International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor (2018): 7.426

Oral Stereognosis - A Review Article

Dr. A. Meenakshi[1], Dr. Guguloth Amani[2], Dr. Mayavaraj[3]

[1]Professor, Department of Prosthodontics, Tamilnadu Government Dental College and Hospital, Chennai

[2, 3]PG Student, Department of Prosthodontics, Tamilnadu Government Dental College, Chennai

Abstract: ***Stereognosis is known as Haptic perception or tactile gnosis or ability to receive and register form of an object in absence of visual and auditory information by using tactile information, provided clues from texture, size, spatial properties and temperature. The physiologic function of the masticatory system is primarily dependent upon the integration of sensory feedback and motor neuron response. . Oral stereognosis involves functions of parietal cortex. Most of the denture wearer patients should show perception or this may lead to dissatisfaction to the denture. Therefore Dentist's understanding of oral stereognosis is important to understand the expectations of patients during complete denture treatment.***

1. Introduction

"Oral stereognosis is the neurosensorial ability of the oral mucous membrane to recognize and discriminate the forms of objects in the oral cavity"

Ruch and patton[1] stated that simplest motor actions are initiated by sensory organs and most complex motor actions are initiated by sensory organs. The process of oral perception involves sensory innervation of periodontal membrane, epithelial surfaces of oral cavity, muscles of tongue, muscles of mastication, temporomandibular joints. The function of masticatory system is very dependent on input of neural system by propioception and perception. A defect may result in poor function or pathological changes to parts of system.

Perception of oral cavity: The sensory innervation of epithelial surfaces of oral cavity plays a key role in function of oral structures.Ringel[2] stated the hypothesis that oral tactile perception may be related to disturbances in speech or other oral activities. It is possible that defects in sensory feedback may be responsible for some patients' ability to function with prosthodontic replacement. Grossman[3] found that the upper lip was most sensitive after testing the relative sensitivity of upper lip, tongue tip and incisive papilla. .Brill and co-workers[4] believed that loss of natural tooth perception is compensated for by the composite results of sensory signals from the joints and receptors in the denture foundations. Brill, Tryde and schubeler[5] found that there is significant decrease in retention of complete dentures following application of surface anesthesia to the supporting tissues; this is due to loss of sensory input from the receptors in the supporting tissues preventing the stabilization of denture.

Muscle propioception: Muscle spindles act as proprioceptors. Afferent fibers from the muscle spindles of jaw closing muscles have their cells in trigeminal mesencephalic nucleus[6]. Cooper, Daniel and whitteridge[7] detected similar responses and detected that cell bodies of this proprioceptors formed part of mesencephalic nucleus. Gill[8] found that most of the muscle spindles of masticatory muscles are distributed throughout the anterior, middle aspects of both upper and lower heads of human lateral pterygoid muscle. Jensen and Mattews believed that receptors in muscle signal both length and rate of change of length.

There is a controversy about tongue muscles spindles. Some investigators have reported presence of muscles spindles in human and animal tongue[9] while others could not demonstrate it[10].Cooper[11] observed afferent impulses from hypoglossal nerve. Kawamura and Adachi[12] observed increase in activity of hypoglossal nerve after stretching of cat tongue.Kawamura[13] believed that fine movement of tongue may be due to some special sensory feedback. Mattews and Yemm[14] also studied muscle receptors following the tooth tapping; they found primary response of tooth tapping was activation of digastrics muscle followed by stretch response in Masseter muscle

Temporomandibular propioception: Some believed that the mandibular position when the teeth are not occluding is maintained by the receptors in the human temporomandibular joint. Kawamura and associates[15] studied on decerebrated and decerebellated cats about sensory innervation of the temporomandibular joint. They noted points of discharge in bulbar and spinal trigeminal sensory nuclei while moving the mandible. It was observed spots were distributed in rostral parts of nuclei in closing motion while opening motion spots were located in caudal part of nucleus. From these studies they suggested that propioception from the joint also participates in control of muscle activities of the jaw .Ransjo and Thilander[16] studied the perception of mandibular position in TMJ disorder patients and concluded pathological changes impaired joint receptors. They also believed that sensory innervation is not affected by muscle dysfunction Oral stereognosis can be classified as[17] General Stereognosis: recognize the shape of objects Homostereognosis: self body recognizing capacity like teeth, tongue and palate organ stereognosis: recognizes muscular units as target areas Heterostereognosis: recognize foreign body inside oral cavity. Many studies have been done on propioception and perception. The purpose of this article is to review this literature and discuss its significance to prosthodontics.

