

LITERATURE REVIEW

Neuromuscular Disorders and Prosthodontic Strategies in Complete Denture Patients

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ABSTRACT

Neuromuscular disorders leads to loss of muscle function because they affect the musculature and/or the nervous system. Etiology could be due to autoimmune disorders, genetic/hereditary disorders. The process of mastication is controlled and coordinated by a well-defined neurological system which primarily consists of skeletal muscles, motor and sensory nerve fibers. This neuromuscular control involves in every phase of complete denture prosthesis construction.

Skeletal muscles directly play a vital role in complete denture prosthesis function. A good muscular control and coordination is necessary for denture stability by means of active and passive muscle fixation. Muscles of mastication and muscles of facial expression are widely involved in denture stability. Hence neuromuscular control plays a vital role in denture construction as well as function.

Key words: Neuromuscular disorders, complete denture, Myasthenia gravis, Cerebral ataxia, Facial paralysis, Parkinson's disease.

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INTRODUCTION

Neuromuscular disorder:

Neuromuscular disorders lead to loss of muscle function which is due to, diseases that affects the musculature and/or the nervous system. It leads to progressive muscle weakness, as it affects the peripheral nervous system. It can be caused by autoimmune disorders, genetic/hereditary disorders.¹

Role of neuromuscular system in complete denture:

A well-defined neurological system controls and coordinates the process of mastication which primarily consists of skeletal muscles, motor and sensory nerve fibers. This neuromuscular control involves in every phase of complete denture prosthesis. Any defect in neuromuscular system leads to lack of coordination in muscle and nervous control which will eventually affect the tonicity of muscles.¹

Neuromuscular system:

The system that controls direct and indirect movements of the body by combining the actions of muscles and nervous system and it is composed of skeletal muscle fibers, motor and sensory neurons¹.

1.Skeletal muscle fibers:^{1,2}

Role of skeletal muscle is directly involved in complete denture prosthesis function. A good muscular control and its coordination are necessary for denture stability. It aids in denture stability by active and passive muscle fixation. Muscles of

mastication and muscles of facial expression are widely involved in denture stability.

Brill et al in 1965 stated that the surface and the borders of the denture that rely on different group of muscles determine the stability of lower denture. The musculature that involves in the stability of the denture space is divided into two groups namely dislocating muscles and fixing muscles².

Dislocating muscles: these are group of muscles which will tend to displace the denture from its position during orofacial movements. These muscles include masseter, mentalis, internal pterygoid, styloglossus, palatoglossus, mylohyoid and incisivus labii inferioris.

Fixing muscles: these are group of muscles that held the denture in desired position by contacting the tissue surface of the denture, these group of muscles include buccinators, orbicularis oris, genioglossus, lingual longitudinal, lingual transverse and lingual vertical.

2.Sensory and motor part of nervous system:²

The peripheral nerves transport the sensory information from the receptor to the CNS which comprises the sensory part of the nervous system. Areas of cerebral cortex, thalamus, cerebellum, the pons and medulla and spinal cord at all levels are conducted with peripheral nervous system.

The motor part of the sensory system controls the actions of the skeletal muscle and smooth muscle, by appropriate contraction, relaxation and secretion of the activated chemicals from exocrine and the endocrine system. The motor impulses which are

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transmitted according to the sensory impulses i.e. voluntarily or involuntarily are transmitted through neuromuscular junctions i.e. the synaptic junctions through which the appropriate impulses are transmitted on the desired location where the desired activity is to be achieved.

The coordinated function of the skeletal muscle fibers, motor and sensory nervous system leads to a well-functioning neuromuscular system e.g. the process of mastication which is a voluntary muscular activity which is transmitted to the CNS by the sensory nerve fibers, processed and leads back through motor nerve fibers that leads to coordinated muscular activity.

Any source of trouble in the components of neuromuscular system leads to uncoordinated muscular movements which lead to poor retention in complete denture. Depending on which part of neuromuscular system affected the characteristic of disorder varies. As in complete denture processing, neuromuscular coordination is required in every procedure, certain modification is necessary to compensate it.

Factors affecting complete dentures due to neuromuscular incoordination³

The factors that are affected by neuromuscular coordination in complete denture prosthesis include occlusion, esthetics, retention & resistance.

