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Temporomandibular joint disorders and their relationship with craniocervical postures

Trastornos de la articulación temporomandibular y su relación con posturas craneocervicales

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Abstract

Introduction: The temporomandibular joint is a bilateral synovial joint between the mandibular condyle and the mandibular fossa of the temporal bone. **Objective:** The objective of this research is to analyze the association between temporomandibular joint disorders and alterations in craniocervical postures. **Methodology:** A narrative review was carried out. Information collection was applied to the following databases: Scopus, PubMed, Web of Science, Google Scholar, from August 2024 to November 2024. **Conclusions:** The posture in which the head is located influences the position of the cervical spine and an alteration in this can cause problems in dental occlusion. Among the abnormal cervical postures, the following postures stand out: kyphotic, lordotic, and flattened. Craniocervical dysfunction is an anomaly in which the head is positioned forward with respect to the axial axis of the body and is usually associated with the appearance of temporomandibular disorders.

Keywords: Dentistry, rehabilitation, health, epidemiology, disorders, temporomandibular joint, craniocervical postures.

Resumen

Intr**oducción**: La articulación temporomandibular es una articulación sinovial bilateral entre el cóndilo mandibular y la fosa mandibular del hueso temporal **Objetivo:** El objetivo de esta investigación consiste en analizar la asociación entre trastornos de la articulación temporomandibular y alteraciones de posturas craneocervicales. **Metodología:** Se efectuó una revisión narrativa. La recolección de la información se aplicó en las bases de datos: Scopus, PubMed, Web of Science, Google académico, durante agosto de 2024 a noviembre de 2024. **Conclusiones:** La postura en la que se encuentra la cabeza influye en la posición de la columna cervical y una alteración en esta puede causar problemas en la oclusión dental. Entre las posturas cervicales anómalas, se destacan las posturas: cifótica, lordótica y aplanada. La disfunción cráneo cervical es una anomalía en la que la cabeza presenta una posición adelantada con respecto al eje axial del cuerpo y suele asociarse con la aparición de trastornos temporomandibulares.

Palabras clave: Odontología, rehabilitación, salud, epidemiología, trastornos, articulación temporomandibular, posturas craneocervicales.

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1. Introduction

The cranial and facial structures including the oral cavity along with its dental organs correspond to one of the most complex and complicated areas of the body that contributes to a series of orofacial disorders including temporomandibular disorders, orofacial pain disorders, myofascial, oral injuries, dental disorders, among others. Temporomandibular disorders being significantly a public health problem, affecting approximately 31% of the adult population, and orofacial pain among the most common of these problems with related symptoms of temporomandibular joint dysfunction and chronic head and neck pain, tension, migraine or mixed type, with an estimated prevalence of 20% of the general population (1,2).

Temporomandibular disorders symptoms can be observed across a wide age range, from 20 to 40 years, with women being more susceptible to these disorders than men (1,2). Furthermore, these craniofacial structures are closely related to feeding, communication, vision, and hearing, impacting appearance, self-esteem, and personal expression, which in turn can significantly affect psychological and functional status. Abnormal craniocervical postures can cause problems in the temporomandibular joint and, consequently, altered dental occlusion (1,2,3). The objective of this research is to analyze the association between temporomandibular joint disorders and altered craniocervical postures.

Due to the high health impact and varied etiologies, the management of these temporomandibular disorders tends to be approached from different medical and dental perspectives. However, each specialist addresses the functional problem according to their area of expertise. Therefore, therapeutic management may be limited, and a comprehensive approach requires a multidisciplinary team .

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2. Methodology

A narrative review was conducted regarding temporomandibular joint disorders and their relationship with craniocervical postures. The search strategy considered criteria such as relevance and origin of data, objective content development, and scope of the research. Based on these parameters, 22 publications were selected, including literature review articles, original articles, textbooks, and clinical cases related to the object of study, published in the last two decades, in English and Spanish. Data collection was performed using the following databases: SCOPUS, PubMed, Web of Science, and Google Scholar. The study was conducted from August 2024 to December 2024.

