

Association of cervical spine signs and symptoms with temporomandibular disorders in adults: a systematic review protocol

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ABSTRACT

Objective: The objective of this systematic review is to assess the evidence of association of cervical spine signs and symptoms with temporomandibular disorders (TMD). This will help to lend credence to mechanisms supporting the association in order to improve care strategies for this condition.

Introduction: The association of cervical spine impairments (in relation to neck posture, cervical spine mobility, muscle tenderness, muscle activity, and neck disability) with TMD has been widely discussed in the literature. Clarification of this relationship is important for health professionals to better assess and treat TMD.

Inclusion criteria: Eligible studies will include participants aged 18 years and over, with a diagnosis of TMD from the Research and Diagnostic Criteria for Temporomandibular Disorders or a revised version. Exclusion criteria will be participants with previous temporomandibular joint surgery, history of trauma or fracture in the temporomandibular joint or the craniomandibular system; serious comorbid conditions such as cancer, rheumatic disease, and neurological problems; primary cervical spine disorders such as disc herniation or spinal degenerative changes; or systemic disease such as ankylosing spondylitis.

Methods: The search for articles will be conducted in the databases PubMed, PEDro, CINAHL, Web of Science, and Embase, without language or time restrictions. Two independent reviewers will review the title, abstract, and full texts of identified studies; select studies against the inclusion criteria; assess the methodological quality of eligible studies using critical appraisal tools; and perform data extraction. Relevant quantitative data will be pooled with statistical meta-analysis, when possible.

Systematic review registration number: PROSPERO CRD42019123698.

Keywords Craniomandibular dysfunction; disability; mobility; pain; posture

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Introduction

Temporomandibular disorders (TMD) are defined as musculoskeletal conditions that involve the masticatory muscles, the temporomandibular joint (TMJ), and associated structures.^{1,2} In the United States, TMD affects 5% to 12% of the population annually, making them the second most disabling musculoskeletal condition after chronic low back pain.^{3,4} They have an impact on the quality of life, affecting daily living

activities, work capacity, and social life.⁵ They present an economic burden for society.⁵ Common signs and symptoms of TMD are localized pain in the stomatognathic region, headaches, difficulty with chewing, tinnitus, dizziness, and/or noise during jaw opening and closing.^{6–8} The Research and Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) is a valid and reliable tool for the diagnosis of TMD for research and clinical purposes.^{9,10} It classifies TMD into three main categories based on specific TMJ structural impairment (RDC/TMD Axis I):

- Muscular disorders and/or
- Disc displacement and/or
- Arthralgia, osteoarthritis, or osteoarthritis.^{3,11}

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Mixed TMD can be diagnosed when affected structures concern more than one category.^{6,12}

The etiology of TMD is complex and multifactorial, making it difficult to determine the correct diagnosis initially. There is a need to improve the understanding of the mechanisms of TMD in order to facilitate its diagnosis and to provide the appropriate care strategy. Therefore, it is important to clearly understand the influence of TMD on the orofacial region and its surrounding areas.

Current and past literature has shown an extensive link between TMD and neck pain. Various types of mechanisms have already been proposed to explain this association. Anatomically, the masticatory muscles of the jaw are closely related to the neck, functionally influencing these two regions.^{1,13,14} Mechanically, the large amplitude of jaw opening or closing is associated with neck extension or flexion, where mobility limitation in one region indubitably influences the other.¹⁵ Neurophysiologically, there is evidence of a convergence of afferents from the mandibular branch of the trigeminal nerve and the nerve roots of the upper cervical region (C1-C2-C3) at the trigeminocervical nucleus. This explains the difficulty for the brain to interpret the exact localization of the original input, resulting in widespread pain or dysfunction in the cervical spine in patients with TMD.⁷ In addition, the diagnosis of TMD may include psychological and social criteria (RDC/TMD Axis II), in which central mechanism of pain may predominate.³ Despite this evidence, some studies still indicate that the aforementioned associated mechanisms are unclear and lack foundation.¹⁶