The oral stereognosis involves functions of the parietal cortex. part of somatosensorial cortex[18] is composed of Broadmann areas (3a, 3b, 1, 2).sensory input of skin is conducted to 3b and input of muscle and articulation are conducted to 3a and processed in area 1, combined with

other information in area2.the S-1 area signals to other locations of parietal lobe, where the somatosensorial impulses are used for learning of new sensations. The sensorial area for tongue, lips, thumbs and index fingers is greater than other sensorial parts for rest of body.

2. Dimensional Proprioception

Dimensional proprioception studies of oral cavity fall under two categories-those that discriminate changes in thickness and those that determine the minimal thickness which can be perceived between the incisal and occlusal surfaces of the teeth.Thiel[19] tested 150 subjects to know the minimal thickness perceived between the incisal and occlusal surface of natural teeth and found that sensory threshold was between 20 and 100µ when using thin platinum foil..Kraft[20] reported that it was impossible to detect if the object between occlusal surfaces is below thickness of 20µ.

Langer and Michman[21] observed that experienced denture wearer patient could discriminate the different grades of hardness better than new wearers by having the patients incise lightly on rubber rods of varying grades of hardness. Manly and associates[22] used graded quantities of calcium carbonate suspended in bland pudding in percentages of 0.1, 1.0, 2.0, 2.9, 4.8, 7.4, 9.1,17,23 and 29 for comparing discrete changes in food texture in patients with natural and artificial teeth. They concluded that most of the denture wearer patient has less sensitivity compared to natural tooth patients as the normal teeth could detect the 2.9 percent of $caco_3$ or less while patient required over 9 % for detection.

Tactile sensitivity of teeth to load: Munch and Schriever[23] reported that a load as little as 1.5 Gm was perceptible in human dentitions.Adler[24]found that thresholds were higher for axial surfaces of mandibular teeth than maxillary teeth and threshold increased from anterior to posterior part of mouth. Lowenstein and Rathkamp[25] determined that minimal load thresholds increased from canine to 1st molar and then decreased to 2nd molar.Wilkie[26] found axial threshold for central incisors-0.44 to 0.52Gm; lateral incisor-0.66 to 0.78 Gm; canines-1.26 to 1.32 Gm. Nishiyama, Funakoshi, Kawamura applied 20Gm loads to 833 natural teeth in 31 patients to assess the judgement of load.The patient judgement was better in localizing the stimulated tooth among anterior than the posterior teeth.

Location of dental receptors: Pfaffman[27] found that there is no change of response after removal of pulpal tissue by studying the potentials from posterior alveolar nerves after applying pressure to the teeth. Hannam stated that he didn't get the similar results with extremely light pressure. Pfaffman and Hannam both felt that majority of receptors giving rise to impulses came from periodontal ligament. Lowenstein and Rathkamp [28] found that the thresholds were 57% higher with nonvital than with vital teeth and also found placement of a cast crown in a non vital teeth did not influence the threshold whereas in vital teeth it is increased by 127%.these findings suggest receptors other than those in periodontal ligament were involved.

Tests to verify oral stereognosis level : This involves manipulation of test pieces inserted into oral cavity and their interactions with lips, tongue and teeth. The aim of current studies is identification of particle size regardless of an object shape since it has direct implication on bolus formation and swallowing. The parameters (3) applied for recognition of forms are 1) no sharp angles for pieces 2) 2 to 3 mm of length is adequate 3) metallic pieces are not tolerable and flexible forms are not correctly identified. 4) Simple forms like square, round or triangle 5) a small number of pieces must be used. Different OS scores are given which lead to several interpretations

OS and Patient Satisfaction: Before initiation of therapy with complete dentures, verify the sensorial perception in order to advise the patient further complications. Oral perception levels are similar in both satisfied and unsatisfied denture wearers

Age: The oral perception levels[29] are higher in young dentate individuals and lower in elderly individuals. There is no difference in dentate and edentulous subjects between 50 to 60 years of age

Dentate Status: oral perception levels were similar in dentate or edentulous patients without relationship between stereognosis and masticatory ability although dentate individuals more often correctly recognised the test forms in shorter time when compared with edentulous patients [30].