3. Development

3.1. Anatomy of the temporomandibular joint

The temporomandibular joint is a bilateral synovial joint between the mandibular condyle and the mandibular fossa of the temporal bone, its complex anatomy is characterized by highly incongruent skeletal surfaces which are therefore separated by a fibrocartilaginous disc into two independent chambers: the superior temporodiscal space and the inferior condylar disc space respectively. This division aims to provide joint stability by enlarging the contact area and provides the temporomandibular joint with dynamic and kinematic behavior, allowing jaw movements with 6 degrees of freedom under the heaviest load on the body's joints ranging from 50 to 80 kilopascals (kPa) (2).

The disc is morphologically biconcave with thick anterior and posterior bands and a thin intermediate zone. Anteriorly, the superior

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belly of the lateral pterygoid muscle inserts into the disc. The inferior belly has variable insertions, including the condyle, the joint capsule, and the disc. Posteriorly, it has a bilaminar zone of connective tissue that joins the temporal bone to the disc. The temporomandibular, sphenomandibular, and stylomandibular ligaments support the temporomandibular joint. The temporomandibular joint is one of the most complex joints in the human body. It behaves as a ginglymoarthroidal joint, which allows both rotational and translational movement of the mandibular condyle on the axis of the glenoid cavity, like a "hinge and glide" joint, with the purpose of maximizing oral opening (3).

3.2. Functions of the temporomandibular joint

Normal temporomandibular joint function requires synchronized and coordinated movement of the disk, condylar head, and masticatory muscles. The mandibular condyle normally aligns with the temporal fossa and posterior band of the disk at the 11 or 12 o'clock position. With mandibular opening, the condyle translates anteriorly to align with the articular eminence. The disk moves with the condyle, with the intermediate zone aligned with the eminence. A pathological intra-articular disk may obstruct these ranges of motion (3,4).

3.3. Constitution of the craniocervicalmandibular system

The craniocervical mandibular system is made up of articular and bony structures. (5) Among the articular structures are the cervical spine, which allows mobility of both the neck and the head. This part has 7 vertebrae; C1 and C2 form the upper cervical spine, and from C3 to C7 is the lower cervical spine. The tongue is a muscular organ that interacts with the articular and bony structures, helps coordinate the movements of the lower jaw, and has direct contact with the teeth (6).

The parts that make up the bone structure are the skull complex which has the function of protecting the brain, serves as support for

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the facial structure, includes cranial cap, skull base, facial bones, joints, and paranasal sinus (7). Another element is the lower jaw or mandible, which is the bone located in the lower part of the face, articulates with the temporal bone of the skull and facilitates the movements of the mouth, its oral functions are speech and facial functions are chewing and finally the hyoid bone which is U-shaped, located in the upper part of the larynx and in the lower part of the jaw. It is suspended by muscles and ligaments that contribute to the complex movements of mastication and speech (8).

Cervical joint problems can cause stress on the capsular elements and ligaments, which work together to provide support and stability to the structures involved. This can lead to headaches, neck pain, atlantoaxial subluxations (C1 and C2), and also generate neurological problems (9).

3.4. Craniocervical joints and cervical vertebrae

The craniocervical joints are linked to the spine because it maintains a connection with the cervical vertebrae that form the cervical spine in the neck. C1-C2 and C7 are atypical vertebrae because they do not have common characteristics and from C3 to C6 are typical because it does have them (10). In this region is the atlanto-occipital joint located between the occipital bone of the skull and C1 (Atlas) which is the first cervical vertebra, whose shape is like a ring. Its primary function is to execute flexion movements and head movements such as tilting. Another joint is the atlanto-axial because it is between the first vertebra C1 and the second vertebra C2 which is shaped like a tooth helps rotate the head (11).

The C7 is a prominent vertebra with the longest and most spinous process relative to the other vertebrae. Therefore, it provides more support and helps distribute weight to both the neck and head. It is also more visible because it is the bone located at the back of the neck. The C3-C6 vertebrae are smaller vertebrae with shorter spinous processes (10).

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3.5. Usefulness of imaging studies in TMJ disorders

The primary method for diagnosing temporomandibular joint disorders is a clinical examination, supported by extensive imaging analysis using radiographs, non-stress MRI or CT, and functional testing. Magnetic resonance imaging (MRI) has been widely used to assess temporomandibular joint characteristics such as disc morphology, disc position, and joint effusion. Although not considered the gold standard for bone evaluation of the temporomandibular joint, this modality has been used for these purposes; however, it is recommended to correlate bone diagnosis with CT (4).

