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The Neuromuscular Part of ‘Stomatognathic System’ – A Review

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ABSTRACT: The term stomatognathic system, describes the intricate network of organs and tissues that are involved in the mouth and jaw's ability to perform various tasks, such as speaking, breathing, swallowing, and chewing (mastication). It is a functional and anatomical unit that is required for a variety of physiological functions. To carry out necessary actions, including speaking, breathing, mastication, swallowing, and facial expressions, the neuromuscular components cooperate. Proper nerve-muscle synchronization ensures effective, regulated, and smooth movements necessary for maintaining dental health and function. Dysfunction in any one of these components can lead to conditions such as temporomandibular disorders (TMD), dysphagia (difficulty swallowing), or speech difficulties. This narrative review focussed on the importance of neuromuscular role on the function of stomatognathic system.

I. INTRODUCTION

Disorders affecting the teeth, jaws, muscles, nerves, temporomandibular joint (TMJ), and supporting tissues can all impact the stomatognathic system. These conditions can cause a variety of symptoms and indicators that interfere with daily activities like breathing, speaking, chewing, and swallowing. [1,2]

The Stomatognathic System's components are as follows: [3,4]

1. Teeth: During mastication, the teeth chop, rip, and grind food.

2. Periodontium: The gums, periodontal ligament, cementum, and alveolar bone make up the periodontium, which serves to anchor and support the teeth.

3. Jaws: The maxilla (upper jaw) and mandible (lower jaw) significantly influence mastication, speech, and facial structure.

4. Temporomandibular joint (TMJ): The joint that connects the mandible to the temporal bone of the skull, known as the temporomandibular joint (TMJ), permits movement of the jaw while speaking, chewing, and other activities.



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- 5. Muscles of Mastication:** The masseter, temporalis, medial pterygoid, and lateral pterygoid muscles are the mastication muscles; they are in charge of moving the jaw.
- 6. Tongue:** Used for communication, it helps to manipulate food for chewing and swallowing.
- 7. Salivary Glands:** Secrete saliva that lubricates, protects, and facilitates digestion of the oral tissues.
- 8. Oral mucosa** is the lining of the mouth that functions as a barrier of defense and is involved in secretion and feeling.
- 9. Lips and Cheeks:** Help with speech articulation and keep food contained within the mouth while eating.
- 10. Palate:** The hard and soft palates, which together form the roof of the mouth and divide the nasal and oral cavities, facilitate speaking and swallowing.
- 11. Nerves and Blood Vessels :** Blood vessels and nerves supply all of the stomatognathic system's components with blood, sensation, and motor control.
- 12. Pharynx:** Involved in speaking and swallowing, it connects the mouth and oesophagus.

Normal functions of of stomatognathic system: [5]

The stomatognathic system regularly performs the following functions:

The stomatognathic system controls numerous essential processes pertaining to the mouth, jaws, and adjacent structures. These functions are essential for daily tasks like breathing, eating, speaking, and maintaining general oral health. The stomatognathic system typically performs the following tasks: The aforementioned tasks are typically performed by the stomatognathic system.

1. Mastication (Chewing):

Function: The breakdown of food into tiny pieces facilitates easier swallowing and digestion. This necessitates coordination of the tongue, lips, cheeks, teeth, and jaws.

The muscles of mastication (the masseter, temporalis, medial, and lateral pterygoids) control jaw motions, while the tongue and cheeks assist in positioning food between the teeth.

Goal: Aids in the formation of a cohesive bolus by mixing food and saliva and increasing food's surface area for enzymatic action in the stomach and intestines.[6]

2. Deglutition (Swallowing):

Function: The movement of a food bolus or liquid from the mouth into the stomach via the pharynx, oesophagus, and stomach.

Parts involved: To guarantee safe and efficient swallowing, the tongue, soft palate, pharynx, larynx, and esophageal muscles cooperate.

The goal is to safely transport liquids and food into the digestive system while preventing aspiration into the respiratory system.[7]

3. Speech (Phonation and Articulation):

Function: The articulation of words and the generation of sound (phonation) that permit verbal communication.

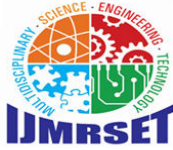
Parts Involved: To control airflow and produce various sounds, the larynx (vocal cords), tongue, lips, teeth, palate, and face muscles cooperate.

Goal: Facilitates social engagement, effective speech, and the expressing of ideas and feelings. [8]

4. Breathing (Respiration):

Function: The process by which air enters the lungs through the larynx, pharynx, and nasal or mouth cavity.

Parts involved: The trachea, mouth, throat, larynx, nose, and related muscles work together to control airflow.



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Its purpose is to make it easier for the body to take in oxygen and expel carbon dioxide, which supports cellular respiration and overall health.