Defining the exact nature of cervical spine signs and symptoms associated with TMD may help to validate the type of connection impacting both regions. Numerous studies have investigated evidence of association between TMD and cervical spine impairments in relation to head and neck posture, upper and global cervical spine mobility, muscle tenderness, muscle activation and motor control, and neck disability. To this point, studies of measures of the craniocervical angle from radiography or photography have not shown a correlation between head posture and TMD.^{5,17} For cervical spine mobility, results of studies have demonstrated an association between TMD and reduced upper cervical spine mobility (occiput, C1, C2); meanwhile, results were more contrasted for the global cervical spine, showing a reduction of mobility only

for sagittal movements.^{6-8,12,18} Concerning muscle tenderness evaluated by manual palpation and determination of pressure pain threshold, results have found significantly more tender points and lower mechanosensitivity on neck muscles in subjects with TMD compared to controls.^{1,8,12} Motor control performance during the craniocervical flexion test, monitored by electromyography or a pressure bio-feedback unit, has been found to be worse in TMD patients compared to healthy subjects.^{5,12,18} Finally, for neck disability, studies have demonstrated good results of relationship and correlation between the cervical spine and patients with TMD from the scores of the Neck Disability Index (NDI) questionnaire in relation with the Limitation of Daily Function in TMD Questionnaire (LDF-TMDQ) or the Conti Amnesic Questionnaire (CAQ).^{1,5,12,18}

A preliminary search of PROSPERO, MEDLINE, the Cochrane Database of Systematic Reviews and the *JBI Database of Systematic Reviews and Implementation Reports* was conducted, and the authors found three reviews addressing cervical spine signs and symptoms with TMD.^{2,14,17} In their systematic reviews, Rocha *et al.*¹⁴ and Chaves *et al.*² focused their searches on the relationship between head and neck posture and TMD. They concluded that it was not possible to confirm a true association between the two because of poor methodological quality of the existing literature and suggested the need for new studies. Costa *et al.*¹⁷ highlighted some aspects of the relationship between cervical spine impairments and TMD. However, their search was not systematic, and the quality of the articles retained was not assessed. In addition, some aspects of the association were not considered, such as the mobility of the upper cervical spine. It is anticipated that the results of studies published since then may offer new evidence.¹⁸⁻²¹

Validating the results of existing literature is an important issue. Several previous studies that investigated the association of signs and symptoms with TMD have not been conclusive because of their small population size, invalid methods of evaluation, and overall poor methodological quality.^{2,14} Hence, analyzing and regrouping the results into a bigger pool through a systematic review may demonstrate better evidence about the cervical spine signs and symptoms that are most likely to be associated with TMD. This step is important for lending credence to already proposed mechanisms for the association of concomitant symptoms between the two

regions.^{1,3,7,13-15} These findings will help health professionals to better assess and treat TMD.

Therefore, the main objective of this systematic review is to assess the evidence of association of cervical spine signs and symptoms with TMD.

Review question

Which cervical spine signs and symptoms are most likely to be associated with TMD in an adult population?

Inclusion criteria

Participants

This review will consider studies that evaluate adult participants 18 years and over with a diagnosis of TMD according to the RDC/TMD classification or a revised version (DC/TMD).^{3,11}

Exclusion criteria will be children younger than 18 years (as pain in the temporomandibular region is relatively uncommon in that population) and participants with previous TMJ surgery; history of trauma or fracture in the TMJ or the craniomandibular system; serious comorbid conditions such as cancer, rheumatic disease, and neurological problems; primary cervical spine disorders such as disc herniation or spinal degenerative changes; or systemic disease that is likely to affect the cervical spine mobility such as ankylosing spondylitis.^{2,14,22}

Exposure of interest

This review will consider studies that investigate TMD as an independent variable. The diagnosis of TMD is based on criteria from the RDC/TMD or a revised version (DC/TMD), including presence of painful and restrictive mouth opening, painful masticatory muscles on palpation, and TMJ sounds.²⁰ The TMD categories of interest are myogenic, arthrogenic, or mixed.

