / 11/28 (39.3%)	P = 0.640	10/15 (66.7%) / 15/28 (53.6%)	P = 0.407	12/15 (80.0%) / 17/28 (60.7%)	P = 0.308	5/15 (33.3%) / 6/28 (21.4%)	P = 0.473	42.2 (SD = 9.3) / 45.6 (SD = 7.6)	P = 0.200	35.4 (SD = 9.3) / 41.2 (SD = 9.0)	P = 0.057
1/14 (7.1%) / 5/28 (17.9%)	P = 0.645	3/15 (20.0%) / 4/28 (14.3%)	P = 0.680	7/15 (46.7%) / 8/28 (28.6%)	P = 0.235	6/15 (40.0%) / 2/28 (7.1%)	P = 0.014*	43.8 (SD = 9.0) / 47.8 (SD = 6.5)	P = 0.144	43.0 (SD = 10.1) / 46.7 (SD = 6.6)	P = 0.216

Study	Sample	Diagnosis	Outcomes	Intervention
Calixtre *et al*. [16]	61 women with TMD were randomized into an IG and a CG.	RCD/TMD	Primary: orofacial pain intensity, current, maximum, minimum pain. Secondary: pain sensitivity, functionality, headache impact.	IG received upper cervical mobilizations and neck motor control and stabilization exercises for 5 weeks.

	Baseline CG	Baseline SG	Follow-up CG	Follow-up SG
Curr. Pain	3.1 (SD = 2.7)	4.0 (SD = 2.6)*	3.1 (SD = 2.3)	2.1 (SD = 2.2)*
Max. pain	6.2 (SD = 1.7)	6.1 (SD = 2.1)*	5.8 (SD = 2.2)	4.0 (SD = 2.4)*
Min. pain	1.5 (SD = 1.5)	1.9 (SD = 1.7)*	1.6 (SD = 1.6)	1.1 (SD = 1.4)*
PPT temp.	1.2 (SD = 0.4)	1.3 (SD = 0.7)	1.3 (SD = 0.5)	1.4 (SD = 0.5)
PPT mass	1.1 (SD = 0.4)	1.1 (SD = 0.6)	1.1 (SD = 0.5)	1.2 (SD = 0.5)
HIT-6	62.5 (SD = 6.1)	61.4 (SD = 6.0)*	60.0 (SD = 6.6)	52.1 (SD = 8.5)*

Study	Sample	Diagnosis	Outcomes	Intervention
Wiest *et al*. [17]	Group without TMD (n = 37), group with low TMD (n = 19), and group with	RDC/TMD	Head position angle, cervical lordosis angle, dorsal kyphosis angle. lumbar	NM

Postural variable	Group without TMD	Group with TMD I – Low	Group with TMD II – Moderate	P-value
Head position angle (°)	53.2 ± 5.3	53.5 ± 5.5	53.4 ± 4.1	0.986
Cervical lordosis angle (°)	41.7 ± 11.1+	43.6 ± 6.7	49.5 ± 7.8+	0.034 *
Dorsal kyphosis angle (°)	44.1 ± 9.3	43.1 ± 5.8	49.1 ± 6.5	0.070 *
Lumbar lordosis angle (°)	46.5 ± 5.2	45.1 ± 4.9	45.9 ± 6.6	0.659

Study	Sample	Diagnosis	Outcomes	Intervention
Coskun Benlida	No control	60 patients with RDC/TMD	Neck pain, TMD-related variable	NM

	Neck pain (-) (n = 32)	Neck pain (+) (n = 28)	Total (n = 60)
Masticatory efficiency (0-4) [a]	2 (0–3)	3 (0–4) **	2 (0–4)
Functional limitation (0-4) [a]	2 (0-4)	3 (0-4)	2 (0-4)

