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‘MASTICATORY CYCLE’ - Relevance to Prosthodontics- A Narrative Review

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INTRODUCTION:

The physiological act of chewing food is sometimes called the jaw movement cycle, mastication sequence, chewing process, or chewing cycle. Preparing food for swallowing must first be broken down in the mouth and combined with saliva. This process, known as mastication, aids in saliva secretion, which is necessary to moisten the food and the mouth.[1] The term "masticatory cycle" describes the synchronized movements of the jaw and related muscles during the chewing or mastication process, which breaks food down into smaller pieces. It is a multi-phase physiological process that is complex. [2,3]

Importance of the Masticatory Cycle [4]

Digestion: Food is broken down into tiny particles by effective mastication, which increases the surface area in the stomach and intestines for enzymatic digestion.

Oral Health: Chewing food properly encourages the creation of saliva, which facilitates the initial digestion of carbohydrates and lubricates food to make swallowing easier. Additionally, it improves oral cleansing by maintaining good oral hygiene.

Muscular Function: The masticatory cycle serves to maintain muscle tone and function by coordinating the contraction and extension of several muscles, including those of the jaw, face, and neck.

Clinical Implications

Dental Health: Proper mastication is important for dental health, as it reduces the risk of dental caries and gum disease by maintaining oral hygiene and pH balance in the mouth.

Nutrition: Efficient mastication facilitates nutrient absorption by preparing food for digestion and absorption in the gastrointestinal tract.

Various stages of masticatory cycle:

The masticatory cycle involves several distinct stages that contribute to the process of chewing food effectively. Here's a detailed breakdown of the stages of the masticatory cycle:

I.Opening Phase:

The masticatory cycle begins with the opening of the mouth, which involves lowering the mandible (lower jaw) to allow food to enter.This phase is primarily controlled by the action of the lateral pterygoid muscles, which contract to move the mandible downward and forward.[5]

II.Closing Phase

After food enters the mouth, the mandible moves upward and backward to close the jaws.The closing phase involves contraction of the masseter, temporalis, and medial pterygoid muscles to elevate and retract the mandible.[6]

III.Mastication Phase

Once the jaws are closed, the mastication phase begins, where food is chewed by repetitive movements of the mandible. Rhythmic Movements occurs in this phase. This phase alternates between lateral (grinding) and vertical (crushing) movements of the mandible to break down food particles.Muscles involved include the masseter, temporalis, medial pterygoid, and lateral pterygoid muscles, which work in coordination to facilitate chewing.[7]

IV.Swallowing Phase

Once mastication is complete, the bolus of chewed food is pushed to the back of the mouth and swallowed. The swallowing phase initiates the swallowing reflex, which involves complex neuromuscular coordination to propel food from the mouth into the esophagus.[8]

***Clinical and Functional Considerations*:** [9]

A).Dental and Oral Health: Proper mastication is essential for maintaining dental health by promoting saliva flow, which aids in digestion and oral hygiene.

B).Muscular Function: Dysfunction in the masticatory cycle can lead to issues such as temporomandibular joint disorders (TMDs) or difficulty in chewing and swallowing.

C).Nutritional Implications: Efficient mastication ensures proper digestion and nutrient absorption, contributing to overall nutritional health.

Understanding the stages of the masticatory cycle is crucial in clinical assessments, treatments for chewing disorders, and management of oral and dental conditions.

The muscles involved during masticatory cycle in phased manner:

During the masticatory cycle, various muscles of the jaw and face work together in a coordinated manner to facilitate chewing and biting. Primary muscles of mastication (chewing food) are the temporalis, medial pterygoid, lateral pterygoid, and masseter muscles. The four main muscles of mastication attach to the rami of the mandible and function to move the jaw (mandible).[10]

***Muscles Involved in Different Phases of the Masticatory Cycle*:**

1.Opening Phase:

Primary Muscle: ***Lateral pterygoid muscle***

Function: Initiates jaw opening by lowering and protruding the mandible.