Occlusion:²

Occlusion is a one of the important factors to access the quality of the denture. Establishment of occlusion is dependent on neuromuscular coordination and the denture, which help in establishing masticatory neuromuscular balance and function. Neuromuscular or myocentric occlusion, which is the relationship between maxilla and mandible recorded in rest position, it is influenced by the muscles of mastication in unstrained position which brings the mandible in a position which coincides with centric occlusion. Occlusion in neutral zone is much preferred as in this position it neutralizes the forces of tongue, cheek and lip towards the denture and prevents dislocation.

Esthetics:²

The memory patterns of facial expression are regained through stimulation of neuromuscular system in patients with neuromuscular disorder. If they are dentulous the natural teeth are used as reference and the position of muscle is enhanced so that patient's original appearance is maintained. In case if neuromuscular patients are edentulous the denture esthetics is achieved by repositioning of the orbicularis oris muscle.

Retention and Resistance:²

The temporomandibular joint posteriorly, the maxillary and mandibular teeth anteriorly with overall neuromuscular system will lead to complex maxillary and mandibular movement in a three-dimensional manner. These movements are

coordinated by the maxillary and mandibular musculature which aids in fixation and stabilization of one position to another. Hence proper coordination of muscles is required for retention and resistance of the denture.

Guidelines for patients with neuromuscular control undergoing prosthetic treatment⁴

Medical consultation:

- a) Consultation of physician regarding the patient's status, severity and level of control.
- b) History of medication and dosages.

Stress reduction:

- a) Reduce stress and anxiety.
- b) Morning, short appointments.
- c) Prescription of medications with minor CNS depressants.

Airway maintenance:

- a) Ventilation.
- b) Precautions with rubber dam.

Infection control:

- a) Antibacterial liquid mouth wash.
- b) Contact with aerosol must be minimum.

TREATMENT STRATEGIES OF PATIENTS WITH NEUROMUSCULAR DISORDERS

Impairment of stomatognathic functions combined with compromise in systemic health status of the patient further worsens the condition. Various modifications are required while fabrication of dentures in patients with neuromuscular disorders. Some common neuromuscular disorders encountered in Prosthodontic clinics include:

- 1) Myasthenia gravis.
- 2) Cerebral ataxia.
- 3) Facial paralysis.
- 4) Parkinson's disease.

1.MYASTHENIA GRAVIS⁵:

It causes muscle weakness and fatigue of skeletal muscles. The incidence rate of myasthenia gravis varies from 1.7 to 21.3 with a global rate of 5.3 million person per year. Prevalance of myasthenia gravis is between 2.19 to 36.71 cases per 100,000 population. Myasthenia gravis affects wide range of age groups but it is considered "a disease of young women and old men" with 20 to 39 years of age group in women and 50 to 70 years in men.⁶

It is caused by autoantibodies that interrupts the post-synaptic membrane which impairs neuromuscular transmission and leads to muscle weakness. In majority of patients autoantibodies against acetylcholine receptors (AChRs) degrade the receptor site in post-synaptic membrane leading to impaired neuromuscular transmission. In few cases autoantibodies against muscle specific tyrosine kinase (MuSK) interact with AChRs and affect neuromuscular transmission.^{7,8}

- The clinical manifestations in myasthenia gravis of prosthodontic interest include;

- a) Facial and masticatory muscle weakness,
- b) Impaired muscle tonicity in patients which often leads to difficulty in achieving peripheral seal leading to decreased retention.
- c) Dysphagia
- d) Dysarthria
- e) Appearance of expressionless face
- f) Impaired lip movements.

- Treatment strategies in complete denture:
 - a. Neutral zone is the area where denture remains stable with lower rate of conflict as this zone provides increased stability and provides maximum retention. If dentures are fabricated with thick flanges it may integrate the symptoms of myasthenia gravis by encroaching the muscles and the frenal attachments. It also tends to provide coordination of muscles while chewing⁴.
 - b. Use of lingualized occlusal scheme.
 - c. Implant supported complete denture increases the retention and resistance of the prosthesis.