					Pain score (0-100) [b]			50.1 ± 21.8	63.7 ± 18.6*	56.4 ± 2.1
					Depression score (0-4) [b]			0.9 ± 0.7	1.4 ± 0.7**	1.2 ± 0.7
					Disability points (0-4) [a]			0 (0-3)	1 (0-4)	0 (0-4)
					C2-C7 angle (°) [b]			9.8 ± 12.7	12.2 ± 12.8	10.9 ± 12.7
					Flexion (°) [b]			60 (40-60)	50 (35-70)	55 (35-70)
					Extension (°) [b]			45 (30–60)	40 (30–60)	45 (30–60)
					Rotation right (°) [b]			60 (35–80)	50 (30–80)	60 (30–80)
					Rotation left (°) [b]			60 (40–80)	55 (40–80)	60 (40–80)
					Side flexion right (°) [b]			45 (35–60)	40 (30–50) **	45 (30–60)
					Side flexion left (°) [b]			45 (30–60)	40 (30–50) **	45 (30–60)
Giacomo *et al.* [19]	Group B–33 patients without dysfunctions; Group A–26 patients with dysfunctions	DC/TMD	C0-C1 and C1-C2 distance values, hyoid bone position, craniocervical angle value	NM		TMD	ANB value	Abnormally low (< 4.5mm)	Normal	Abnormally high (> 4.5mm)
					C0-C1 distance value	Absent (n = 33)	5 to 9	3 (9%)	23 (70%)	7 (21%)
						Present (n = 26)		9 (35%)	15 (58%)	2 (8%)
					C1-C2 distance value)	Absent (n = 33)	5 to 9	4 (12%)	24 (73%)	5 (15%)
						Present (n = 26)		6 (23%)	19 (73%)	1 (4%)
					Hyoid bone position	Absent (n = 33)	5 to 9	15 (45%)	18 (55%)	-
						Present (n = 26)		14 (54%)	12 (46%)	-
					Craniocervical angle value	Absent (n = 33)	5 to 9	18 (55%)	13 (39%)	2 (6%)
						Present (n = 26)		12 (46%)	13 (50%)	1 (4%)
Hong *et al.* [20]	45 patients, who showed no signs of myofascial TMD or cervical pain; 26 patients with myofascial TMD (mTMD); 49 patients with both myofascial TMD and cervical pain (cerTMD)	RDC/TMD	CMO, MMO, VAS from TMD, number of active/latent trigger points in masticatory/cervical muscles	NM			CG (n = 45)	mTMD (n = 26)	cerTMD (n = 49)	P-value
					CMO (mm)		45.0 ± 5.9	44.2 ± 7.2	41.0 ± 7.4	0.016 *
					MMO (mm)		45.3 ± 5.1	45.7 ± 6.6	42.8 ± 6.8	0.021 *
					VAS from TMD		0	5.12 ± 2.47	6.78 ± 2.75	< 0.001 ***
					Number of active trigger points in masticatory muscles		0	1.65 ± 1.32	2.47 ± 1.60	< 0.001 ***
					Number of active trigger points in cervical muscles		0	1.15 ± 1.76	5.10 ± 3.18	< 0.001 ***
					Number of latent trigger points in masticatory muscles		0	0.62 ± 0.85	0.71 ± 1.15	0.096
					Number of latent trigger points in cervical muscles		0	0.04 ± 0.30	1.04 ± 1.93	< 0.001 ***
					C0-C1 distance		26.3 ± 8.3	25.8 ± 8.4	22.3 ± 6.6	0.019 *
					C1-C2 distance		39.6 ± 8.9	32.9 ± 8.1	31.3 ± 9.9	< 0.001 ***

RDC/TMD: Research diagnostic criteria for temporomandibular disorders; MMO: maximum mouth opening; CMO: comfortable mouth opening; MOL: mouth opening limitation; VAS: visual analog scale; NM: not mentioned; PPT: pressure pain threshold; temp: temporalis; mass: masseters.

*Significant difference (P < 0.05)

** P < 0.01

*** P < 0.001

[1]Differences between groups were tested with a t-test.

[2]Differences between groups were tested with a chi-square test.