Finding correlations between structural changes of the temporomandibular joint and clinical features can help guide patient management and provide prognostic information. Rudisch in 2001 showed that temporomandibular joint pain has been correlated with several MRI findings including: internal derangements, degenerative condylar changes, joint effusion, and medullary edema. Currently, Sang in 2024 limits MRI as a diagnostic aid in patients who primarily suffer from masticatory muscle pain (myalgia), as no relevant results were obtained in studies (1).

3.6. TMJ disorders

Temporomandibular joint disorder (TMJD) is a term used to describe musculoskeletal disorders of the jaw system, comprising the temporomandibular joints and their associated musculature. Pathological changes can affect all joint tissues, including the articular cartilage, disc, subchondral bone, and synovial membrane. Degenerative changes are often considered the result of mechanical impairment (2).

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3.7. Temporomandibular joint disorders.

Below are a number of disorders that can affect the temporomandibular joint (2):

1 Joint pain
- a. Arthralgias
- b. Arthritis

2 Joint disorders
- a. Disc disorders
  - i. Disc displacement with reduction
  - ii. Disc shifting with intermittent locking reduction
  - iii. Disc displacement without reduction with limited opening
  - iv. Disc displacement without reduction without limited opening
- b. Hypomobility disorders other than disc disorders
  - i. Adhesions and adhesions
  - ii. Ankylosis
    1. Fibrous
    2. I mean
- c. Hypermobility disorders
  - i. Dislocations
    1. Subluxation
    2. Dislocation

3. Joint diseases
- a. Degenerative joint disease
  - i. Osteoarthritis
  - ii. Osteoarthritis
- b. Osteochondritis dissecans
- c. Osteonecrosis

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d. Neoplasia

e. Synovial chondromatosis

4. Fractures

5. Developmental / congenital disorders

a. Aplasia

b. Hypoplasia

c. Hyperplasia

Masticatory muscle disorders

1. Muscle pain

a. Myalgia

i. Local myalgia

ii. Myofascial pain

iii. Referred myofascial pain

b. Tendinitis

c.Myositis

d. Spasm

2. Contracture

3. Hypertrophy

4. Neoplasia

5. Mobility disorders

a. Orofacial dyskinesia

b. Oromandibular dystonia

6. Masticatory muscle pain attributed to systemic/central pain disorder

a. Fibromyalgia/generalized pain

Headache

1. Headache attributed to temporomandibular disorders

Associated structures

1.. Coronoid hyperplasia (2).

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3.7.1 . Arthralgia

Pain of temporomandibular joint origin on palpation or that is affected by movement, function or parafunction of the jaw (2,3).

3.7.2. Rheumatoid Arthritis

Inflammatory autoimmune disease, symptoms include pain of joint origin with characteristics of inflammation or infection over the affected joint: edema, erythema, associated symptoms occlusal changes. Magnetic resonance imaging is the most accurate modality (95%) for diagnosis, with destruction of the articular disc and bilaminar zone, resulting in an abnormal position of the disc with decreased biconcave morphology, this proliferation of synovial widening suggests data of rheumatoid arthritis and is the precursor of bone changes (3).

3.7.3. Internal disorders.

Internal derangement is defined as an abnormal anatomical relationship of the articular disc to the mandibular condyle, articular eminence, and glenoid fossa. It accounts for 70% of temporomandibular joint symptoms, and is more common in women between their second and fourth decades of life. Trauma, malocclusion, bruxism, stress, and primary bone abnormalities are known causes. Early in the disease, patients may present with discomfort, pain, abnormal range of motion, and clicking sounds during mouth opening and closing. Chronically, patients may complain of pain and decreased range of motion, symptoms commonly confused with myofascial pain syndrome, the latter being a stress-related disorder involving extracapsular masticatory muscles, while temporomandibular joint syndrome refers to an abnormality or disorder involving the joint itself (3).

3.7.4. Disc displacement with reduction.

Intracapsular biomechanical disorder involving the condyle-disc complex. In the closed mouth position, the disc is anterior to the condyle

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and is reduced when the mouth is opened. Medial and lateral displacement of the disc may be present, and clicking and popping sounds may occur with disc reduction (2,3).

3.7.5. Disc displacement with intermittent locking reduction.

Closed mouth position, the disc is in the anterior position to the condyle and is reduced to the oral opening, when this is not reduced, an intermittent limited mandibular opening occurs, presenting clicking and snapping noises (2,3).