5. Maintenance of Oral Homeostasis:

Function: controlling the mouth cavity's environment to preserve health and fend against illness. The salivary glands produce saliva, which contains antimicrobials, enzymes, and buffers that stabilize the pH and prevent infection. Saliva has a variety of purposes in the mouth, including lubricating oral tissues, preventing tooth decay, assisting with digestion, and facilitating the healing of soft tissues.

6. Facial Expression:

Function: The facial muscles are used to communicate emotions through expressions such as frowning, smiling, and other facial movements.

Parts Involved: The facial nerve (Cranial Nerve VII) controls the facial muscles, such as the zygomaticus major and minor, buccinator, and orbicularis oris.

Goal: Promotes social connection, emotional expression, and nonverbal communication.

7. Sensory Perception:

Function: The sense of taste, touch, temperature, and pain in the mouth and face regions, as well as their interpretation. The following components are involved: trigeminal (Cranial Nerve V) and facial (Cranial Nerve VII) nerves; sensory receptors in the tongue (taste buds); oral mucosa; teeth; and periodontal tissues.

The purpose of this sensory feedback is to support appropriate function (e.g., identifying hazardous stimuli, altering bite force), improve overall sensory experience, and contribute to flavor perception.

8. Protection of Oral and Pharyngeal Structures:

Tissue mechanical protection and defense against pathogens.

Teeth, lips, cheeks, oral mucosa, and saliva—which contains lysozymes, immunoglobulins, and other antimicrobial agents—are the components involved.

Goal: Protects against damage from chemicals (such as acidic foods), infections (such as bacteria and viruses), and mechanical forces (such as sharp food particles).

9. Jaw Stability and Posture:

stabilizing the head and neck's posture and preserving the proper mandibular position in relation to the maxilla. The temporomandibular joint (TMJ), the masticatory muscles, and the neck muscles are the components involved. Objective: Preserves equilibrium and proper alignment of the head and neck while guaranteeing effective performance when chewing, speaking, and swallowing.

10. Development and Maintenance of Proper Occlusion:

Function: Ensuring that the upper and lower teeth are properly aligned and in touch when biting and chewing. Teeth, periodontium (gums, periodontal ligament, alveolar bone), TMJ, and masticatory muscles are the components involved.

Goal: Equally distribute biting pressures to protect teeth and supporting structures from excessive wear and damage, while also promoting general oral health and function.

11. Suckling and Sucking (in Infants and Children):

A coordinated movement of the lips, cheeks, tongue, and jaw used when an infant feeds from a breast or bottle. The tongue, cheek, and lip muscles, as well as the oral reflexes, are the involved components.

Goals: Provides vital nutrition for development and growth; lays the groundwork for oral motor function; and promotes jaw and face growth.



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12. Regulation of Saliva Flow:

The mouth continuously produces and secretes saliva to keep the oral cavity lubricated, balanced, and moist. Major (parotid, submandibular, and sublingual) and minor (autonomic nervous system-controlled) salivary glands are the components involved.

Function: Promotes oral hygiene; aids in speech and swallowing; guards teeth and mucosa; and aids in digestion.

II. THE NEUROMUSCULAR PART OF STOMATOGNATHIC SYSTEM INCLUDES

The stomatognathic neuromuscular system is the network of muscles and nerves that cooperate to regulate and synchronize the different activities of the mouth, jaws, and associated tissues is known as the neuromuscular system of the stomatognathic system. This mechanism is necessary for actions like speaking, swallowing, chewing, and making facial expressions. [9]

III. COMPONENTS OF THE NEUROMUSCULAR SYSTEM INVOLVING THE STOMATOGNATHIC SYSTEM

I. Cranial Nerves: A variety of cranial nerves, including the following, mediate the neuromuscular control of the stomatognathic system.

A).Trigeminal Nerve (Cranial Nerve V):The trigeminal nerve (Cranial Nerve V) is in charge of facial sensation and controlling the muscles that move the jaw (such as the masseter, temporalis, medial, and lateral pterygoid muscles). The trigeminal nerve divides into three branches: the mandibular, maxillary, and ophthalmic. The mandibular branch is primarily responsible for the jaw's movements.

B).Facial Nerve (Cranial Nerve VII): Regulates the muscles used for facial expression. These muscles are required for lip movement while eating and speaking, as well as for keeping the mouth shut during mastication. Additionally, it supplies certain taste-related sensory fibers to the tongue's anterior two thirds.

C).Glossopharyngeal Nerve (Cranial Nerve IX): Supplies sensory innervation to the tonsils, pharynx, and posterior third of the tongue. It also contributes to the swallowing and gag reflexes.

D). Vagus Nerve (Cranial Nerve X): Regulates the pharyngeal and laryngeal muscles involved in speaking and swallowing. It also gives the salivary glands parasympathetic innervation.