Outcomes

The outcomes of interest will be measures for the cervical spine listed below:

- Muscle tenderness measured by mechanical pressure pain threshold.¹ It has been shown to be a valid and reliable method to assess mechanosensitivity.
- Pain measured by visual analog scale. It is considered reliable, with a minimal clinically important difference of between 9 and 11 mm.

- Mobility of the cervical spine evaluated by an inclinometer placed on top of the subject's head. For measurement of neck flexion and extension, previous reports showed good validity and reliability.
- Mobility of the craniovertebral region evaluated by the flexion-rotation test. It has been shown to be a valid and reliable measure of upper cervical movement.
- Neck or craniocervical posture measured on the basis of photographs or radiography.⁵
- Muscle activation and motor control, measured by craniocervical flexion test. This method has been shown to have good reliability.^{5,18}
- Disability of the TMJ measured by the LDF-TMDQ/JFS and the CAQ.^{13,23} The LDF-TMDQ/JFS is multidimensional and allows a functional and specific evaluation of TMD patients.¹³ The CAQ is composed of 10 questions in relation to TMD, and its reliability has not been evaluated.²²
- Disability of the neck measured by the NDI. It has been shown to be a valid and reliable questionnaire.²⁴

Types of studies

This review will consider observational study designs, including prospective, case control, cohort, and cross-sectional studies.² Descriptive studies such as case reports or case series, as well as experimental studies such as randomized controlled trials, quasi-experimental, or before-and-after studies, will not be included.²⁵ The exclusion of experimental studies is motivated by the aim of assessing the evidence of association of cervical spine signs and symptoms with TMD and lending credence to already proposed mechanisms supporting the association in order to improve care strategies.

Methods

This systematic review will be conducted in accordance with the JBI methodology for systematic reviews of etiology and risk.²⁶

Search strategy

The search strategy will aim to locate both published and unpublished studies. A three-step search strategy will be undertaken. An initial limited search in PubMed and CINAHL will be conducted, followed

by an analysis of the text words contained in the titles and abstracts, as well as in the index terms used to describe the articles found. Keywords will be related to TMD and cervical spine signs and symptoms: temporomandibular joint disorders, craniomandibular disorders, neck muscles, neck, cervical vertebrae.

A second search using all identified keywords and index terms will then be undertaken across all relevant databases. A full search strategy for PubMed is presented in Appendix I. Individual search strategies will be developed for each database to take into account any differences in thesaurus terminology and indexing.

To identify additional gray literature, databases dedicated to unpublished studies and conference proceedings will also be searched.

Thirdly, the reference lists of all studies selected for critical appraisal will be screened for additional studies.

The search for articles will be performed without language or time restrictions.

Information sources

The following databases will be searched from date of inception: PubMed (1996), Physiotherapy Evidence Database (PEDro) (1999), CINAHL (1961), Web of Science (1900) and Embase (1947), Google Scholar (2004), ProQuest Dissertations and Theses (1743), WorldCat, and OpenGrey.

Study selection

Following the search, all identified citations will be collated and uploaded into EndNote V8 (Clarivate Analytics, PA, USA) and duplicates will be removed. Titles and abstracts will then be screened by two independent reviewers for assessment against the inclusion criteria for the review. The full text of potentially relevant studies will be retrieved and their citation details imported into JBI System for the Unified Management, Assessment and Review of Information (JBI SUMARI; JBI, Adelaide, Australia).²⁶ The full text of selected citations will be assessed in detail against the inclusion criteria by two independent reviewers. Reasons for exclusion of full-text studies that do not meet the inclusion criteria will be recorded and reported in the systematic review. Any disagreements that should arise between the reviewers at each stage of the study selection process will be resolved through discussion, or with a

third reviewer. The results of the search will be reported in full in the final systematic review and presented in a Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram.²⁷

Assessment of methodological quality

Eligible studies will be critically appraised by two independent reviewers at the study level for methodological quality in the review, using standardized critical appraisal instruments for observational studies from JBI.²⁶ Any disagreements that arise will be resolved through discussion, or with a third reviewer. The results of critical appraisal will be reported in narrative form and in a table.