[a]values represented median (minimum-maximum)

[b]values represented mean ± standard deviation

Characteristics of included studies

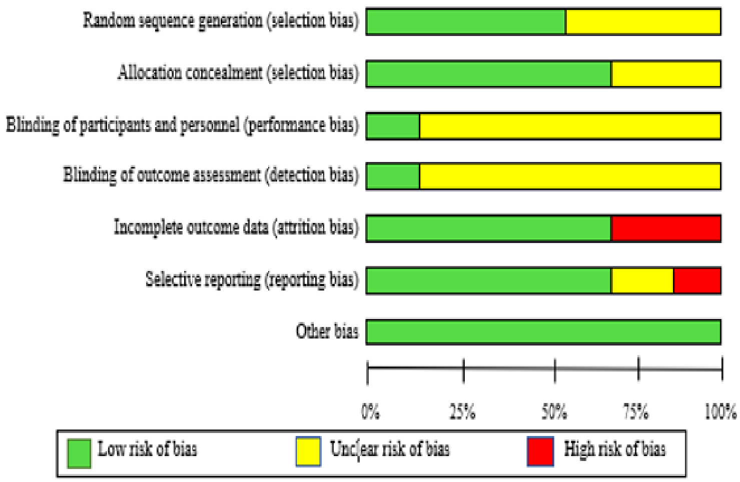
This systematic review included various study designs, such as observational [17] and cross-sectional [20] studies, a single-blind randomized controlled trial [16], one research article [19], and 2 studies [15, 18] that didn't specify their study type.

Bias Risk Assessment

The risk of bias in all 6 studies was assessed qualitatively using the Cochrane Collaboration tools (**Figure 2**), with two reviewers conducting the evaluations independently. 2 studies [17, 19] were found to have a high risk of bias due to incomplete outcome data. The research by Wiest *et al.* [17] showed a high risk of bias in selective reporting. Most studies had a low risk of bias in areas such as allocation concealment, incomplete outcome data, and selective reporting, while the blinding of participants, personnel, and outcome assessors showed the highest proportion of unclear risk of bias.

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance	Blinding of outcomes assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Calixtre *et al.* 2018 [15]	+	-	?	+	+	+	+
Giacomo *et al.* 2018 [16]	+	-	?	+	-	+	+
Benlidayi *et al.* 2018 [17]	+	-	?	+	-	?	+
Hong *et al.* 2019 [18]	+	-	+	+	-	?	+
Wiest *et al.* 2019 [19]	+	-	?	+	-	+	+
Kim *et al.* 2019 [20]	+	-	?	+	-	?	+

a)



b)

Figure 2. Evaluation of bias risk in the studies included in the review; a) overview of risk of bias, and b) graphical representation of bias risk. Symbols: (+) indicates low risk of bias, (?) denotes unclear risk of bias; (-) represents high risk of bias

Clinical characteristics of TMD patients

A total of 417 individuals were considered potential participants for TMD-related clinical trials, with 302 patients ultimately selected for the intervention groups. The diagnosis of TMJ dysfunctions followed the research diagnostic criteria for temporomandibular disorders (RDC/TMD), a commonly used method for evaluating TMDs. The RDC/TMD consists of two main components: Axis I, which involves clinical and radiographic assessments for conditions such as myofascial pain, disc displacement, arthralgia, arthritis, and arthrosis, and Axis II, which addresses psychological factors and pain-related disability [21, 22]. TMJ-related disorders included orofacial myalgia, myofascial pain, disc displacement with reduction, reduced jaw mobility, limited side-to-side flexion, jaw cracking or popping, arthralgia, and osteoarthrosis [15-20].

Clinical assessment between TMD and cervical spine abnormalities

In research by Calixtre *et al.* [16], 61 female participants were randomly assigned to either an intervention group (IG) or a control group (CG). The IG underwent 10 physiotherapy sessions over 5 weeks, with treatments given twice a week and at least 48 hours apart. The study evaluated both primary and secondary outcomes, such as pain sensitivity and functionality. After five weeks of upper cervical spine-focused therapy, orofacial pain intensity was significantly reduced (P < 0.05) in the IG, compared to the CG. The IG also showed a significant improvement (P < 0.05) in headache impact, as measured by HIT-6, at both time points. However, no significant changes in the pressure pain threshold (PPT) of the masticatory and temporal muscles were found after treatment.

