Review Article

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Temporomandibular Disorders and Nutrition: A Narrative Review on The Bidirectional Relationship

Abstract:
Temporomandibular disorders (TMDs) are a collective term that includes conditions where the temporomandibular joint and associated musculature are in pain or dysfunction. Research has highlighted a bidirectional relationship between TMDs and nutrition, suggesting that dietary factors may influence the onset and progression of TMDs, while TMDs can impact nutritional intake and dietary habits. Through our article, we have discussed the complex interactions of TMDs with nutrition by collaborating with the literature on how nutritional deficiencies, dietary patterns, and food-related behaviours can affect TMD symptoms and management. Conversely, the review also explores how TMDs can lead to changes in eating habitsand overall nutritional status. Through a comprehensive examination of these reciprocal influences, the review seeks to provide insights into potential dietary interventions and management strategies that could improve outcomes for individuals with TMDs and enhance their nutritional well-being.

Key-words: Bidirectional Relationship, Dietary Patterns, Nutritional Deficiencies, Temporomandibular Joint Dysfunction

Introduction:

Temporomandibular disorders (TMD) represent a combination of complex clinical situations affecting the muscles of mastication, the temporomandibular joint (TMJ), and surrounding structures, as defined by the American Academy of Orofacial Pain.[1]

A study conducted in India in 2023 reported a prevalence of temporomandibular joint disorders (TMD) in 11.6% of the evaluated population. Among the affected individuals, tenderness was the most frequently observed clinical finding (47.83%),followed by joint clicking (43.48%).[2] Similarly, a study from Northern India identified joint clicking as the most common symptom of TMD, present in 42.5% of patients, while 40.8% exhibited mandibular deviation during mouth opening.[3] Another study conducted in Haryana demonstrated a significant association between TMD, increased overbite, and bruxism, with an overall TMD prevalence of 51% among the study population.[4]

The pathophysiology of TMD is affected by age, gender, emotion or psychosocial status. The occurrence of TMD is generally seen inthe 25 to 45 years age group with an occurrence rate of 30% in adolescents between14 to 18years.[5]A higher prevalence is observed in females, for which biological, psychological, and social factors present during their reproductive years may be responsible. [6-10]

In the case of temporomandibular joint disorders,restrictions on various diets can lead to deficiencies of some critical nutrients. These deficiencies may subsequently contribute to

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inflammation and pain; for example,low vitamin D levels may influence bone metabolism and also contribute to the inflammatory processes and psychological symptoms associated with TMDs.[11] Conversely, excessive intake of certain minerals and vitamins can also have potential adverse effects.Experience of orofacial pain may impact dietary habits and nutritional intake, which indicates thatdiet can influence the onset and severity of TMD symptoms.

By understanding this bidirectional relationship, better treatment planning with dietary interventions can be taken so that more precise management of TMDs can be undertaken.

2. Dietary patterns observed in patients with TMD:

Patients with temporomandibular disorders (TMD) often experience significant alterations in their dietary patterns due to pain and functional limitations associated with the condition. Many individuals find it difficult to consume hard or chewy foods, leading to the avoidance of meats, fruits, and whole grains, which are rich in nutrients. As a result, these patients often resort to softer diets, which often necessitate modifying food preparation techniqueslike mashing, boiling, and pureeing.Very often, it is observed thatpatients with temporomandibular disorders (TMD) are advised for soft diet, often without specifying which foods to avoid. These reduce the nutritional value of foods. This shift in dietary habits may contribute to nutritional deficiencies, especially in fibre, which can exacerbate the chronicity of TMD by establishing a cycle of dietary inadequacy. Additionally, the social implications of TMDpatients can further restrict food choices, as individuals may feel embarrassed or uncomfortable eating in public due to audible joint sounds or the time required to consume meals. Although there is an absence of significant differences in overall calorie, macronutrient, or micronutrient intake, Temporomandibular Disorder (TMD) can significantly impact dietary enjoyment and food selection. These factors should be considered when providing targeted dietary advice to improve the overall well-being of patients.[12,13]

3. Dietary issues causing TMD.:

Martina Ferillo suggested that serum levels of Vitamin D and Vitamin D receptors (VDRs) might have a role in the onset and progression of TMDs. However, the exact mechanism is yet to be fully characterized.Vitamin D deficiency is prevalent worldwide, and this condition is seen in disorders involving bone cartilage and other associated tissues. It also leads to poor physical performance with reduced muscle strength. Studies have also shown an association between musculoskeletal disorders like osteoarthritis, risk of falling and low vitamin D levels.[14]

These findings imply that although routine biochemical parameters may not differ substantially, vitamin D deficiency may negatively impact TMD symptoms and quality of life. Deficiency of omega 3 Fatty acids in TMD cases is often associated with heightened inflammatory response, which increases pain and discomfort.[11]