3.7.6. Disc displacement without reduction with limited opening.

Closed mouth, the disc is positioned anterior to the condyle and the disc does not reduce with oral opening, persistent limited mandibular opening. Also known as "closed lock" (2,3).

3.7.7. Disc displacement without reduction without limited opening.

Mouth closed, the disc position anterior to the condyle and the disc does not reduce with oral opening, it is not associated with limited opening (2,3).

Wilkes in 1990, proposed a classification to adequately standardize the pathology of internal disorders, the Wilkes classification divides temporomandibular joint disorders into five increasing stages of internal disorders, with stages I and II referring to acute and chronic reductive

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displacement of the disc, while stages III, IV and V refer to acute, subacute and chronic non-reductive displacement of the disc, respectively. Stage V mentions osteoarthritis (3,13,14).

Table1. Wilkes classification of internal disorders of the temporomandibular joint.

Stage I	Early reduction of disc displacement, without pain or limitation, early opening click.
Stage II	Late reduction disc displacement, one or more episodes of pain, mid-to-late opening click, and transient blocks.
Stage III	Non-reducing disc displacement – acute/subacute, with multiple painful episodes, blockage, restricted mobility.
Stage IV	Non-reducing disc displacement - chronic, with increasing functional disturbance.
Stage V	Non-reducing disc displacement – chronic with osteoarthritis, crepitus, scraping, pain symptoms, restricted movement, limited function.

Fountain: Drawn from Pope (3), Dimitroulis (13) and Elledge (14).

Dimitroulis in 2013 proposed a new classification based on 5 increasing degrees of joint pathology (3, 13, 14).

Table 2. Dimitroulis classification of temporomandibular joint pathology.

Category	Clinical presentation	Image
1	Arthralgia, joint pain with limited oral opening movement	Structurally normal joint
2	Intermittent clicking associated with intermittent joint pain and locking	Disc displacement with reduction

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3	Chronic pain Closed lock	Disc displacement without reduction Disc exhibits normal contour
4	Severe joint pain, limited chewing function, reduced mouth opening	Disc degeneration, deformation and perforation. Early condylar changes.
5	Constant crepitus, mild to moderate pain, reduced masticatory function, intermittent blockage	Degenerative joint disease, end-stage disc and condyle degeneration, destructive, catastrophic.

Source: Prepared from Pope (3), Dimitroulis (13) and Elledge (14).

3.7.8. Adhesion and adhesions.

Restricted mandibular movement with deflection towards the affected side on opening, adhesions secondary to joint inflammation, adhesion in the upper or lower joint space characterized by intermittent clicking (1,2).

3.7.9. Ankylosis.

Most common cause of trauma, less common cause of infections or inadequate surgical treatment of the condylar area. Fibrous ankylosis, no predominant bone changes, severe limited capacity for oral opening, deviation towards the affected side. Bone ankylosis, radiographic evidence of bone proliferation, with marked deviation to the affected side (1,2).

3.7.10. Condylar subluxation/hypermobility.

It represents a hypermobility disorder involving the condyle-disc complex and articular eminence. When the mouth is opened, the condyle-disc complex is placed anterior to the articular eminence, making it

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impossible for mandibular closure. Condylar hypermobility is observed in patients with Ehlers-Danlos syndrome (1,2).

The duration of the dislocation may be momentary or prolonged, when the patient can reduce the dislocation by himself it is called subluxation, when the patient needs the assistance of the doctor to reduce the dislocation and normalize mandibular movement it is known as dislocation (1,2).

3.7.11. Degenerative joint disease.

Osteoarthritis, also known as degenerative joint disease, is the clinical and pathological outcome of a number of disorders and conditions characterized by joint deterioration with concomitant bony changes at the condyle and/or articular eminence, leading to pain, disability, and structural insufficiency in synovial joints. Primary osteoarthritis can be localized and generalized when three or more joint sites are involved, and is distinguished from secondary osteoarthritis, which follows a clearly defined predisposing disorder or disease (12).

Over the years, in addition to genetic background, mechanical and psychological stress has been consistently linked to pain conditions and impaired function associated with the temporomandibular joints and masticatory muscles (12).

The development of all types of degenerative diseases of the temporomandibular joint is associated with multiple etiological and risk factors, among which we can mention: trauma, functional overload, age, systemic diseases, hormonal factors (12).

