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Review Article

MUSCLES IN PROSTHODONTICS – A REVIEW

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ABSTRACT:
Muscles are an organ system, made of up fibres, that work together in coordinated systems to create movement. As a soft tissue system, there are three different types of muscles; skeletal, cardiac, and smooth muscles. The function of masticatory system is complex. The musculature is involved directly in several important phases of prosthodontic treatment. Most obvious is of course, the action of muscles as prime movers of the mandible and hence as the power of repeated occlusion of the teeth. In addition, they are also active during mastication, deglutition, and speech. They exert a direct and indirect influence upon the peripheral extension, shape and thickness of denture bases, the positions of teeth both horizontally and vertically, and facial appearance. Muscles are the primary focus in vertical dimension, the neutral zone, arch form, occlusal disease and even smile design. Hence, the article focuses on explaining the various aspects in which muscles play a role in prosthodontics.
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INTRODUCTION

Muscles are an organ system, made of up fibres, that work together in coordinated systems to create movement. As a soft tissue system, there are three different types of muscles; skeletal, cardiac, and smooth muscles.
The function of masticatory system is complex. The musculature is involved directly in several important phases of prosthodontic treatment. Most obvious is of course, the action of muscles as prime movers of the mandible and hence as the power of repeated occlusion of the teeth. In addition, they are also active during mastication, deglutition, and speech. They exert a direct and indirect influence upon the peripheral extension, shape and thickness of denture bases, the positions of teeth both horizontally and vertically, and facial appearance.[1]
Muscles are the primary focus in vertical dimension, the neutral zone, arch form, occlusal disease and even smile design.[2] Hence, the article focuses on explaining the various aspects in which muscles play a role in prosthodontics.

Orofacial muscles:

Macrostructure

Muscle fibers - The muscle fibers are cylindric or spindle-shaped cells with considerable variation in size (10-100 micrometer) and length (1-200 mm). The muscle fibers are classified into two main groups:

- Type I with light-stained typically correlated with long contraction times (slow twitch) and resistance to fatigue
- Type II with dark-stained correlated with rapid contraction times (fast twitch) and fatigability[3]

In prosthodontics, the muscles that play an important role are :

- Muscles of mastication
- Muscle of facial expression

- Muscles of soft palate
- Muscle of Tongue
- Pharyngeal muscles
- Suprahyoid muscles
- Infrahyoid muscles.

Role of muscles in Complete Denture

Impression taking and Border moulding:

Impressions are the basis to practice in prosthodontics. Impressions are a negative replica of the oral cavity, helping in diagnosis and treatment planning in patients.

Faber in 1984 described various ways in which muscles and their functional activity affects the impression procedure:

(A) **Muscle power**- selective pressure impression technique allowing coverage of buccal shelf and pear shaped pads should be used in patients with above average muscular forces.

(B) **Anatomic attachment height**- in patients with preprosthetic surgery contraindicated, unfavourable attachment height provides less basal seat area for physical factors of retention, consequently poor prognosis.

(C) **Valve seal borders**-proper border extensions are inescapable for impression making especially in mandible. Labial and buccal musculature are primarily dislodging muscles. While lingual musculature is capable of both dislodging and proving good border seal, if functionally accommodated. Mylohyoid muscles tenses during deglutition. Therefore, impression techniques that do not border mould the lingual flange by swallowing can produce lower dentures with vague, arbitrary lingual flange.[4]

Border moulding is done record the peripheral margins of the denture and to ensure their extension to the sulcus reflection and in the post dam area in the maxilla. With the use of green stick compound for border moulding it is possible to record the border details.

Figure: Border moulding

They exert a direct and indirect influence upon the peripheral extensions, shape, and thickness of denture bases, the positions of teeth both horizontally and vertically, and facial appearance.[5]

Maxilla

Anatomic region	Tissues that mold	How to Activate	\\'hat Activation accomplishes
Labial flange	• Orbicularis oris Quadratus labii inferioris • Risorius	Mold this area externally using fingers, while simultaneously applying pressure to control the width of the border. Instruct the patient to lick his upper lip [6]	• Moves the orbicularis oris in a common activity. • Manipulates the lips with their associated musculature.[6]
Buccal frena	• Caninus muscle Orbicularis oris muscle	Pull the buccal frena[6]	Activates the connective tissue fibres of the frena while simultaneously causing movement of the associated muscles.[6]
Zygomatic area or buccal flange	• Buccinator muscle	Manually mold the cheek in a side-to-side direction. Also instruct the patient to move his jaw from side to side to have the coronoid process coronoid the compound.[6]	The lip movement causes the buccinator muscle to contract. Improves esthetic form of lips and cheeks.[6]
Retrozygomatic region	• Buccinator muscle fibres	Manually push compound in retro zygomatic region, manipulate cheek in anterior, posterior, and downward direction.[6]	• Activates the buccinator. • Causes the masseter muscles to contract against the modelling plastic.[6]