2. CEREBRAL ATAXIA:¹

'Ataxia' means poor coordination. Prevalence of dominant hereditary cerebral ataxia is 2.7/100,000 population whereas prevalence of recessive hereditary cerebral ataxia is found to be 3.3/100,000 population.⁹ Cerebral ataxia arises due to defect in input and/or output pathways of cerebellum. Agonist-antagonist-agonist is generally observed in normal limb movement, but this is affected in ataxic patients by extended initial agonist action followed by subsequent delays and sudden antagonist burst in muscle movement. Antagonist muscle movement occurs in opposite direction to agonist muscle movement which leads to dysmetria. Tremor in ataxic patients does not occur at rest, but while performing actions (intentional tremor).¹⁰

- The clinical manifestation of cerebral ataxia includes:
 - a) Poor coordination – while walking, uncoordinated eye movements and trouble while eating and swallowing
 - b) Intentional tremor
 - c) Cerebral ataxic gait
 - d) Nystagmus – involuntary movements of eye.
 - e) Dysmetria – inability to control the movements in means of speed and complexity.
 - f) Dyssynergia – small, jerky, clumsy movements.
 - g) Dysarthria – speech tends to become slow and irregular as muscles become weak.
- Treatment strategies in complete denture:¹¹
 - a. Non anatomic teeth as the choice of occlusion.
 - b. High strength heat cure resin is used as the denture base material reinforced with metal mesh. As the patient tend to have poor incoordination.
 - c. Dawson's bimanual manipulation technique¹ aids while recording the centric jaw

relation. Dawson describes centric jaw relation as "the relationship of mandible to maxilla when properly aligned condyle-disc assemblies are at their most superior position against the eminence, irrespective of tooth position or vertical dimension". Patient is placed in supine position while recording, as at this position patient tend to more be relaxed and protrusion of mandible is reduced which makes it easy for operator to position and manipulate the mandible. Patients head is positioned between the rib cage and the forearm; it is stabilized to guide the mandible. Thumbs are positioned in the symphysis region and mandible which are encircled by fingers to form a "C", and manipulated in centric position to mark the midline. On repeated the procedure, centric closure was crosschecked and centric relation is recorded with elastomeric bite registration system in nick and notch technique.

- d. Neutral zone as the area of minimum conflict.

- e. Providing proper guidelines for the patient regarding the usage of the denture

3. FACIAL PARALYSIS:¹ It is inability to move the muscles of one or both sides. It involves the muscles and structures where facial nerve innervates. The incidence rate of facial palsy as around 10 to 40 per 100,000 population and age groups 15-45 are usually affected. The onset of palsy is always sudden and progress over 7-10 days. In 70% of cases it recovers spontaneously while in rest recurrence occurs every once in a while. The pathology of facial paralysis depends on what way the nerve is disturbed or damaged; it can be due to various causes. Few causes are trauma, hypertension, malaise, vertigo, Herpes simplex (HSV 1) infection, Ramsay-Hunt syndrome etc.¹²

- The clinical manifestations include:
 - a) Loss of blinking
 - b) Slurred speech
 - c) Drooling
 - d) Impaired mandibular movement
 - e) Pain around jaw and ear

- Treatment strategies in complete denture
 - Implant supported prosthesis

- a. Detachable and un detachable cheek plumpers are used to enhance the support the muscles of orofacial regions like buccinators, orbicularis oris and levator anguli oris which tends to get weakened in facial paralysis, to improve the esthetics. A conventional cheek plumper make their insertion challenging and it is contraindicated in patients with restricted mouth opening as its bulkiness leads to difficulty in inserting and removing the denture and it also compromises the retention of the maxillary denture. Hence detachable cheek plumpers are suggested which are incorporated with magnets or buttons.¹³

- b. Neutral zone helps to balance the forces between tongue and buccal musculature.

4. PARKINSON'S DISEASE²: It was estimated that the prevalence of parkinson's disease to be around 9.4 million. It could be due to degeneration of dopamine neurons especially in the substantia nigra of the mid brain leading to loss of motor functions. Lewy body which are uncommon aggregation that develops inside the nerve cells are found in patients with Parkinson's disease.¹⁴

- The clinical manifestations include:

- a) Poor neuromuscular coordination
- b) Poor muscle rigidity
- c) Postural instability
- d) Gait disturbances

- Treatment strategies in complete dentures:¹¹

- a. Lingualized occlusal scheme
- b. Implant supported denture
- c. Magnet supported denture
- d. Neutral zone technique.

CONCLUSION

Providing proper health care to geriatric people is still a critical part in health care system. Neuromuscular disorders are common among the geriatric group. As prosthodontists already plays an important role in improving the quality of lifestyle in geriatrics, it is important to recognize the presence of any condition and its characteristics to formulate the treatment plan which should overcome the hindrances of clinical manifestations to restore a normal, healthy and the quality life for the people.

CONFLICT OF INTEREST

There is no conflict of interest

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