2.Closing Phase:

Primary Muscles: ***Masseter, temporalis, and medial pterygoid muscles***

Functions:

Masseter: Elevates the mandible to close the jaws.

Temporalis: Elevates and retracts the mandible.

Medial pterygoid: Assists in elevating and closing the mandible.

3.Mastication Phase:

Primary Muscles:

***Masseter*:** Powerful muscle that elevates the mandible and aids in grinding movements.

Temporalis: Works with the masseter to elevate and retract the mandible.

Medial pterygoid: Assists in closing the jaws and provides grinding movements.

Lateral pterygoid: Assists in protrusion and lateral movements of the mandible during chewing.

4.Swallowing Phase:

Primary Muscles: Muscles involved in the swallowing reflex include:

***Genioglossus*:** Protrudes and depresses the tongue during swallowing.

***Styloglossus*:** Retracts and elevates the tongue.

Mylohyoid: Elevates the hyoid bone and the floor of the mouth.

***Digastric*:** Elevates the hyoid bone.

Functional Considerations:The masticatory muscles work in a coordinated manner to achieve efficient chewing and swallowing.

Muscle Imbalance: Imbalances in muscle function can lead to temporomandibular joint disorders (TMDs) or difficulties in chewing and swallowing.

Clinical Applications: Understanding muscle involvement helps in diagnosing and treating conditions related to mastication and jaw function.[7]

Disorders which influence masticatory cycle:

Disorders affecting the masticatory cycle can range from conditions that affect the muscles and joints of the jaw to neurological disorders that impact chewing function. Here are some common disorders that influence the masticatory cycle, along with references for further reading:

1.Temporomandibular Joint Disorders (TMDs)

TMDs encompass a group of conditions affecting the temporomandibular joint (TMJ) and surrounding muscles, causing pain, limited jaw movement, and dysfunction during chewing. TMDs can disrupt the smooth coordination of jaw movements required for effective chewing.[11]

2.Bruxism (Teeth Grinding)

Bruxism involves involuntary grinding or clenching of teeth, often during sleep, which can lead to muscle fatigue, jaw pain, and tooth wear. Chronic bruxism can affect the muscles of mastication and contribute to TMJ disorders. [12]

3.Myofascial Pain Syndrome

Myofascial pain syndrome involves localized muscle pain and tenderness, often associated with trigger points in the muscles of the jaw and neck. Trigger points can cause referred pain and affect muscle function during chewing. [13]

4.Neurological Disorders

Neurological conditions such as stroke, Parkinson's disease, or Bell's palsy can affect motor control and coordination of masticatory muscles. These disorders can lead to muscle weakness, impaired chewing ability, and difficulty in controlling jaw movements. [14]

5.Malocclusions

Malocclusions refer to misalignment of teeth or incorrect relation between the upper and lower dental arches.Impact on Mastication: Severe malocclusions can affect how teeth meet during chewing, leading to inefficient mastication and potential muscle strain. [15]

Clinical Management and Treatment:

Understanding these disorders and their impact on the masticatory cycle is crucial for accurate diagnosis and effective management. Treatment approaches may include physical therapy, medication, dental interventions, or surgical procedures depending on the underlying cause and severity of the condition.

Neural control of masticatory cycle : [16-18]

The neural control of the masticatory cycle involves complex coordination between various parts of the nervous system, including the central nervous system (CNS) and peripheral nerves. Here's an overview of how neural control influences the masticatory cycle

A).Central Nervous System (CNS) :

Motor Cortex: Initiates and coordinates voluntary movements of the jaw and facial muscles involved in mastication.

Basal Ganglia and Cerebellum: Contribute to the planning, execution, and coordination of masticatory movements.

Brainstem (Trigeminal Nucleus): Receives sensory input from the trigeminal nerve and integrates motor commands for chewing.