Coronoid Process area	• Temporalis muscle fibres	Instruct the patient to open wide then close and move his mandible to the opposite side.[6]	• Activates the coronoid process and the attached fibres of the temporal muscle against the modelling plastic.[6]
Posterior Palatal seal area	• Pterygomaxillary raphe Pterygoid hamulus and hamular notch • Palatopharyngeus muscle • Palatoglossus muscle • Tensor veli palatini muscle • Levator veli palatini muscle	Instruct the patient to open wide. Hold the patient's nostrils closed with your fingers; instruct the patient to blow through his nose.[6]	• Causes the pterygomaxillary raphe to become more taut. • Causes the soft palate to depress against the modelling plastic.[6]
Massetric notch (Arthur)	• Masster • Buccinator	The patient is asked to close onto the clinician's fingers while the clinician resists the closure movement and gently presses downward on the tray.6	• Forces the masseter muscle into action; the masseter, in turn, forces the buccinator in the direction of the distal buccal corner of the retromolar pad, creating the masseter groove.6

Mandible

Anatomic region	Tissues that mold	How to Activate	\\'hat Activation accomplishes
Labial flange	• Mentalis muscle • ncisive labii - inferioris • Orbicularis oris with associated muscles of facial expression • Lablal frenum	Hand massage and manipulale the lip in a side-to-side. Instruct the patient to evert the lower lip. Instruct the patient to lick the upper and lower lips with tongue.[6]	Activates the orbicularis oris, mentalis muscle.[6]
Retromolar area and retromylohyoid curtain	• Inferior constrictor muscle • Glossopalatine muscle	Instruct the patient to push his tongue against the handle and then bite down on fingers. Instruct the patient to move his tongue into his right and left cheeks.[6]	Superior constrictor muscle and the glossopalatine muscle contract and act against the denture border. the internal pterygoid muscle contracts and acts against the denture border.[6]
Mylohyoid area	Mylohyoid muscle Tongue	Have the patient perform repetitive swallowing. Instruct the patient to move his tongue into the upper and lower vestibules on each side of his mouth.[6]	Causes a forcible contraction of mylohyoid muscle.[6]
Sublingual fold space	• Genioglossus muscle • Tongue • Mylohyoid muscle	Instruct the patient to gently wet his upper and lower lips with tongue.[6]	Activation of mylohyoid and genioglossus muscle.[6]

Role of muscles in Jaw relation

The adaptability of the masticatory system to vertical changes of occlusion has been shown in previous studies, but such changes have been thought to be hazardous for the health of muscles and joints.[7]

Boos in 1952 stated that rest position is the neutral centre of the masticatory musculature and closing from that position includes a coordination of muscle function.[8]

Lytle in 1964 described a method of recording tentative vertical relation of occlusion by neuromuscular perception of an edentulous patient using central bearing device under proper guidance, further evaluated by aesthetics, phonetics, and functional requirements. The stretch reflex action and proprioceptive mechanism of muscles, ligaments of temporomandibular joint plays important role in patient's perception of mandibular position.[9]

Role of muscles in Centric relation

Various methods of recording centric relation are influenced by the jaw-closing muscles.

Relaxation: To record centric relation asking the patient to protrude and retrude the mandible continuously for as long as possible and to finish in a retrusive position with the blocks in contact with the objective to tire the lateral pterygoid muscles, so that they will relax when the movement ceases, allowing condylar heads to be retruded.[10]

Temporalis muscle check: The fingers are placed on the temples and the patient closes the rims firmly the contraction of anterior fibres of the temporalis may be used as an assessment of mandibular retrusion.[10]

A repeatable and recordable relation, if centric relation is considered a bone-to bone relationship, one muscle with a critical role in to derive centric relation is lateral pterygoid.