Giacomo *et al.* [19] classified patients based on the integrated DC/TMD system, which categorizes individuals with or without TMJ dysfunction. The study group consisted of individuals with conditions like disc displacement with reduction, myalgia, myofascial pain, subluxation, TMD-related headaches, arthralgia, and osteoarthrosis. To investigate the relationship between TMD and cervical spine abnormalities, cephalometric measurements were taken for the C0-C1 and C1-C2 distances, hyoid bone position, and craniocervical angle. The study found no significant differences in the changes in the ANB value between the two subgroups.

In research by Coskun Benlidayi *et al.* [18], sixty individuals with TMD, including those with and without neck pain, were assessed using the RDC/TMD criteria. Significant differences in the outcomes were only observed in patients with neck pain. Specifically, masticatory efficiency (P < 0.01), pain levels (P < 0.05), and depression scores (P < 0.01) were markedly higher in the neck pain group than in those without. Furthermore, patients with neck pain exhibited significantly reduced side flexion (P < 0.01) when compared to those without neck pain. However, no statistically significant differences were found in functional limitations, disability scores, or cervical spine measures (such as the C2-C7 angle, flexion, extension, and rotation) between the two groups, indicating that TMJ dysfunctions weren't associated with cervical abnormalities.

In another study by Hong *et al.* [20], participants were grouped into three categories: a control group with no TMD signs, a myofascial TMD (mTMD) group, and a combined myofascial TMD and cervical pain (cerTMD) group. The cerTMD group showed significantly reduced comfort and maximum mouth opening compared to the other two groups (P<0.05). Additionally, the cerTMD group reported higher pain intensity and a greater number of active trigger points in the masticatory and cervical muscles compared to both the mTMD and control groups (P<0.001). Cephalometric measurements of the C0-C1 and C1-C2 distances were taken to assess head and neck alignment [23]. Both the mTMD and cerTMD groups showed an important decrease in these distances (P<0.05 and P<0.001, respectively), with the cerTMD group showing the most substantial reduction. A reduction in the C0-C1 distance suggests posterior rotation of the cranium.

In research by Wiest *et al.* [17], 71 patients were divided into three groups: those without TMD, those with mild TMD, and those with moderate TMD. The moderate TMD group exhibited significantly higher cervical lordosis and dorsal kyphosis angles (P < 0.05) compared to both the no TMD group and the mild TMD group. A weak but significant correlation with the severity of TMD was noted. However, no significant differences were found between the groups regarding the head position angle or lumbar lordosis angle about cervical spine abnormalities and TMD.

Kim *et al.* [15] studied 43 patients who had been clinically diagnosed with TMD and received conservative treatment for over a year. The presence of upper cervical spine abnormalities, including fusion abnormalities or posterior arch deficiency (PAD), was recorded. After treatment, all groups showed improvement in both comfortable and maximum mouth opening, with the PAD group showing the most significant improvement (P < 0.05). The PAD and TMJ abnormalities groups also experienced significant increases in the mouth opening range (P < 0.05). Although pain relief in masticatory muscle palpation did not show significant differences between the groups, the PAD group demonstrated a positive response (P = 0.014). No significant correlations were observed in pain intensity, pain during mouth opening, or capsule palpation after treatment.

Statistical analysis

Initially, both a systematic review and a meta-analysis (including both qualitative and quantitative assessments) were planned. However, due to the significant heterogeneity of the data, a meta-analysis could not be performed. Consequently, the systematic review focused on a descriptive analysis of the collected data, without quantitative evaluation, to identify and explore relevant information for potential statistical significance. Statistical findings were presented as means with standard deviations (Mean ± SD).