Furthermore, polyamines and magnesium deficiency have often been linked to sensitization of pain and neuromuscular hyperexcitability, potentially aggravating TMD related pain. Neuropathic pain mechanisms may further intensify TMD symptoms, resulting in increased pain sensitivity in the orofacial region. Sufficient magnesium levels may help reduce muscle tension and associated discomfort, thereby contributing to symptomatic relief in TMD patients.[11,15,16]

4. Pathophysiology of TMD based on dietary deficiency.:

The pathophysiology of painful temporomandibular disorder (TMD) is complex, involving biological, psychological, and social factors.[17] Although the precise mechanisms remain unclear, several interrelated factors have been tried to explainthe onset of TMDs and the coexistence of other painful and non-painful conditions.

1. **Genetic Factors**: Research has identified specific single-nucleotide polymorphisms (SNPs) associated with clinical, psychological, and sensory phenotypes in TMD patients. Certain SNPs have shown predictive value for TMD and pain incidence. Notably, variations in the catecholamine-O-methyltransferase (COMT) gene influence pain sensitivity and TMD onset through adrenergic pathways. Women carrying haplotypes linked to decreased COMT activity exhibit heightened pain sensitivity and approximately two times heightened risk. [18-20]
2. **Inflammatory Mediators**:In individuals with painful TMDs, it is observed that proinflammatory cytokines, for example, monocyte chemotactic protein-1 (MCP-1), are raised; on the other hand, anti-inflammatory factors, for example, transforming growth factor-1 (TGF-1), arereduced.

TMD cases are advised to consume an antioxidant and omega # fatty acid-rich diet.[21]

3. **Neuropeptides**: In cases of neurogenic inflammation,Calcitonin gene-related peptide (CGRP) has a critical role. Elevated CGRP levels in the joint capsule of TMD patients contribute to inflammation and pain through mechanisms of peripheral and central sensitization.[22]
4. **Sensitization Mechanisms**: The interplay between genetic, inflammatory, and neurogenic factors leads to peripheral and central sensitization, which enhances the excitability and synaptic efficacy of nociceptive neurons. This phenomenon manifests as increased pain signalling, particularly in trigeminal pathways. Patients with heightened sensitization are at an increased risk of experiencing other chronic pain conditions, including headache and fibromyalgia, which frequently coexist with TMD.[23,24]

Understanding these interconnected mechanisms is essential for developing targeted interventions for individuals suffering from TMD and associated pain conditions.

5. Dietary assessment and recommended diet plans for TMD.

Dietary assessment toolkits:

Dietary assessment toolkits are essential resources for researchers, clinicians, and nutritionists aiming to gather accurate and reliable dietary data.[25]

(i) Diet, Anthropometry and Physical Activity Measurement Toolkit (DAPA; UK);
(ii) National Cancer Institute's (NCI) Dietary Assessment Primer (USA);
(iii) Nutritools website (UK);
(iv) Australasian Child and Adolescent Obesity Research Network (ACAORN) method selector (Australia); and
(v) Danone Dietary Assessment Toolkit (DanoneDAT; France).
(vi) MUST tool (Malnutrition Universal Screening Tool) [11]

A general nutrition assessment includes taking anthropometric measurements. For TMD patients, clinical examination of the joint and a questionnaire, along with routine nutritional assessment, are done.[26]

Anthropometric Assessment	• Weight • Height • Body Mass Index (BMI) • weight-for-height index (WHZ) • MUAC, (measurement of upper arm circumference) • Head circumference and skinfold.
Biochemical Assessment	Lab test for evaluating patient's blood, urine, or stool.
Clinical Assessment	• Clinical picture of nutritional deficiencies • Medical history • Examination of the temporomandibular joint for pain, clicking, restricted mouth opening
Dietary Assessment	• Patient is asked to record the details of his meals/food/drinks consumed in the past 24 hours • Food frequency questionnaire • Food group questionnaire • Listing particular foods or liquids they are avoiding due to a chronic OFP • Investigating any dietary restrictions they may have placed on themselves because of TMDS • A list of food items higher in sugar content, with dairy fat and protein rich food, should be prepared and compared with standard values.

