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PROTECTIVE FEATURES OF HUMAN DENTITION'- A REVIEW

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ABSTRACT

In both natural and artificial dentition, a wide range of intricate defense mechanisms preserve the dentition's longevity and integrity. Innate defense mechanisms found in natural dentition include pulpal nociceptors for pain perception, neuromuscular reflexes for bite force regulation, periodontal mechanoreceptors for proprioception, enamel for physical barrier protection, and saliva for chemical buffering and antimicrobial action. These systems are crucial for preserving oral function, safeguarding both soft and hard tissues, and reacting to unpleasant stimuli. They are mainly controlled by the trigeminal nervous system. However, when you sleep or are in a compromised state like bruxism or periodontitis, these systems are partially diminished.

Artificial dentition must be made to mimic or support these protective functions when natural teeth are lost. Clinicians can restore functional protection through careful prosthetic design, which includes balanced occlusion, the use of resilient materials, shock-absorbing components, preservation of proprioceptive input (e.g., overdentures), and the promotion of saliva-friendly environments. Furthermore, increased customization and accuracy in prosthesis design are made possible by digital technologies and occlusal analysis tools. When properly designed and maintained, artificial systems can greatly compensate for the sensory and reflexive losses of natural teeth, even though they cannot completely replace them.

1. INTRODUCTION

What are the protective features of human dentition

The human dentition has developed a number of defense mechanisms that support the preservation of oral health, guard against harm, and guarantee functional effectiveness. An overview of the main protective characteristics is provided below:

Protective Features of Human Dentition

1. Tooth Morphology

In order to reduce damage, cusps and grooves distribute occlusal forces and facilitate effective mastication. Dental arches' curved shape aids in the dissipation of force during chewing. [1]

2. Enamel

Enamel, the tooth's outermost layer, is the hardest material in the human body. It offers a strong surface that is impervious to chemical deterioration and mechanical wear. [2]

3. Dentin and Pulp Response

Beneath enamel, dentin absorbs masticatory stress and offers resilience. In reaction to trauma or irritation, the pulp may start a defensive reaction (such as the development of tertiary dentin). [3]

4. Occlusion and Functional Contacts

Anterior teeth guide the mandible while posterior teeth take the brunt of forceful chewing thanks to a mutually protected occlusion. Wear is avoided and lateral forces on anterior teeth are reduced as a result. [4]

5. Saliva

Saliva lubricates oral tissues, supplies antimicrobial enzymes, buffers acids, and promotes enamel remineralization. [5]

6. Periodontium

The alveolar bone is shielded from occlusal forces by the periodontal ligament (PDL).

The alveolar bone and gingiva offer immunological and mechanical defense. [6]

7. Dental Arch Form and Tooth Alignment

Teeth and supporting tissues are shielded from damage and excessive wear by proper alignment and arch shape, which distribute forces uniformly. [7]

8. Eruption Sequence and Spacing

Larger permanent teeth are accommodated and crowding is lessened by the primary dentition's primate spacing and tooth eruption timing. [8]

The sensory feedback system, which helps control chewing forces and identify dangerous stimuli, is one way that receptors contribute significantly to the protective mechanisms of the dentition.

Receptors Act as Protective Mechanisms in Dentition as follows:

1. Periodontal Mechanoreceptors- Recognize vibrations, pressure, and tooth displacement. assist in controlling bite force and avoiding overstressing teeth. crucial for proprioception, which enables exact control over jaw movements. [9]

2. Pulpal Nociceptors- inside the pulp of the teeth. Take note of chemical, mechanical, and thermal stimuli. To stop additional harm (such as from dental cavities, trauma, or restorative procedures), start a pain response. [10]

3. Oral Mucosal and Gingival Receptors- Assist with temperature, pain, and touch.

Support the protective reflexes, such as coordinated mastication and withdrawal from dangerous stimuli. [6]

4. Temporomandibular Joint (TMJ) Receptors - aid in controlling load distribution and jaw movement. involved in reflexes that guard against tooth trauma and joint overload. [11]

By identifying dangerous stimuli, receptors—particularly in the PDL, pulp, and surrounding oral tissues—form a crucial component of the dentition's defense mechanism. adjusting the motor control. causing discomfort or reflexes to reduce damage.