The purpose of this systematic review was to examine the connection between TMJ dysfunctions and cervical spine abnormalities, while also evaluating the dysfunctional and functional aspects of the craniocervical mandibular system. Eight articles were included based on predefined eligibility criteria. Given the high methodological variability among the studies, a meta-analysis was not feasible. Nonetheless, the qualitative analysis indicated that factors such as reduced side flexion [18], TMD-related pain intensity, an increased number of active trigger points in masticatory and cervical muscles, a decrease in C0-C1 distance [20], and greater cervical lordosis and dorsal kyphosis angles [17] can significantly affect cervical abnormalities associated with TMD. Additionally, a one-year course of conservative treatment was found to significantly alleviate TMD-related symptoms [15].

The study conducted by Walczyńska-Dragon *et al.* [24], along with its clinical follow-up, highlights the frequent coexistence of TMD with cervical spine pain. A major takeaway from their research is the notable improvement in cervical spine range of motion (ROM) and the resolution of cervical pain in the experimental group. These results underscore the importance of interdisciplinary collaboration between orthopedists, laryngologists, neurologists, and dentists in treating these conditions.

Although the study did not explore the connection between cervical spine abnormalities, TMJ dysfunctions, and bruxism, a separate study by Piekartz *et al.* [25] found that women with bruxism exhibited more signs of myofascial TMD based on DC/TMD criteria. However, their study didn't specifically investigate the link between bruxism and TMD. Nevertheless, the results indicated that both bruxism and the severity of TMD were independent predictors of pain and cervical disability, as measured by the Neck Disability Index (NDI). Notably, the study reported that physical measurements strongly correlated with pain variables but showed no significant relationship with ROM variables. This suggests that in clinical practice, individuals with bruxism may present with cervical pain during physical exams, which may not be directly connected to issues in the craniocervical region because of the absence of cervical impairments.

In our research, the direct effects of treatment were not observed. However, the research by Calixtre *et al.* [26] provides valuable insights into this matter. Their findings revealed significant improvements in myofascial pain and mouth opening after manual therapy in cases of myogenous-TMD when compared to baseline measurements. Short-term data analysis suggests that manual therapy, particularly mobilization and manipulation of the upper cervical spine, can be an effective approach for treating TMD. Nevertheless, it is crucial to recognize the lack of high-quality evidence regarding the optimal procedures or combinations of manual therapy techniques, as well as the ideal treatment duration for TMD. Lam *et al*. [27] also emphasized the absence of a standardized treatment protocol for TMD, leading many clinicians to adopt a multimodal approach that includes education, exercise, and manual therapy. In this context, the cervical spine is often considered a potential source of TMJ symptoms. Previous systematic reviews, such as those by Lam *et al*. [27], have examined the effectiveness of different cervical manual therapy techniques for TMJ dysfunction, including myofascial release targeting the masticatory and cervical muscles, as well as cervical and thoracic spine mobilization/manipulation and combined therapies. Moreover, TMJ dysfunction has been linked to poor sleep quality and heightened stress, particularly in the presence of muscular pain. Clinical variability across trials may result from factors such as psychological factors, chronic stress, the duration of pain, and individual patient beliefs and expectations about treatment. These variables may contribute more significantly to subjective outcomes that could explain the observed inconsistencies in subjective pain ratings and pressure pain thresholds (PPTs) of the masseter and temporalis muscles, as opposed to more objective measures like maximal mouth opening. Despite the small effect sizes and significant heterogeneity, specific interventions still yield meaningful results.

Conclusion

This review aimed to examine the link between abnormalities in the cervical spine and temporomandibular joint (TMJ) dysfunctions. Key findings showed that reduced side flexion heightened pain levels related to TMD, a greater number of active trigger points in the masticatory and cervical muscles, and a decreased C0-C1 distance played a significant role in cervical abnormalities tied to TMJ issues. Additionally, conservative treatment lasting over a year resulted in notable improvements in TMJ symptoms. These results highlight the intricate relationship between the cervical spine and TMJ, stressing the importance of interdisciplinary approaches when managing patients with both TMD and cervical pain. Further studies are needed to investigate the role of bruxism in influencing TMD and cervical dysfunction.

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