E).Hypoglossal Nerve (Cranial Nerve XII): Provides motor innervation to the tongue's muscles, which is essential for swallowing, food manipulation, and speech articulation.

II. Muscles of Mastication: These are the muscles that move the jaw when you chew.[10]

III. Facial Expression Muscles: These muscles, which include the buccinator and orbicularis oris, are responsible for creating facial expressions, moving the lips and cheeks, and holding the food bolus in place when chewing. [11]

IV. Intrinsic and Extrinsic Muscles of the Tongue:

To prevent food or liquid from entering the nasal cavity during swallowing and speaking, use the levator veli palatini, tensor veli palatini, palatoglossus, and palatopharyngeus muscles to tension or elevate the soft palate. Pharyngeal constrictors assist in propelling food bolus from the mouth into the oesophagus.

V. Muscle Spindles and Golgi Tendon Organs: These sensory receptors found in muscles and tendons provide feedback to the central nervous system regarding muscle length and tension, allowing for precise control and coordination of jaw movements.



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VI. Central Nervous System (CNS):

The brainstem, specifically the trigeminal motor nucleus and facial nucleus, coordinates the voluntary and reflexive movements of the jaw and face muscles.

Cerebral Cortex: Responsible for the conscious regulation of speaking, swallowing, and mastication. The cerebellum regulates the timing and accuracy of movements in the stomatognathic system.

VII. Autonomic Nervous System: of saliva from both the main and minor salivary glands, which is necessary for lubricating food, initiating digestion, and safeguarding the oral tissues.

The situations in which this neuromuscular part of stomatognathic system will disturb:

Various illnesses, pathologies, and external causes that impact the nerves, muscles, joints, or supporting structures can cause disturbances or disruptions to the neuromuscular system of the stomatognathic system. These disruptions may make it harder to speak, chew, swallow, and take care of your teeth. The stomatognathic system's neuromuscular system may be impaired by the following typical circumstances and ailments:

1. Temporomandibular Disorders (TMD):[12)

Description: A group of conditions affecting the temporomandibular joint (TMJ), muscles of mastication, and associated structures.

Causes: Trauma, arthritis, bruxism (teeth grinding), excessive clenching, stress, or malocclusion (misalignment of the teeth).

Impact: Pain, limited jaw movement, clicking or popping sounds in the jaw, muscle spasms, headaches, and difficulty chewing.[13,14]

Treatment Protocol:[15]

Conservative Treatments:

Self-care: Resting the jaw, avoiding hard or chewy foods, applying moist heat or cold packs.

Medications: Analgesics (e.g., NSAIDs), muscle relaxants, and low-dose tricyclic antidepressants for pain management.

Physical Therapy: Jaw exercises, massage, ultrasound therapy, and electrical nerve stimulation.

Occlusal Appliances: Custom-made mouthguards or splints to reduce bruxism, prevent teeth grinding, and stabilize the jaw.

Behavioral Therapy: Stress management, relaxation techniques, and cognitive-behavioral therapy to reduce muscle tension.

Advanced Treatments:

Intra-Articular Injections: Corticosteroids or hyaluronic acid injections into the TMJ to reduce inflammation and pain.

Surgery: Arthroscopy or open joint surgery for severe cases (e.g., joint damage or disc displacement) not responding to conservative treatments.

Bruxism:[16]

Description: Involuntary grinding or clenching of teeth, often during sleep.

Signs and Symptoms: Worn, flattened, or chipped teeth; Tooth sensitivity or pain; Jaw pain, muscle fatigue, or soreness; Headaches, especially upon waking; Ear pain or a feeling of fullness in the ears; Tightness or stiffness in the jaw muscles.

Treatment Protocol:[17]

Behavioral Modifications:

Stress Management: Techniques like biofeedback, cognitive-behavioral therapy, and relaxation exercises.

Habit Reversal: Training to avoid daytime clenching or grinding.

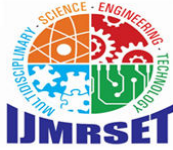
Occlusal Appliances:

Nightguards or Splints: Worn during sleep to prevent teeth grinding and protect teeth from damage.

Medications:

Muscle Relaxants: To reduce muscle spasms.

Botox Injections: Temporarily paralyzing muscles involved in grinding.



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2. Neurological Disorders:[18,19]

Stroke: Can cause paralysis or weakness in the muscles involved in chewing, swallowing, and speaking (dysphagia and dysarthria).

Parkinson's Disease: Leads to tremors, rigidity, bradykinesia (slowness of movement), and difficulty with fine motor control, affecting the muscles of the face, tongue, and jaw.

Multiple Sclerosis (MS): Affects nerve conduction, leading to coordination problems, muscle weakness, and difficulty swallowing.