Detailed elaboration on the protective features of human dentition:

1. Tooth Morphology

Masticatory forces are absorbed and distributed in large part by the anatomical shape of teeth, which includes cusps, fissures, ridges, and roots. Whereas anterior teeth have sharp incisal edges for cutting, posterior teeth have broad occlusal surfaces for grinding. The morphology prevents fractures and restricts the concentration of stress. With several roots and occlusal grooves, molars enhance stability and food digestion without putting undue strain on any one cusp. [12]

2. Enamel Structure

Because enamel contains approximately 96% hydroxyapatite, it is the hardest material in the body. Teeth are shielded from acid erosion and mechanical wear by its prismatic structure and thickness gradient, which is thicker on the occlusal surfaces. It serves as a passive barrier against outside stimuli because it lacks innervation. [13]

3. Dentin-Pulp Complex Defense

In addition to supporting enamel, dentin contains microscopic tubules that communicate with the pulp. Odontoblasts create tertiary (reparative) dentin in reaction to trauma or caries in order to shield the pulp. The pulp provides defense through pain and inflammation because it contains nociceptors and immune cells. [14]

4. Periodontal Mechanoreceptors and PDL

With the help of its elastic collagen fibers, the periodontal ligament (PDL) absorbs pressure. includes mechanoreceptors that sense pressure and trigger reflexes to regulate jaw pressure, avoiding tooth overload. Proprioception, or the awareness of tooth position and force, depends on these receptors. [15]

5. Saliva

Saliva buffers acids (via the bicarbonate and phosphate systems) to protect teeth. supplying antimicrobial proteins, such as lactoferrin, IgA, and lysozyme. using calcium and phosphate ions to aid in remineralization. protects enamel by lubricating oral tissues, lowering friction, and forming the acquired pellicle. [16]

6. Occlusal Scheme and Functional Occlusion

In a mutually protected occlusion, anterior teeth disengage posterior teeth in lateral movements, while posterior teeth absorb vertical forces during mastication. avoids damaging horizontal forces that might cause TMJ issues or attrition. Excessive posterior wear is frequently seen in patients with worn anterior guidance, indicating the protective nature of functional occlusion. [17]

7. Gingiva and Alveolar Bone

Bacterial invasion is prevented by the gingiva's mechanical barrier function. In order to maintain periodontal health, alveolar bone supports tooth roots and remodels when subjected to mechanical stress. Its protective function in healthy conditions is demonstrated by the fact that periodontal inflammation results from plaque-induced loss of gingival integrity. [18]

8. Receptors and Sensory Feedback

Pulpal nociceptors trigger protective withdrawal reflexes in response to painful stimuli. Mastication and speech are coordinated by oral mucosal receptors that react to temperature, touch, and pain. By triggering defensive reactions or warning of impending illness, these sensory systems stop harm. [19]

9. Arch Form and Alignment

In addition to ensuring even load distribution, proper tooth alignment lowers the possibility of crowding or trauma. Malocclusion frequently results in abnormal mobility, wear, or TMD. Plaque retention is increased by crowded dentition during the mixed dentition phase, indicating a link between alignment and periodontal protection. [20]

Oral health and function are maintained by the intricate system of structural, physiological, and sensory defenses found in the human dentition. To withstand mechanical forces, microbial challenges, and chemical threats, these protective features work in concert.

Muscle spindle

The muscle spindle is an essential neuromuscular element that plays a role in the natural dentition's defense mechanisms, especially in controlling and perfecting masticatory forces and jaw movements.

Role in Protective Mechanism of Natural Dentition

A muscle spindle is a sensory receptor found in skeletal muscles, especially in masticatory muscles (e.g., masseter, temporalis) and other muscles involved in fine motor control. It is made up of intrafusal fibers that sense variations in the length and rate of muscle contraction. Muscle spindles trigger reflexes that modify muscle activity by sending signals to the central nervous system through afferent nerve fibers (Group Ia and II). to start stretch reflexes for fine motor control, preserve muscle tone, and facilitate proprioception.

How Do Muscle Spindles Protect Natural Dentition?