Collagen genes are associated with different types of bone and cartilage dysplasias where osteoarthritis is part of the more complex phenotype. Physiologically, osteoarthritis as a disease involves the production of cytokines by cartilage, synovium and bone. Cytokines such as TNF (tumor necrosis factor), IL-1 and IL-6 are produced by chondrocytes, macrophages, T cells and osteophytes in response to tissue damage. Pro-MMPs (matrix metalloproteinase), released by synovites and

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macrophages contribute to tissue damage, T cells and B cells are recruited by the cytokine environment in the synovial fluid and contribute to local synovitis. Bone cells release several cytokines most notably IL-6 and RANKL (receptor activator of nuclear factor ligand) (2).

3.7.12. Systemic arthritis.

Joint inflammation resulting in painful symptoms or structural changes caused by systemic diseases including: rheumatoid arthritis, juvenile idiopathic arthritis, spondyloarthropathies (ankylosing spondylitis, psoriatic arthritis, infectious arthritis, Reiter's syndrome), gout, autoimmune diseases and other mixed connective tissue diseases (scleroderma, Sjögren's syndrome, lupus erythematosus). Condylar resorption may be associated with malocclusion (12).

3.7.13 Osteochondritis dissecans.

Joint condition in which there are osteochondral fragments, associated with pain, inflammation, joint noises and limitation of mandibular movements (3,12).

3.7.14. Osteonecrosis.

This symptomatic condition, also called avascular necrosis, may involve the temporomandibular joint in patients with disc displacement without destruction. Theoretically, the anterior disc compromises extraosseous and venous blood flow to the condyle by compressing the insertion of the lateral pterygoid muscle into the mandibular condyle. Computed tomography images may show sclerosis of the subchondral bone; magnetic resonance imaging shows decreased T1 and T2 signal (12).

3.7.15. Neoplasms, tumors and similar conditions.

Rare condition in the temporomandibular joint, defined as the result of tissue proliferation involving the temporomandibular joint with histological characteristics that may be benign (81%) or malignant, may

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present inflammation, pain during limited oral opening function, crepitus, occlusal changes and sensory-motor changes, facial asymmetry (12).

Synovial chondromatosis is a benign neoplasm resulting from intra-articular proliferation of cartilaginous nodules originating from the synovial membrane, it is common in other joints, its symptoms involve pain, swelling, crepitation and limited movement, diagnostic aids are computed tomography and magnetic resonance imaging, findings include widening of the joint space, joint effusion, soft tissue edema, irregular joint surfaces and multiple loose calcified bodies that resemble ossified bodies on tomography as isodense signal, loose bodies are often found in the superior joint space, causing destruction and sclerosis of the articular eminence / glenoid fossa (12).

3.7.16 Traumatic conditions

Mandibular fractures occur most frequently in motor vehicle accidents, condylar fractures represent between 25 and 50% of mandibular fractures, and are classified for study into fractures of the condylar head (extra or intracapsular) and condylar neck (high, middle and low) resulting in most cases a malocclusion and altered function. The fractured fragments are generally displaced medially by the action of the lateral pterygoid muscle. Computed tomography and three-dimensional reconstructions are useful for surgical planning and evaluation of adjacent structures (12).

3.7.17, Condylar deficiency Aplasia .

Condylar deficiency includes complete or partial absence of the condyle and incomplete development of the articular fossa and eminence resulting in facial asymmetry., Common causes of aplasia include rheumatoid arthritis, juvenile idiopathic arthritis, radiation therapy

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and parathyroid hormone related processes affecting chondrocyte differentiation. Aplasia is also associated with syndromes such as Goldenhar, hemifacial microsomia, Treacher Collins syndrome, Proteus syndrome, Morquio syndrome and auriculocondylar syndrome, Agenesis is associated with external ear, auditory canal and middle and inner ear anomalies (12).

3.7.18. Hypoplasia.

Incomplete development of the mandibular condyle, which may be secondary to trauma or congenital anomalies, results in facial asymmetry and micrognathia (1,2,12).

3.7.19. Hyperplasia.

Exaggerated development of the mandibular condyle, with a non-neoplastic increase in cells. It usually presents unilaterally, exposing facial asymmetry. It may be idiopathic or associated with endocrine disorders. The condyle may be normal or elongated (1,2,12).

