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Short Article

The impact of whiplash injury on temporomandibular joint function: a literature review

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Abstract

Introduction: Whiplash injuries are one of the most prevalent consequences of traffic collisions and are associated with a wide range of conditions referred to as whiplash-associated disorders (WAD). These manifestations are most commonly associated with pain and limited mobility of the cervical spine. A growing number of research indicates that these injuries may also impair the function of the temporomandibular joints (TMJs), thereby contributing to the development of their subsequent disorders.

The aim of the study: The objective of the study was to discuss the correlations and dependency between whiplash injury and temporomandibular joint function. Acquiring this knowledge enables specialists to make precise diagnoses and implement appropriate therapeutic procedures, thereby reducing the risk of misdiagnosis or misdiagnosis omissions.

Materials and methods: The following literature review provides a comprehensive discussion of the association between whiplash injuries and temporomandibular joint function. In December 2025, an extensive search of prominent electronic databases (PubMed, Google Scholar) was undertaken in order to identify relevant published studies on this subject.

Conclusions: Studies indicate that whiplash injury may impair TMJ function and contribute to the development of TMJ disorders. The mechanisms underlying this relationship may be functional or neurophysiological in nature, but remain under investigation.
Symptoms may be transient or persist long-term for several years, underscoring the necessity for a holistic diagnosis and an interdisciplinary therapeutic approach in patients after whiplash injury.

Keywords: whiplash injuries, temporomandibular disorders, temporomandibular joint, cervical vertebrae

Introduction

Whiplash injury is a significant clinical problem, being one of the most prevalent consequences of traffic accidents.[1] It is estimated that it affects up to 83% of patients involved in such collisions. [2] The mechanism of injury may be associated with hyperextension of the lower cervical spine in relation to the relative flexion of the upper region, causing the cervical spine to assume a characteristic S-shaped form. [3] Sudden movements of the head relative to the torso lead to overload of the muscle structures, ligaments, and nerves of the cervical region. Consequently, due to anatomical connections, this may affect the function of the temporomandibular joints. The craniocervical and temporomandibular areas are functionally related, and any head and neck injuries may disrupt motor control and impair natural masticatory function. [4] The literature increasingly describes cases of temporomandibular joint pain, limited mandibular mobility, and myofascial symptoms subsequent to whiplash injury. [5,6] These manifestations constitute a picture of temporomandibular dysfunction, which may be divided into two categories: those affecting the muscles and those affecting the joint structures themselves. [7] The symptoms discussed may be secondary to the injury or lead to the manifestation of pre-existing disorders. [8] A frequently observed phenomenon among researchers is a higher incidence of temporomandibular joint pain following whiplash injury, compared with individuals who have not sustained such trauma. [9,10] It is therefore imperative to perform comprehensive and interdisciplinary diagnostics of patients following injury, including not only examination of the cervical spine, but also assessment of the temporomandibular joints and masticatory muscles. These evaluations are crucial for maximizing the effects of treatment and mitigating the risk of possible post-traumatic complications.

The aim of the study

The aim of this study is to analyze the connection between acceleration-deceleration injuries and temporomandibular disorders (TMDs), with particular emphasis on the clinical manifestations, pathophysiological mechanisms, and risk factors for TMD following injury. Identifying this relationship is crucial to reduce the likelihood of misdiagnosis, avoid undiagnosed conditions, serious complications and enables the implementation of appropriate therapeutic procedures. The latest reports on this subject are presented in this article.

Materials and methods

The study was conducted by means of a review of the latest available literature, especially articles on whiplash injuries and temporomandibular joint dysfunction found in the PubMed

and Google Scholar databases. A multiple search terms were employed, including:“ whiplash injuries,” “temporomandibular disorders,” “temporomandibular joint,” and “cervical vertebrae.” All selected articles were the most relevant articles available for this review.

Clinical picture

A study of 300 patients diagnosed with temporomandibular disorders (TMDs) who had previously been involved in a traffic accident, conducted by Friedman et al., determined that the most commonly reported symptoms were jaw pain, neck pain, post-traumatic headache and severe clicking in the temporomandibular joints. The most prevalent TMD diagnoses included: myofascial trigger points, excessive activity of the jaw closing muscles, TMJ synovitis and disc derangements.[11]

In turn, Pressman et al. most frequently observed disc displacement, abnormal fluid or swelling of the temporomandibular joint in the majority of their studies employing magnetic resonance imaging. [12]

An accurate MRI-based diagnosis provided a comprehensive understanding of the condition, leading to the publication of a study in 2021 that analyzed alterations in the temporomandibular joints (TMJs) and surrounding muscles following whiplash-associated injury (wTMD) compared with alterations observed in patients with idiopathic temporomandibular disorders (iTMD). [13] The most significant abnormal findings in the MRI study of the wTMD group were as follows: disc deformity, degeneration of the mandibular condyles, anterior displacement of the disc without reduction, anterior displacement of the disc with reduction, and effusion. [13] In the analysis of the masticatory muscles, the most significant structural changes were observed in the lateral pterygoid muscle (LPM) with both volume and signal changes on MRI being considerably more prevalent in the post-traumatic group. In the case of other muscles, including the temporal, medial pterygoid muscle (MPM) and masseter, changes were rarely observed or not detected at all. The degree of muscle pain upon palpation was most severe in the masseter muscle in both groups, while the temporal muscle, LPM and MPM exhibited heightened tenderness in patients with whiplash injury compared to iTMD group. Surprisingly, however, despite the observation of actual structural changes in the lateral pterygoid muscle on MRI, tenderness was rare in both groups. [13]