Mao et al. found a significant proportion of fibres of lateral pterygoid anaerobic, therefore fast acting and fatigue-susceptible, seeming to correlate with clinical finding of muscle discomfort from bruxing or clenching when only muscle occlusal interferences were present. Precise occlusal correction can eliminate premature contacts. The complete release of the inferior lateral pterygoid takes place to seat in centric relation.[2]

The inferior lateral pterygoid muscle has the sole responsibility of forward positioning of the mandible to align with maximal interocclusal contact whenever centric relation is not coincident with maximal intercuspation.[2]

Role of muscles in Facial esthetics

The prosthodontic significance of a smile is the recognition that if one part of the intricate complex which produces smiling is out of position, this affects all of the other components which make up the smile. With the elevation of the maxillary lips and the retraction of the corners of the mouth, the lips are drawn against the teeth, and the placing of these teeth becomes extremely important in forming the backdrop for the smile. If the teeth are placed too far labially, the orbicularis oris is stretched and the modioli are positioned too far anteriorly so that they are prevented from moving in the positions they were accustomed to when natural teeth were present. This stretching effect of the lips against the teeth also tends to exert a dislodging force on the maxillary denture. On the other hand, if there is lack of maxillary lip support and teeth are set on the crest of the ridge, there is a downward cast to the smile which is similar to expressions of grief.[11]

Repeated contraction of the muscles which are inserted into the skin, wrinkles develop into grooves or dimples. These grooves become deeper with advancing age because of loss of elasticity of the skin. Hereditary tendencies, environmental influences, occupation, temperament, and speech habits of the individual can also affect the depth of grooves such as the nasolabial and mentolabials.[11]

Modiolus

On each side of the face, several muscles converge towards a focus just lateral to the buccal angle, where they interlace to form a dense, compact, mobile, fibromuscular mass called the modiolus.[12]

It is the hub of 8 muscles namely Orbicularis oris, Zygomaticus major, Zygomaticus minor, Levator labii superioris, Levator aguli oris. Buccinator, Triangularis and Risorius.[7]

Contraction of the modiolus presses the conrner of the mouth against the premolar so the occlusal table is closed infront. Food is crushed and doesn't escape at the corner of the mouth. Points are marked on occlusion rims as anterior landmark for height of occlusal plane.[13]

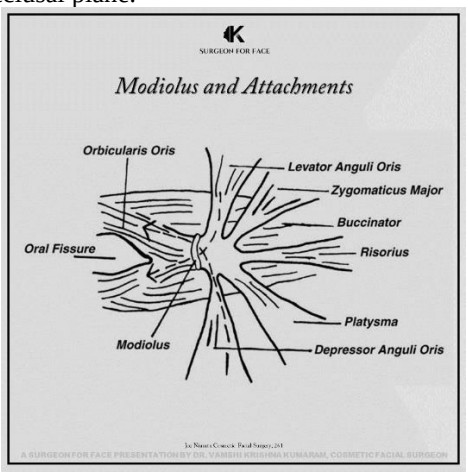

Figure: Modiolus and its attachments

Neutral zone and Teeth arrangement

The neutral zone is that area in the potential denture space where the forces of the tongue pressing outward are neutralized by forces of the cheeks and lips pressing inward.[14] Natural or artificial teeth are subject to equal and opposite forces in this zone from the surrounding musculature.[15]

Historically, different terminology has been loosely associated with this concept, including dead zone, stable zone, zone of minimal conflict, zone of equilibrium, zone of least interference, biometric denture space, denture space and potential denture space.[16]

Fish in **1933** drew the attention towards the cameo or polished surfaces of dentures and highlighted the importance of the muscular function of the tongue, cheeks, and lips as being critical factors for denture stability.[14]

The two buccinators and the orbicularis form a functional unit that depends on the position of dental arches and the labial contours of the mucosa or the denture base for effective action which get impaired with the loss of teeth.[4]

When all natural teeth have been lost, there exists within the oral cavity a void which is the potential denture space. A neutral zone is that area in the potential denture space.[17]

These neuromuscular forces vary in magnitude and direction in different areas of the oral cavity, in different individuals, and at different periods of life. The neutrocentric concept requires that posterior mandibular denture teeth be arranged to occupy as central a location as possible, relative to the denture foundation, without disturbing adequate tongue function. The trajectory of force applications to prosthetic surfaces will either serve to stabilize or dislodge the complete dentures.[16]

Thus, artificial teeth should be arranged in the neutral zone for denture stability.[17]

Positioning artificial teeth in the neutral zone achieves 2 objectives:

- Teeth will not interfere with the normal muscle function
- The forces exerted by the musculature against the denture are more favourable for stability and retention.[17]