3.7.20. Myalgia

Pain of muscular origin, in masticatory muscles upon palpation or oral opening, which is affected by movement (2,12).

3.7.21. Local myalgia

Pain of muscular origin in the masseter and temporalis on palpation with localization of pain at the palpation site during myofascial examination (2,12).

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3.7.22. Myofascial pain

Pain of muscular origin that extends beyond the site of palpation, but with the limit of the muscle when examined (2,12).

3.7.23. Referred myofascial pain

Pain of muscular origin with reference to pain beyond the limit of the muscle when palpated during examination (2,12).

3.7.24. Tendinitis

Pain of tendon origin affected by jaw movement and function. Replication of this pain occurs with masticatory tendon provocation tests (2,12).

3.7.25. Myositis

Pain of muscular origin with clinical characteristics of inflammation and infection (2,12).

3.7.26. Spasm.

Sudden, involuntary, reversible tonic contraction of a muscle that can cause severe pain (2,12).

3.7.27. Contracture

Shortening of a muscle due to fibrosis of tendons, ligaments, or muscle fibers, associated with a history of radiation therapy, trauma, or infection. It is frequently observed in the masseter muscle (2,12).

3.7.28. Hypertrophy

Enlargement of one or more muscles that is generally not associated with pain and may be secondary to chronic muscle tension, genetic

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cause, diagnosis is based on clinical evaluation considering craniofacial morphology and ethnicity (14).

3.7.29. Orofacial dyskinesia

Involuntary movement that may involve the face, lips, tongue, jaw, generally in psychotic patients with prolonged treatment of antipsychotics of the phenothiazine and butyrophenone group (14).

3.7.30. Oromandibular dystonia.

Characterized by strong contractions of the face, lips, jaw and tongue that cause difficulty in opening and closing the mouth, affects chewing and speech, associated with neurological disorders or exposure to medications, can affect the muscles of the neck, eyelids, larynx (2,14).

3.7.31. Fibromyalgia.

Disorder characterized by generalized musculoskeletal pain, accompanied by fatigue, sleep, memory, mood (2,14).

3.7.32. Headache attributed to temporomandibular disorders.

Temporomandibular disorders and headache are closely related to pathologies, primary headaches such as migraines, episodic tension or chronic daily pain are common in patients with symptoms of temporomandibular disorders, it occurs with provocation tests of the masticatory system (2,14).

3.7.33. Coronoid hyperplasia.

Progressive lengthening of the coronoid process that prevents mandibular opening when it is obstructed by the zygomatic process (2,14).

Recognizing the causes of pain and dysfunction associated with temporomandibular disorders is important for guiding treatment decisions. Systemic considerations may be associated with the etiology of temporomandibular disorders; these are not commonly considered by

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clinicians but can be assessed by most specialists. Relevant information from the patient at the time of history-taking is also limited, and it is considered irrelevant to not mention them unless specifically requested (4).

The most important part of diagnosing temporomandibular disorders is differentiating common diseases from clinically significant but unusual conditions, as well as conditions that are more serious and require urgent attention. This is the case with neoplasms, such as chondrosarcoma of the temporomandibular joint, a malignant lesion that may initially share signs and symptoms with some of the common diagnoses of temporomandibular disorders, such as pain in the preauricular region and limited mouth opening. Another example that requires urgent attention is temporal arteritis, which is an inflammatory condition of the temporal vessels with some symptoms similar to those of temporomandibular disorders, such as headache, pain in the temporal region, and limited mouth opening. However, temporal arteritis is a medical emergency that can cause permanent blindness if not treated promptly (14). Some of the differential diagnoses for orofacial pain that can mimic temporomandibular disorders are mentioned below in Table 3.