Although muscle spindles are not located in the teeth or periodontal tissues, they protect the dentition indirectly through neuromuscular control. Here's how:

1. Regulation of Bite Force (Load Protection)

Masticatory muscles' spindles detect excessive stretching or erratic movements that occur when biting or chewing. To prevent overstretching the teeth, they set off a myotatic (stretch) reflex that modifies the contraction force. [21]

2. Jaw Reflexes and Proprioception

Jaw jerk reflexes are facilitated by muscle spindles, which guarantee fluid and controlled motions. This prevents teeth and the temporomandibular joint (TMJ) from being harmed by forceful or ill-coordinated closure. Muscle spindles regulate stretch reflexes, which help limit excessive force during a sudden bite onto a hard object and prevent tooth fracture. [22]

3. Coactivation with Periodontal Mechanoreceptors

Muscle spindles control the related muscle activity, while periodontal receptors sense pressure on teeth. Only the appropriate amount of force is used thanks to sensorimotor integration, especially when performing delicate tasks like speaking or cutting soft foods.[23]

Patients with neuromuscular disorders that affect the muscle spindles, such as those who have Parkinson's disease or stroke, frequently exhibit poor jaw control, which can result in TMD or abnormal occlusal wear. Spindle-related neuromuscular feedback loop dysregulation may also be connected to bruxism and malocclusion.

By monitoring the stretch of the jaw muscles, muscle spindles play a protective neuromuscular role. controlling the forces used in chewing. collaborating with TMJ and periodontal receptors. avoiding harm from excessive or improperly applied bite forces. They therefore constitute an essential component of the protective reflex arc for preserving the functional integrity of the dentition, despite not being dental tissues in and of themselves.

The nervous system responsible for all protective mechanisms of natural dentition

The nervous system, especially parts of the peripheral and central nervous systems, regulates the protective mechanisms of natural dentition. Somatic, autonomic, and reflex arcs play important roles in these processes. Natural Dentition's Protective Mechanisms Involve the Nervous System

Primary Nervous System Involved:

1. Trigeminal Nervous System (Cranial Nerve V)- This is the chief neural pathway for protective dental reflexes.

Trigeminal nerve (CN V) provides: Sensory innervation to the teeth, periodontium, TMJ, oral mucosa, and face. Motor control to masticatory muscles (via mandibular branch V3).

Major Divisions Involved:

V2 (Maxillary Nerve): Sensory input from maxillary teeth and gingiva.

V3 (Mandibular Nerve):

Sensory: From mandibular teeth, gingiva, tongue, TMJ.

Motor: To muscles of mastication (masseter, temporalis, pterygoids). [24]

2. Brainstem and Reflex Centers

Protective oral reflexes are mediated through the brainstem, especially the mesencephalic nucleus and trigeminal motor nucleus. Jaw jerk reflex, Bite force modulation, Gag reflex, Mastication reflexes [25]

3. Autonomic Nervous System (ANS)

controls salivary flow, which aids in mechanical cleaning and shields enamel from acid. Saliva production is increased by parasympathetic stimulation (through the facial (CN VII) and glossopharyngeal (CN IX) nerves. [26]

4. Somatosensory System

The central nervous system receives information from mechanoreceptors (found in the PDL), nociceptors (found in pulp), and proprioceptors (found in the TMJ and muscle spindles). This makes it possible to detect load, pressure, pain, and tooth contact. In order to protect the teeth, these sensory inputs cause motor reactions (such as biting adjustments or withdrawal from pain). [27]

The protective mechanisms of natural dentition are mainly the result of the trigeminal nervous system, which is bolstered by somatosensory pathways, autonomic control, and brainstem reflex circuits. Safe mastication, force regulation, pain avoidance, and salivary defense are all guaranteed by this intricate neural integration.

Does all these protective mechanisms works during sleeping?

While not all of the natural dentition's defense mechanisms are as effective while you're asleep as they are when you're awake, some of them do remain active.

Table-1 Depicting Protective Mechanisms During Sleep

Protective Mechanism	Active During Sleep?	Explanation
Tooth Morphology		
Enamel Protection	Yes	Enamel remains a physical barrier, regardless of sleep state.
Saliva	Reduced	**Salivary flow drops significantly** during sleep (especially REM sleep), reducing buffering and antimicrobial protection. This makes teeth more vulnerable to acid attacks and bacterial activity.
Periodontal Mechanoreceptors	Mostly Inactive	These require conscious mastication or force application. They do not function during passive clenching or grinding in sleep (bruxism).
Pulpal Nociceptors	Diminished Response	They can still transmit pain (e.g., from toothache), but reflex withdrawal or protective adjustment is delayed or absent during sleep.
Muscle Spindles (Jaw Muscles)	Altered Activity	Spindles may remain partly active and can contribute to **sleep bruxism**, but **conscious feedback loops** and fine motor control are reduced.
Brainstem Reflexes (e.g., Jaw Jerk Reflex)	Partially	Basic reflex arcs (like jaw jerk) can still operate, but they may be less responsive or inhibited depending on the sleep stage
Trigeminal Sensory Feedback	Mostly Inactive	Without conscious chewing or active sensory input, most trigeminal feedback pathways are **dormant during sleep**
Autonomic Salivary Control	Partially	Low-level parasympathetic activity still produces **basal saliva**, but not enough to fully protect enamel.