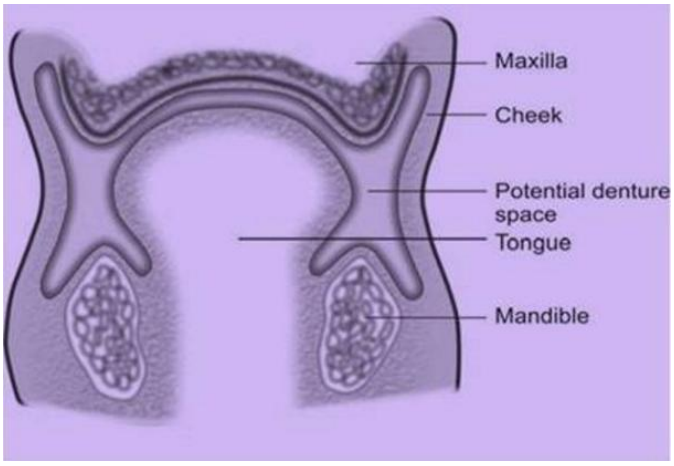

Figure: Neutral zone

Numerous authors have described prosthodontic management with the neutral zone technique for patients undergoing mandibular surgical reconstruction, segmental mandibulectomy, brain surgery, marginal mandibulectomy, maxillectomy and partial glossectomy and for those with severe neurological disorders, Parkinson's disease, and severely resorbed residual ridge and mandibular continuity defects.[4]

Tongue

The tongue is a highly mobile muscular organ that merits careful attention during the construction of complete dentures. In coordination with the lips, cheek, palate, and pharynx, the tongue functions in speech, mastication, and swallowing[11] and which is anchored to hyoid bone, mandible, soft palate, pharyngeal wall and styloid process in the oral cavity.[18]

The position, size, and activity of the tongue are important factors in denture success or failure.[19]

Lack of teeth encourages the patient to mash food against the alveolar ridges and the palate with the tongue. As in the other muscles of the body, this increased function leads to greater muscular tonicity. When confined later, the strong tongue can easily move a complete denture.[20]

The horizontal extension of the lingual flange in dentures is defined as the lower surface is affected by any rising movement on the floor of the mouth, such as when opens the mouth, swallowing or rising or protruding the tongue which is functionally affected when the patient thrusts his/her tongue laterally into the cheek and forward hence, it determines the border dimension of the horizontal extension of the lingual flange in a biologically acceptable fashion by increasing the area of the denture, which enhances retention and stability.[21]

Shanahan wrote that the ideal tongue position could be forward and resting on the superior portion of the mandibular anterior residual ridge when the patient casually opens the mouth also indicated that a retruded tongue makes it almost impossible to establish this seal.[19]

The occlusal plane must lie at the lateral border of the tongue, if higher may result in unstable denture due to lateral tilting forces directed against the teeth.[18]

Role of muscles in Occlusal harmony

Ideal mandibular function results from a harmonious inter-relationship of all the muscles that move the jaw. Muscle becomes fatigued if it is not allowed to rest. When teeth are added to the stomatognathic system, they can exert a unique influence on the entire interbalance of the system. If tooth inclines interfere with this uppermost position, the lateral pterygoid muscle is forced into positioning the mandible to accommodate to the teeth.[2]

In the presence of an occlusal interferences, they can never be relieved of this function without allowing the misaligned teeth to be stressed and as the muscles cannot relax the protective bracing contraction exists as long as the occlusal interference is present. Elimination of interfering contacts permits an almost immediate return to normal muscle function. The deviation pattern is forgotten as soon as it is no longer needed.[2]

The relationship between occlusal support regions and masseter muscle activity level was studied by Ogasawara. He reported that as the number of occlusal support regions decreased from four to one, the general amount of muscle activity of four muscles decreased as well.[22]

Role of muscles in Phonetics

The articulations between the vocal folds, the velum and the pharynx, the velum and the tongue, and palate, the lips and teeth, and finally the lips themselves all serve more primitive and vital functions of producing sound. The tongue is the principal articulator for speech, and learning its position for a given sound is the key to speech learning.[5]

Lips, tongue, soft palate, hard palate and teeth, which form the musculoskeletal valves to control the amount of air passage are more vital to us.[23]

The precise area of normal tongue palatal contact for a given sound must be known if it is hoped to establish normal tongue contact on the palate of the denture.[5] Using technique suggested by Pound we can patient's class of occlusion, vertical dimension, centric anatomic harmony are achieved, the exact position for arrangement upper and lower anterior teeth.[24]

Muscles of soft palate

Soft palate plays a vital role not only in normal physiological functions but also during fabrication of prosthesis in various situations like complete dentures, obturators, palatal lift prosthesis, sleep apnoea, and so. Correct and exact identification of type of soft palate is of vital significance in diagnosis treatment planning and prognosis.[25]

Conclusion

As described in the above literature, muscles are core of prosthodontic treatment. From the steps of impression taking, border moulding, recording jaw relations, teeth arrangement to reduction of occlusal interferences, a basic understanding of muscle of the oral cavity and their application in procedures in prosthodontics is a requirement to enhance work skills and to minimize treatment failures.

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