For individuals with TMD (temporomandibular joint disorder), dietary choices maydependon the level of pain and the ability to open the mouth, chew, and swallow. For those who can open their mouths comfortably and experience minimal pain, a diet consisting of soft or easy-to-chew foods is often recommended. This type of diet includes foods that require minimal chewing. Below is a list of recommended diets.[27]

Temporomandibular Joint Association (2015) recommended soft meals [27]

	Recommended meals	Not recommended meals
Dairy/ Dairy Alternatives	Smooth yoghurt, custard, puddings, and cottage cheese.	Hard cheese slices, coconut, nuts, and yoghurt with bits of fruit.
Grains	Soak bread (devoid of nuts or seeds) till it becomes soluble.	breads containing nuts or seeds, rice, and French toast without syrup.
Fruits	Fruit nectar, mashed ripe bananas, fruit juice, fruit nectar, and seedless jam or jelly are some examples of edibles.	Whole grapes and fresh fruit with skins or seeds
Vegetables	legume pastes, mashed white or sweet potatoes, Pureed carrots.	diced tomatoes, lettuce, and fresh veggies like celery and carrots
Protein Foods	Smoothies made with yoghurt, pureed nuts and seeds, and liverwurst.	Hard-boiled eggs, fried eggs, breaded and fried meats, and nuts.
Soups	soups that have been blended or that are smooth (like tomato soup).	soup made with rice, celery, or undercooked carrots.
Desserts	Dessert soups, puddings, custards, gelatin, cakes wet with milk or sauce,	Hard and dry cakesand brownies that are challenging to chew.

Discuss the interplay.

Temporomandibular joint disorders are multifactorial in origin. Various factors like age, gender, social, physchological and systemic factors influence TMDS. Nutritional status also plays an important role, which is often overlooked, and should be well evaluated.

The role of nutrients and minerals in managing Temporomandibular Joint Disorders (TMD) is critical for the overall well being of the patients. Here's how these nutrients specifically impact TMD:[28]

I. Vitamin A:

a. **Functions**: Vital for the synthesis of collagen, which supports joint and soft tissue health, and maintains the integrity of epithelial tissues around the joint. also helps in lysosomal stability and glycoprotein synthesis.

b. **Clinical Relevance**: Supplementation may help in maintaining the health of joint tissues and supporting overall recovery in TMD patients.

II. Vitamin C:

a. **Functions**: Essential for repairing damaged tissues, including those around the TMJ, and for immune system support to defend against infections.

b. **Clinical Relevance**: Helps in wound healing and may alleviate inflammation associated with TMD.

III. Vitamin D:

a. **Functions**: Crucial for calcium metabolism, which is important for bone health and the maintenance of TMJ integrity. Deficiency can contribute to bone and joint issues.

b. **Clinical Relevance**: Adequate levels of vitamin D may prevent complications like joint pain and inflammation, and support bone strength in TMD patients.

IV. B-Complex Vitamins:

a. **Vitamin B1 (Thiamine)**: Supports neurotransmitter synthesis and energy production, which can be beneficial for managing pain and muscle function around the TMJ.

b. **Vitamin B6 (Pyridoxine)**: Important for protein synthesis and neurotransmitter production, which may help with muscle function and reduce discomfort associated with TMD.

c. **Vitamin B12 (Cyanocobalamin) and Folate**: helps in DNA synthesis and repair, which is important for maintaining tissue health around the TMJ.

V. Proteins:

a. **Functions**: Aid in the repair and remodelling of tissues, including those affected by TMD.

b. **Clinical Relevance**: Supports recovery and healing of muscles and connective tissues around the TMJ.

VI. Iron:

a. **Functions**: Supports collagen synthesis and enhances immune function, which can help in managing inflammation and repair processes in TMD.

b. **Clinical Relevance**: Adequate iron levels may contribute to better tissue health and reduced inflammation around the TMJ.

VII. Zinc:

a. **Functions**: Essential for DNA synthesis and acts as a cofactor for numerous enzymes, supporting tissue repair and immune function.

b. **Clinical Relevance**: Important for maintaining joint health, reducing inflammation, and aiding in the healing of the TMJ and surrounding tissues.

Incorporating these nutrients into the management of TMD can help improve healing, reduce inflammation, and support overall joint and tissue health, contributing to better treatment outcomes and enhanced patient comfort.[28]

Nutrition may have an impact on the pathogenesis and treatment of common illnesses such as trigeminal neuralgia, burning mouth syndrome, chronic orofacial pain, and persistent dentoalveolar pain disorders[9]. A qualified dietitian nutritionist should be consulted to evaluate and recognize patients who have difficulty in balance their nutrition and energy needs or the ones with fluctuating weight without warning. This also helps in determining or identifying individuals who have a compromised diet pattern because of painful TMDs.

Dietary recommendations as per need of individuals patient and their functional limitations are often provided by the clinician to help in adapting. While the primary objective is to achieve pain-free eating by means of physical adjustments to the patient's diet, there are certain circumstances in which patients may find it advantageous to take various supplements to fulfil theirmicronutrient, protein, and calorie requirements[29]. In these situations, prompt identification and treatment may hasten recuperation and improve patient outcomes.

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