Key Concerns During Sleep:

Sleep grinding, or bruxism, occurs when proprioceptors or mechanoreceptors do not provide protective feedback. Decreased salivary flow raises the risk of halitosis, erosion, and dental cavities.

Reflex impairment: Without protective bite-force modulation, teeth may unintentionally clash or overload. According to Lavigne et al. (2003), sleep bruxism is not controlled by the typical proprioceptive protective mechanisms and is linked to micro-arousals in the central nervous system. [28]

How to safe guard these mechanisms

especially since aging, stress, sleep, and illness weaken many of the defenses that our teeth provide. Here is a helpful, evidence-based guide to preserving the health of your natural dentition and safeguarding these defenses:

How to Safeguard the Protective Mechanisms of Natural Dentition

Prevent plaque buildup by maintaining good oral hygiene, which safeguards the gingiva, periodontium, and dentin-pulp complex. Toothpaste containing fluoride strengthens enamel. Soft toothbrushes are better for protecting gingiva and enamel. [29]

2. Encourage and Sustain the Flow of Saliva

Drink plenty of water. Chew sugar-free gum, paying particular attention to xylitol. In cases of xerostomia, take into account salivary substitutes. Avoid alcohol and caffeine as they can cause dry mouth.

Protects: food clearance, microbial control, enamel, and pH buffering. [30]

3. Protect Teeth During Sleep

For those who suffer from bruxism, use a customized night guard. To relieve jaw strain, sleep on your back. Steer clear of stress and alcohol at night as they can cause grinding episodes.

Protects: Against PDL overload, enamel wear, and grinding at night. [31]

4. Preserve Neuromuscular Reflexes

Refrain from making needless extractions that compromise occlusal harmony and feedback. Use quality orthodontic or prosthodontic work to guarantee appropriate occlusion. Use well-made prosthetics to replace lost teeth in order to preserve muscle memory and sensory input. Protects: Jaw reflexes, periodontal mechanoreceptors, muscle spindle coordination. [32]

5. Follow a Tooth-Friendly Diet

Avoid frequent sugar/acid exposures (which overwhelm enamel and saliva buffering). Eat crunchy fibrous foods like carrots and apples (stimulate saliva and clean teeth).

Protects: Enamel, salivary activity, pulp-dentin health.

6. Regular Dental Check-ups- early identification of periodontal disease, bruxism, malocclusion, caries, or enamel flaws. Professional sealants and fluoride treatments can improve the protection of enamel.

Protects: All structures—especially those you can't monitor yourself.

7. Manage Stress and Sleep Quality. Stress increases risk of bruxism and TMD.

Restful sleep aids in muscle recovery, hormone balance, and healing. Clenching and grinding can be lessened with the use of relaxation techniques or Cognitive Behavioral Therapy (CBT).Protects: Neuromuscular control, TMJ health, occlusal stability. [33]

8. Avoid Harmful Habits

No ice-crunching, no pencil-chewing, no nail-biting. Avoid using your teeth as tools, such as when opening packages or bottles. Quit smoking because it damages the gingiva and lowers blood flow to the tissues of the periodontal region. Protects: Periodontium, enamel, PDL, receptors.

In order to replicate, make up for, or maintain the inherent protective qualities of teeth and the masticatory system, we can and should include protective mechanisms in artificial dentition (such as dentures, bridges, implants, etc.). Artificial teeth can be made to cooperate with the body's natural systems to preserve oral structures and improve function, even though they are unable to regenerate tissues or create reflexes.

Protective Mechanisms for Artificial Dentures: Strategies & Methods

Here's a thorough examination of how protective mechanisms can be replicated or supported in prosthetics that are fixed, removable, and implant-supported:

1. Occlusal Scheme Design

Goal: Prevent overload, maintain neuromuscular harmony, and protect supporting structures. [Table-III]

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Table- 2: Explains the type of prosthesis with design features [34]

Type	Design Features
Complete Dentures	Balanced occlusion, lingualized occlusion to ensure stability and prevent tipping during mastication.
Fixed Prosthodontics	Mutually protected occlusion to protect anterior and posterior teeth from parafunction.
Implants	Group function or canine guidance to reduce lateral load on implants, which lack PDL.