B).Peripheral Nerves:

Trigeminal Nerve (CN V): Provides sensory input from the face and oral cavity and motor control to the muscles of mastication (masseter, temporalis, medial pterygoid, and lateral pterygoid muscles).

Facial Nerve (CN VII): Innervates muscles involved in facial expression, including some muscles indirectly related to mastication.

C).Neurological Pathways:

Corticobulbar Tracts: Transmit motor commands from the motor cortex to the trigeminal motor nucleus in the brainstem.

Trigeminothalamic Tract: Transmits sensory information from the trigeminal nerve to the thalamus and higher cortical areas for processing.

Masticatory cycle change in edentulous patients : [19-21]

In edentulous patients, the masticatory cycle undergoes significant changes due to the absence of natural teeth and the consequent alterations in jaw structure and function. Here’s an overview of how the masticatory cycle changes in edentulous patients:

1).Altered Jaw Mechanics

a).Loss of Teeth: Without natural teeth, edentulous patients lack the primary structures for biting and grinding food.

b).Jaw Structure: Edentulous jaws may exhibit bone resorption and changes in morphology, affecting jaw closure and movement coordination.

2).Adaptation Mechanisms

a).Muscle Adaptation: Muscles involved in mastication may undergo adaptive changes to compensate for the lack of teeth and altered jaw mechanics.

b).Compensatory Movements: Edentulous patients may rely more on soft tissue adaptation and tongue movements to manipulate and swallow food.

3).Impact on Food Processing

a).Chewing Efficiency: Reduced ability to chew and grind food properly can impact digestion and nutrient absorption.

b).Mechanical Changes: Chewing becomes less efficient, potentially leading to increased effort and longer masticatory cycles.

Clinical Implications and Management

Denture Use: Complete dentures are commonly prescribed to restore function and aesthetics, although they may not fully replicate natural chewing efficiency.

Prosthetic Adjustments: Proper fitting and adjustment of dentures are critical to improving masticatory function and patient comfort.

Nutritional Considerations: Edentulous patients may require dietary modifications or supplemental nutrition to compensate for reduced chewing efficacy.

Prosthodontic significance of Masticatory cycle: [22,23]

Understanding the prosthodontic significance of the masticatory cycle is essential in designing and fitting prosthetic devices that restore chewing function and overall oral health. Here's an overview of the prosthodontic significance of the masticatory cycle, supported by references:

A.Prosthetic Design and Function: [24]

Optimal Occlusion: Prosthetic devices such as dentures or implants need to replicate natural occlusal relationships to facilitate efficient chewing.

Masticatory Efficiency: Proper prosthetic design ensures adequate masticatory efficiency to support digestion and oral health.

B.Patient Comfort and Adaptation:

Muscle and Tissue Adaptation: Prosthetic appliances should be designed to minimize muscular strain and promote adaptation of oral tissues for improved comfort and function.

C.Functional Assessment: Assessment of masticatory function guides prosthetic adjustments to optimize patient outcomes.

Long-Term Stability and Maintenance : [25]

Denture Stability: Ensuring stability and retention of removable dentures or implant-supported prostheses during chewing movements enhances longevity and patient satisfaction.

Maintenance: Regular follow-up and maintenance of prosthetic devices are crucial to address wear, stability issues, and changes in masticatory function over time.

D.Clinical Applications and Research:[26]

Digital Dentistry: Advances in digital technologies allow for more precise prosthetic fittings and occlusal adjustments based on real-time masticatory feedback.

Implant Dentistry: Integration of implants with prosthetic restorations enhances masticatory function by providing stable support and natural bite force distribution.

Research Advances: Studies continue to explore innovative materials and techniques to improve prosthetic outcomes and patient satisfaction in masticatory rehabilitation.

CONCLUSION:

Understanding the masticatory cycle is crucial in dental and medical contexts for assessing oral function, diagnosing chewing disorders, and providing effective treatment for conditions that affect mastication.

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