A review of the literature also reveals gender-related differences in clinical symptoms and structural changes in TMJ tissues after whiplash injury. In their study, Lee et al. examined 50 men and 50 women, taking into account their injury history, clinical symptoms and MRI results. The results of the study indicated that women reported higher levels of pain and muscle tenderness during palpation and demonstrated greater signal and volume changes in the lateral pterygoid muscle (LPM) as well as greater anterior disc displacement without reduction (40% vs. 20%) in comparison to men. [14]

Patophysiological mechanisms

The lateral pterygoid muscle participates in controlling mandibular movement through its attachment to the articular disc and mandibular condyle. Its upper head plays a significant role in rotation and translation of the disc and condyle, therefore any damage or functional impairment may be associated with temporomandibular joint dysfunction. [15] Researchers emphasize that changes in the LPM and disc displacement caused by whiplash injury may be a significant risk factor for TMD [16].

Over the years, various possible pathophysiological mechanisms for the development and maintenance of TMD pain have been investigated. The concepts of pain spreading, superimposition, and referral of pain have been analyzed. [17-19] A significant role has been attributed to neurophysiological mechanisms related to central sensitization. It is imperative to acknowledge the pivotal role of central sensitization in the process of lowering the pain threshold and perpetuating the persistent pain experienced by these patients. This phenomenon is attributed to the heightened sensitivity of the central nervous system observed in patients with chronic WAD. [20]

Risk factors and long-term outcomes

Research indicates that acute disorders following whiplash injury frequently resolve spontaneously within several months. The persistence of symptoms depends on the severity of the injury, the presence of prior temporomandibular joint disorders, and the patient's age. [21] The following negative prognostic factors identified as potentially contributing to the development of temporomandibular disorder (TMD) are: high-impact speed (>60 km/h), increased initial pain intensity, head position during impact, lack of a headrest, advanced age, and female gender. [21] The role of the female gender as a risk factor for delayed recovery is also emphasized in a meta-analysis by Walton et al. [22] Additionally, the intensity of neck pain in the acute phase after cervical spine injury may also increase the risk of developing chronic orofacial pain. [23] Furthermore, patients with recent cervical spine injury exhibited heightened levels of pain and disability in the jaw and neck area in comparison to control patients who had not sustained neck injury. [23] It is also vital to acknowledge that individuals who exhibit heightened baseline pain sensitivity are more prone to developing painful temporomandibular disorders in comparison to those with reduced sensitivity. [24] Authors Salé and Isberg suggest that one in three people who have suffered a cervical spine injury are at risk of developing delayed temporomandibular joint symptoms that may require clinical treatment. [25] A 15-year follow-up study of patients with temporomandibular joint symptoms after whiplash injury revealed that joint pain persisted in two-thirds of the patients and the prevalence remained elevated compared to pre-injury levels or the control group. [26]

Conclusions

A review of the extant literature reveals that whiplash injury is associated with an increased prevalence of temporomandibular joint dysfunction in comparison to the population without a history of such trauma. Clinical and imaging studies, including MRI-based studies, demonstrate the existence of structural alterations in the joints and masticatory muscles, especially the lateral pterygoid muscle. Changes in the position of the articular disc and features of increased muscle tenderness are also described. Available reports suggest that the association between whiplash injury and temporomandibular joint dysfunction is multifactorial and involves functional, neuromuscular and neurophysiological mechanisms, including central sensitization processes. Individual differences are also evident, encompassing gender-dependent differences indicating greater severity of symptoms and structural alterations in tissues in women. The manifestation of TMD symptoms may be transient or persistent. In consideration of the data presented, a comprehensive diagnostic approach for patients following whiplash injuries is vital. Such evaluations should focus on the function of TMJs and masticatory muscles, in order to reduce the risk of misdiagnosis or the onset of late complications. An interdisciplinary approach may be crucial for improving the prognosis and quality of patients life. It is imperative to consider whiplash injuries as a potential contributing factor to the development of temporomandibular joint disorders. However, further prospective studies are necessary to better understand the mechanisms underlying this relationship.

Disclosure

Author's contribution:

Conceptualization: K.C., M.N.;

Methodology: K.C., O.Z.;

Investigation: M.Ł., K.W., S.Ł., A.Z-W., A.R., W.S.;

Writing rough preparation: K.C.;

Writing review and editing: K.C., O.Z., K.W., S.Ł., A.Z-W., M.N., M.Ł., A.R., W.S.;

Supervision: K.C.;

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