Table 3. Differential diagnoses of temporomandibular joint disorders

Neuropathic pain	Trigeminal neuralgia
	Glossopharyngeal neuralgia
	Postherpetic neuralgia
	Traumatic neuralgia
	Burning mouth syndrome
	Burning mouth syndrome
	Atypical odontalgia
	Atypical facial pain

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Odontogenic pain	Dental caries
	Periodontal disease
	Dental abscess
	Dental sensitivity
	Cracked tooth syndrome
	Pericoronitis
Intracranial pain	Tumors
	Aneurysms
	Bleeding
	Infection
Pain attributed to adjacent structures	Ear
	Nose
	Throat
	Eyes
	Paranasal sinuses
	Salivary glands
	Lymph nodes
	Cervical region
Headaches not attributed to temporomandibular disorders	Migraine
	Cluster headaches
	Tension headaches
	Temporal arteritis
	Referred pain
	Psychogenic pain

Source: Prepared from Elledge (14)

3.8. Normal posture

When conceptualizing posture, it cannot be seen as a static action. According to Andrade, in 2016, a normal posture is "one where a minimum of energy expenditure is required. The joints receive a minimum load and the muscular kinematic chains remain aligned" (15). During the process

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of species evolution, the human species has differentiated itself by the acquisition of new brain structures, with greater cortical representations due to the functions of its hands in gripping and activities they perform together. Therefore, it had to adopt the bipedal position, giving rise to the intervention of gravity, generating structural changes, adapting and obtaining the human posture. Significant changes are observed in the physiological curvatures of the spine, such as: kyphosis and lordosis (15).

To maintain a static position requires certain elements such as muscular reflexes that maintain the joints of the body and dynamic posture other elements are found. The physiological posture in a static position is acquired through muscular reflexes that fix the joints of the human body, while in a dynamic process there are several factors that provide an adequate posture, such as proprioceptive receptors, exteroceptives that include vision, hearing, touch and the central nervous system (16).

To adapt to posture, there are the following models: Biomechanical, Psychosomatic and Neurophysiological or cybernetic. The neurophysiological theory is the most obvious, since it implies that posture needs information received from various input and output receptor systems such as: vestibular, oculomotor, pedal input and the stomagnatic apparatus, which through the central nervous system achieves correction of posture, balance and tone (16).

The correct posture can be evaluated in a simple and effective way by examining the plumb line, which is just a rope with a plumb line at the end to keep it stable, which should reach the base of the feet, this being the reference point, to do this the plumb line is placed suspended on the patient and viewed from the back, where the feet are parallel in relation to the rope and laterally the plumb line should go in front of the lateral malleolus (17).

According to Kendall et al (17), in the correct posture they can be observed with the following parameters:

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3.8.1. Side view:

- Neutral head, without inclinations,
- Posterior to the coronal suture
- External auditory canal
- Odontoid process of the axis
- The spine must maintain its physiological curvatures,
- Flat scapula in relation to the upper back
- Sacral promontory
- The hip and knee joint must be in extension,
- The ankle joint should be at 90 degrees.

3.8.2. Rear view:

- Head aligned, neutral position
- Midline of the head
- The spinous processes of the spine must be aligned
- Shoulders should be aligned, neither too depressed nor too raised.
- The shoulder blades should be equidistant from each other, 8 cm apart.
- Lower limbs parallel as well as the feet, without deviations.

3.8.3. Previous view:

- Head aligned in neutral position
- Facial symmetry
- Straight shoulders in relation to each other
- Parallel knees
- Feet on the floor and parallel.

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Correct posture is influenced by antigravity muscular forces and gravity, therefore, the force of gravity that influences the body must be balanced by the muscles that have the function of opposing this force and maintaining balance. Each individual will have unique characteristics, defined by muscle tone and trophism, the condition of ligaments, and bone surfaces (18).

3.8.4. Normal curves of the spine

There are four normal or physiological curvatures in the spine: at the cervical region, a convex curve pointing forward is observed; in the dorsal region, a convex curve pointing backward; and in the lumbar region, this curve is convex forward. When the lumbar spine is in a normal position, it corresponds to a neutral spine (17).

3.8.5. Abnormal posture

Considering the normal curves of the spine, there may be abnormal curves that cause incorrect posture. According to Kendall (17), the following stand out:

3.8.5.1. Kyphotic posture , observed from the sagittal plane we will find: head directed forward, with the cervical spine hyperextended, abducted scapulae, dorsal spine with increased kyphosis, lumbar region with hyperextension, forward tilt of the pelvis and hip in flexion, at the level of knees they are hyperextended and ankles in plantar flexion.

3.8.5.2. Lordotic posture , observed from a sagittal plane: the head is in a neutral position, the cervical and dorsal spine are normal, however, in the lumbar spine there is hyperlordosis, that is, it is hyperextended, the pelvis is observed with anterior inclination,

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knees in slight hyperextension and the ankle in slight plantar flexion.