All studies, regardless of the results of their methodological quality, will undergo data extraction and synthesis (where possible). The results of the critical appraisal will help to discuss the results of the synthesis and select valuable information supporting the association of cervical spine signs and symptoms with TMD.

Data extraction

Data will be extracted from papers included in the review using the standardized data extraction tools in JBI SUMARI by two independent reviewers. The data extracted will include specific details about the exposure of interest, populations, study methods, outcomes or dependent variables of significance to the review question, and specific objectives. Any disagreements that arise between the reviewers will be resolved through discussion, or with a third reviewer. Authors of papers will be contacted to request missing or additional data where required.

Data synthesis

When possible, quantitative data will be pooled in statistical meta-analysis using JBI SUMARI and statistical software STATA, version 15 (Stata Corp LLC, Texas, USA). All results will be subject to double data entry by two reviewers (PB and VH). Effect sizes will be expressed as odds ratio (for dichotomous data) and weighted mean differences (for continuous data), and their 95% confidence intervals will be calculated for analysis. Risk ratios, odds ratios, and/or hazard ratios will be pooled where appropriate. A random effects model will be used to conduct meta-analyses as the direction of effects in observational studies is difficult to

assess with certainty. Heterogeneity will be assessed in the first instance by visual inspection of the forest plot, and then statistically using the I^2 test. A funnel plot will be generated to assess publication bias if there are 10 or more studies included in the meta-analysis. Statistical tests (Begg test, Harbord Test) for funnel plot asymmetry will be performed, where appropriate.

Subgroup analysis will be conducted where there are sufficient data to investigate the association of type of TMD (myogenic, arthrogenic, or mixed), TMD alone or with associated conditions (e.g. headaches), or a dose–response relationship between cervical signs and symptoms and TMD-related pain and/or disability. Sensitivity analysis will be conducted to test the impact of studies with poorer methodological quality.

Where statistical pooling is not possible, the findings will be presented in narrative form including tables and figures to aid in data presentation where appropriate.

Assessing certainty in the findings

The Grading of Recommendations, Assessment, Development and Evaluation (GRADE)²⁸ approach for grading the certainty of evidence will be followed and a Summary of Findings (SoF) will be created using GRADEpro GDT software (McMaster University, ON, Canada). The SoF will present the following information where appropriate: absolute risks for the treatment and control; estimates of relative risk; and a ranking of the quality of the evidence based on the risk of bias, directness, heterogeneity, precision, and risk of publication bias of the review results. The outcomes reported in the SoF will be cervical spine signs and symptoms.

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Appendix I: Search strategy

PubMed search conducted on September 17, 2019.

(“Temporomandibular Joint Disorders”[Mesh] OR “Craniomandibular Disorders”[Mesh] OR “temporo-mandibular joint disorders”[Title/Abstract] OR “temporomandibular disorders”[Title/Abstract] OR “temporomandibular joint dysfunction”[Title/Abstract] OR “temporomandibular dysfunction”[Title/Abstract] OR “temporo-mandibular joint disorders”[Title/Abstract] OR “temporo-mandibular disorders”[Title/Abstract] OR “temporo-mandibular joint dysfunction”[Title/Abstract] OR “temporo-mandibular dysfunction”[Title/Abstract] OR “craniomandibular disorders”[Title/Abstract] OR “craniomandibular dysfunction”[Title/Abstract] OR “cranio-mandibular disorders”[Title/Abstract] OR “cranio-mandibular dysfunction”[Title/Abstract] OR “TMD”[Title/Abstract] OR “CMD”[Title/Abstract]) AND (“Cervical Vertebrae”[Mesh] OR “Neck”[Mesh] OR “Neck Muscles”[Mesh] OR “cervical”[Title/Abstract] OR “neck”[Title/Abstract])