2. Material Selection

Use materials that resist fracture, wear appropriately, and protect opposing dentition.

Material-Protective Benefit

Acrylic resin-Cushions occlusal forces in complete dentures (good for ridge preservation)

Zirconia-High strength, but needs polishing or glazing to prevent wear of opposing teeth

Hybrid composites-More shock-absorbing than ceramics; good for occlusal restorations or overdentures

Residual ridge, natural teeth, temporomandibular structures.

3. Shock Absorption & Load Distribution

Compensate for the loss of periodontal ligament (PDL) and mechanoreceptors. [35]

4. Neuromuscular Integration

Restore proprioception and muscle coordination.

Method Function

Tooth-supported overdentures Retain proprioception via remaining Use osseoperception (limited tactile feedback from implants via peri-implant nerves)

Tactile cue training Encourage patient adaptation and bite-force awareness with new prosthesis.

Protects: Bite control, jaw muscle harmony, reduces parafunctional activity. [36]

5. Saliva Management

Goal: Compensate for reduced natural lubrication or salivary defense in edentulous or xerostomic patients.

Salivary substitutes Moisturize oral cavity for better denture adhesion and microbial protection. Denture-friendly salivary stimulants Sugar-free lozenges, xylitol gum (if some teeth remain). Surface texture design Polished intaglio surfaces reduce plaque retention and microbial irritation Protects: Soft tissue, microbial balance, denture comfort.

6. Biofilm & Caries Prevention (For Partial Dentures or Bridges)

Reduce plaque accumulation around abutment teeth and implants.

Method Benefit

Fluoride-releasing materia Reinforce enamel around fixed prostheses Custom oral hygiene instructions
Bridge floss threaders, water flossers, etc.

Good marginal adaptation prevents microleakage and secondary caries Protects: Abutment teeth, peri-implant tissues, supporting periodontium. [24]

7. Digital & Individualized Design

Goal: Use digital planning (CAD/CAM) to tailor prostheses to patient-specific risk factors and anatomy.

Technology Benefit

CAD/CAM prostheses - Ensure proper occlusal contacts, even force distribution

Digital occlusal analysis (T-Scan) - Prevent premature contacts and high-pressure zones

- Allows rapid prototyping and adjustments to improve fit and force balance

Protects: Entire prosthesis system, TMJ, natural occlusion. [30]

2. CONCLUSION

The protective mechanisms of natural dentition—ranging from anatomical features like enamel and tooth morphology to dynamic systems involving neuromuscular reflexes, saliva, and periodontal receptors—are intricately designed to preserve oral function, prevent injury, and maintain homeostasis. These mechanisms operate in harmony under the regulation of the trigeminal and autonomic nervous systems, ensuring adaptability to functional and environmental challenges.

In the absence of natural teeth, artificial dentition must be thoughtfully engineered to replicate these defenses. While complete restoration of biological sensory and reflex systems remains beyond current prosthetic capabilities, advancements in prosthodontic materials, occlusal design, implantology, and digital technologies allow for the re-establishment of many essential protective functions. Through patient-specific planning and maintenance, artificial dentition can effectively safeguard oral structures, enhance comfort, and support long-term prosthetic success. Ultimately, a deep understanding of both natural and prosthetic protective mechanisms is essential for clinicians aiming to deliver functionally stable, biologically harmonious, and patient-centered restorative outcomes.