3.8.5.3. Flattened posture, examined in a sagittal plane, we can observe: that the head is forward, cervical spine in extension, upper dorsal spine in hyperflexion and the lower spine straight, the lumbar curve is rectified, in posterior inclination we can see the pelvis, hips and knees in extension and the ankles in slight plantar flexion.

Another anomaly seen from the coronal plane, from the back are the deviations or lateralized postures of the spine that could be muscular alterations, which lead to the column convexity of this, leading the hip and its analogous structure to change its normality; There are also alterations where changes are observed at the level of shoulders where the head can be aligned, but what corresponds to the shoulder joint from the scapulas are elevated or rotated. Alterations in postures are observed, the patterns related to the predominance of the use of a limb, in the case of a person who uses his right hand, it can be noticed that the right shoulder is lower than the left, the pelvis is deviated to the right and the right hip is higher than the left, with a slight deviation of the spine, this predominance can occur from a very young age in the individual (17).

Likewise, the curvatures observed from the frontal plane that are lateralized are abnormal (17), this very common dysfunction that alters the anatomy of the spine is scoliosis, which is where the spine presents lateral displacements where the vertebrae are rotated, whose diagnosis is in the coronal plane (16).

3.9. Relationship between craniocervical dysfunction and temporomandibular disorders

Due to its joint relationships, the posture of the head influences the position of the cervical spine, and an alteration in this can cause occlusion

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problems. Considering that the first cervical vertebra (atlas) joins the head through the articular condyles of the occipital, in addition to a large number of muscular insertions that connect between both structures. When the head is in a straight position, the jaw is at rest and there is between 2 and 4 mm of disocclusion. When there is an alteration in the occlusion, it will directly affect the Temporomandibular Joint (TMJ) (19).

Craniocervical dysfunction (CHD) is an anomaly in which the head is positioned forward with respect to the axial axis of the body. It is accompanied by symptoms such as cervical pain due to the excessive force exerted by the cervical muscles in their effort to maintain the balance of the head, causing limitation of movements and postural changes (20). CHD can arise from bad posture habits such as excessive use of mobile devices, mouth breathing, in the latter case, when there is mouth breathing the jaw descends and causes a decrease in the tension of the suprahyoid muscles, causing the hyoid to be positioned more backward and downward (21).

Some of the clinical characteristics presented by patients with DCC are: a reduction of the suboccipital, posterior cervical, upper trapezius and splenius muscles; hyperextension of the cervical spine, forward shoulders, loss of control of the shoulder blade and alterations in the head and neck muscles (21).

Due to the anatomical relationship of the structures of the craniocervical-mandibular system, in most cases patients with CCD also present temporomandibular disorders (TMD). Bautista et al. (20) evaluated 87 participants with TMD, resulting in 69% presenting CCD.

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TMD has a multifactorial etiology. A relevant factor is that the function of the masticatory muscles influences the transverse growth of the craniofacial skeleton in the areas where they exert their direct action, as well as in areas of the arch where the molars are erupting (22).

On the other hand, if there is a physiological curvature of the cervical spine, it will be rectified or inverted, due to tension in the cervical fascia that is fixed to the hyoid bone, which causes a posterior traction of the latter. The aforementioned results in a lowering of the normal position of the tongue and jaw (19).

4. Conclusions

The temporomandibular joint is a bilateral synovial joint between the mandibular condyle and the mandibular fossa of the temporal bone, its complex anatomy is characterized by highly incongruent skeletal surfaces which are therefore separated by a fibrocartilaginous disc into two independent chambers: the superior temporodiscal space and the inferior condylar disc space respectively.

The position of the head influences the position of the cervical spine, and any alteration in this position can cause occlusion problems. Abnormal cervical postures include: kyphotic posture, lordotic posture, and flattened posture.

Craniocervical dysfunction (CHD) is an anomaly in which the head is positioned forward with respect to the axial axis of the body.

Due to the anatomical relationship of the structures of the cranio-cervical-mandibular system , in most cases patients with DCC also present temporomandibular disorders.

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5. Contribution of the authors

MDOS : Introduction, development and final review of the article
KLCG : development and final revision of the article
AMUV : development and final review of the article
LESP : methodology, development and final review of the article.
MGCR : development and final review of the article.

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