Amyotrophic Lateral Sclerosis (ALS): Progressive degeneration of motor neurons, causing weakness and atrophy in muscles, including those involved in mastication, swallowing, and speech.

3. Muscle Disorders:[20]

Myasthenia Gravis: An autoimmune neuromuscular disorder characterized by muscle weakness and fatigue, particularly in muscles controlling the eyes, face, and swallowing.

Muscular Dystrophy: Genetic disorders causing progressive muscle weakness and loss, which can affect the muscles involved in mastication, swallowing, and facial expression.

Myositis: Inflammation of the muscles, potentially affecting the muscles of mastication and swallowing, leading to pain and weakness.

4. Peripheral Nerve Injury:

Trigeminal Neuralgia: Severe facial pain due to irritation or damage to the trigeminal nerve (Cranial Nerve V), which can affect chewing and facial muscle function.

Facial Nerve Paralysis (e.g., Bell's Palsy): Sudden weakness or paralysis of the facial muscles due to inflammation or damage to the facial nerve (Cranial Nerve VII), affecting lip and cheek movements and oral competence.

Hypoglossal Nerve Damage (Cranial Nerve XII): Impairs tongue movement, affecting speech and swallowing.

5. Structural Abnormalities or Trauma:

Fractures of the Jaw (Maxilla or Mandible): Trauma can disrupt the alignment and function of the TMJ, muscles, and nerves, causing pain, limited motion, and difficulty chewing.

Congenital or Acquired Deformities: Conditions such as cleft palate, craniofacial syndromes, or malocclusions can affect the alignment and function of the jaw, teeth, and associated muscles.

6. Dental and Prosthetic Issues:

Poorly Fitting Dentures or Prostheses: Ill-fitting removable or fixed dental prostheses can lead to muscle strain, pain, difficulty chewing, and changes in jaw alignment.

Tooth Loss: Missing teeth can disrupt the normal occlusion and distribution of bite forces, leading to muscle imbalance and temporomandibular joint disorders.

7. Inflammatory and Autoimmune Conditions:

Rheumatoid Arthritis (RA) or Osteoarthritis (OA): Can affect the TMJ, leading to joint pain, inflammation, and dysfunction.

Sjögren's Syndrome: An autoimmune disorder causing dry mouth (xerostomia) that affects chewing and swallowing due to reduced saliva production.

8. Psychological Factors:

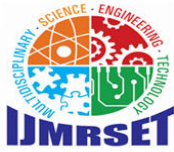
Stress and Anxiety: Can lead to bruxism (teeth grinding) and clenching, contributing to muscle fatigue, pain, and TMJ disorders.

Depression: May lead to changes in oral hygiene practices, diet, and neuromuscular function, indirectly affecting the stomatognathic system.

9. Systemic Diseases:

Diabetes Mellitus: Can cause neuropathy (nerve damage) and reduce saliva flow, affecting chewing and swallowing.

Thyroid Disorders: Hypothyroidism can cause muscle weakness and dysfunction, while hyperthyroidism may lead to muscle wasting or tremors.



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10. Aging:

Degenerative Changes: Age-related changes in muscles, joints, and nerves can lead to decreased strength, flexibility, and coordination, affecting chewing, swallowing, and speech.

Sarcopenia: Age-related loss of muscle mass and function can affect the muscles involved in mastication and swallowing.

11. Medication Side Effects:

Certain medications, such as anticholinergics, antihypertensives, and antidepressants, can cause dry mouth (xerostomia), muscle weakness, or coordination problems, impacting the function of the stomatognathic system.

12. Radiation Therapy:

Head and Neck Cancer Treatments: Radiation therapy can cause fibrosis, muscle stiffness, nerve damage, and reduced salivary gland function, affecting chewing, swallowing, and speaking.

13. Infection or Inflammatory Conditions:

Infections (e.g., abscesses, cellulitis): Can cause pain, swelling, and reduced function in the jaw muscles and nerves.

Temporomandibular Joint Infections: Can lead to inflammation, pain, and restricted jaw movements.

14. Nutritional Deficiencies:

Deficiencies in vitamins (like B vitamins) and minerals (like calcium and magnesium) can affect nerve function and muscle health, leading to disturbances in the neuromuscular control of the stomatognathic system.

15. Habitual Behaviors:

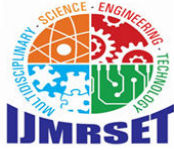
Parafunctional Habits: Such as nail-biting, tongue thrusting, or frequent gum chewing can strain the muscles and joints involved in the stomatognathic system, leading to pain and dysfunction.

IV. CONCLUSION

In conclusion these disorders can significantly impact the quality of life, affecting essential functions like eating, speaking, and facial expressions. Prompt diagnosis and appropriate treatment by dental or medical professionals are crucial for managing these conditions and minimizing their impact on the stomatognathic system.

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