3. REFERENCES

[1] Kraus BS, Jordan RE. The Human Dentition Before Birth. Lea & Febiger, 1965.
[2] Ten Cate AR. Oral Histology: Development, Structure, and Function, 8th ed. Elsevier, 2013.
[3] Nanci A. Ten Cate's Oral Histology, 9th ed. Elsevier, 2017.
[4] Okeson JP. Management of Temporomandibular Disorders and Occlusion, 8th ed. Elsevier, 2020.
[5] Humphrey SP, Williamson RT. “A review of saliva: Normal composition, flow, and function.” J Prosthet Dent. 2001;85(2):162–169.https://doi.org/10.1067/mpr.2001.113778.
[6] Newman MG, Takei H, Klokkevold PR, Carranza FA. Carranza's Clinical Periodontology, 13th ed. Elsevier, 2018.
[7] Proffit WR, Fields HW, Larson B, Sarver DM. Contemporary Orthodontics, 6th ed. Elsevier, 2018.
[8] Moorrees CFA, Fanning EA, Hunt EE. “Age Variation of Formation Stages for Ten Permanent Teeth.” J Dent Res. 1963;42(6):1490–1502.
[9] Trulsson M, Johansson RS. “Encoding of tooth loads by human periodontal afferents and their role in jaw motor control.” Prog Neurobiol. 2002;67(3):245–262. https://doi.org/10.1016/S0301-0082(02)00019-1.
[10] Byers MR. “Dental injury models: Experimental tools for understanding neuroinflammation and neuropathic pain in dentistry.” Crit Rev Oral Biol Med. 2001;12(4):315–329.
[11] Sessle BJ. “Mechanisms of oral somatosensory and motor functions and their clinical correlates.” J Oral Rehabil. 2006;33(4):243–261.
[12] Kraus BS, Jordan RE. The Human Dentition Before Birth. Lea & Febiger, 1965.
[13] Shellis RP, Featherstone JD, Lussi A. “Understanding the chemistry of dental erosion.” Monogr Oral Sci. 2006;20:13–23.
[14] Tziafas D, Smith AJ, Lesot H. “Designing new treatment strategies in vital pulp therapy.” J Dent. 2000;28(2):77–92.
[15] Trulsson M, Johansson RS. “Encoding of tooth loads by human periodontal afferents and their role in jaw motor control.” Prog Neurobiol. 2002;67(3):245–262.
[16] Humphrey SP, Williamson RT. “A review of saliva: Normal composition, flow, and function.” J Prosthet Dent. 2001;85(2):162–169. https://doi.org/10.1067/mpr.2001.113778.
[17] Okeson JP. Management of Temporomandibular Disorders and Occlusion, 8th ed. Elsevier, 2020.
[18] Newman MG, Takei H, Klokkevold PR, Carranza FA. Carranza’s Clinical Periodontology, 13th ed. Elsevier, 2018.
[19] Sessle BJ. “Mechanisms of oral somatosensory and motor functions and their clinical correlates.” J Oral Rehabil. 2006;33(4):243–261.
[20] Proffit WR, Fields HW, Sarver DM. Contemporary Orthodontics, 6th ed. Elsevier, 2018.
[21] Trulsson M, Johansson RS. “Orofacial mechanoreceptors in humans: encoding characteristics and responses during natural orofacial behaviors.” Behav Brain Res. 2002;135(1-2):27–33.
[22] Miles TS, Flavel SC. “Jaw reflexes evoked by mechanical stimulation of human teeth.” Arch Oral Biol. 1990;35(12):903–907.
[23] Lund JP, Kolta A. “Brainstem circuits that control mastication: Do they have anything to say during speech?” J Commun Disord. 2006;39(5):381–390.
[24] Kandel ER, Schwartz JH, Jessell TM. Principles of Neural Science, 5th ed., McGraw-Hill, 2013.
[25] Lund JP, Kolta A. “Brainstem circuits that control mastication: Do they have anything to say during speech?” J Commun Disord. 2006;39(5):381–390.
[26] Garcia-Godoy F, Hicks MJ. “Maintaining the integrity of the enamel surface: The role of saliva.” J Am Dent Assoc. 2008;139 Suppl:25S–34S.

[27] Sessle BJ. "Mechanisms of oral somatosensory and motor functions and their clinical correlates." J Oral Rehabil. 2006;33(4):243–261.

[28] Lavigne GJ, Rompré PH, Montplaisir JY. "Sleep bruxism: a comprehensive overview for the dental clinician interested in sleep medicine." Dent Clin North Am. 2003;47(3):513–543.

[29] Featherstone JDB. "The science and practice of caries prevention." J Am Dent Assoc. 2000;131(7):887–899.

[30] Humphrey SP, Williamson RT. "A review of saliva: Normal composition, flow, and function." J Prosthet Dent. 2001;85(2):162–169.

[31] Lavigne GJ et al. "Sleep bruxism: A comprehensive overview." Dent Clin North Am. 2003.

[32] Trulsson M, Johansson RS. "Sensory-motor function of periodontal mechanoreceptors in humans." Physiol Behav. 2002.

[33] Manfredini D et al. "Psychosocial factors in bruxism: A literature review." J Orofac Pain. 2010;24(3):252–262.

[34] Zarb GA, Bolender CL. Prosthodontic Treatment for Edentulous Patients, 12th ed. 2004.

[35] Kim Y et al. "Biomechanical comparison of implant-supported overdentures." J Adv Prosthodont. 2010;2(2):36–41.

[36] Trulsson M. "Sensory-motor function of single-tooth implants." Clin Oral Implants Res. 2006.