Gender: Studies are few and inconclusive[31]

Denture Experience: Denture wearers who had experience of 11.5 years OS levels did not effect the patient adaptive capacity with new dentures whereas in new denture wearers who has been edentulous for 8 years has less capacity[32]

OS and Oral Motor Diseases: edentulous patients with stroke and Parkinsons's disease, the oral perception and oral motor ability can improve if dentures are worn during rehabilitation with no statistically significant differences between two groups

3. Discussion

The phenomenon oral stereognosis have been difficult to understand. Some factors discussed in the literature needs more standardization. From a sensorial point, oral stereognosis constitutes the highest level of learning. The recognition process can be hypothesized in below given sequence: after the completion of oral stereognosis, heterostereognosis suffers a transition period, adapts and identifies the foreign body, weighing particle size. Since aging decreases muscular ability and increases the time needed for the recognition of forms. The tongue and palate constitute more than one third of somatosensorial cortex area, further studies are needed to determine the role of gingival exteroceptors. The very high ratio of sensory innervations of oral cavity is shown by the size of sensory division of trigeminal nerve and its innervations areas which has very large representation in the cerebrum compared to innervations dealing with peripheral areas. Canines are proprioceptive and are last tooth to be lost. To preserve the sensory input, it is important to retain these canines for a conventional prosthesis or for overlay dentures. Any force

on an individual tooth evokes a specific neural response in the trigeminal nucleus. Placement of fixed partial denture or clasp in a partial denture produces new sensory inputs and may present with problems relating to successful integration of masticatory function. change of sensory input is due to forces from fixed partial denture or forces from opposite side of arch in partial denture. The extraction of natural teeth results in complete loss of tooth proprioception, directional sensitivity, dimensional propioception and tactile sensitivity to load. The perceptive sensations sent to higher areas by the areas contact with dentures are not discrete or discriminatory as the receptors in the periodontal ligament. Many areas which are in contact with dentures are not very sensitive. This fact is stated in the literature that posterior parts of mouth and tongue have fewer sensory nerve endings and is less sensitive. The capacity of stereognosis and localization also decreases significantly in the posterior part of the mouth. The literature reveals that patients with complete dentures do not posses as much perception as natural teeth. Kawamura and Watanabe found that denture wearing patients could not discriminate small dimensional differences as compared to persons with natural teeth. Manly and coworkers observed that sensitivity of food texture judgment was considerably low in complete denture wearers than non denture wearers. The literature showed that anterior teeth were more sensitive than posterior teeth. The patient could locate a stimulated anterior teeth with more ease than that of posterior teeth. This fact shows the importance of establishment of incisal guidance as the precursor of oral rehabilitation and importance of anterior teeth as abutments for prosthesis. This literature also showed that receptors around the roots of teeth continued to send impulses even though most of the root was removed and was mechanically stimulated by extremely light pressure. It supports the retention of natural tooth roots can be used for stud attachments or overlay dentures to preserve this sensory input. It also supports conservative treatment to the patients with advanced periodontitis and concomitant loss of bone support. Any non integration or pathosis of masticatory system including the periodontal ligament, the epithelial surfaces of the oral cavity, the muscles, and temporamandibular joint may result in proprioceptive inputs which are out of synchrony. This results in multiplicity of asynchronous sensory inputs which may lead to disharmony in function of masticatory system. Since most of the treatment modalities are conceived in the form of implant-supported or implant retained over dentures. Thus, the role of oral stereognosis cannot be underestimated.

4. Conclusion

This review of literature indicates the following

1) Oral cavity has very high level of sensory innervation
2) The capacity of stereognosis decreases significantly in the posterior part of mouth.
3) Stereognosis ability decreases with age
4) Complete denture wearers do not posses as much perception as patient with natural teeth.
5) Degree of satisfaction is not related to a high or low perception level.
6) Stereognosis can improve with training.
7) The use of complete dentures during oral-motor disorders (bruxism, dystonia, dyskinesia, and drug induced dystonic extra pyramidal reactions) rehabilitation enhances oral sensation.
8) Implant supported prosthesis provides stereognostic levels near to that of natural dentition.
9) A lack of standardization exits in tests for shape of objects and recognition of forms.

This entire field of oral proprioception and the proprioceptive effect of prosthodontic replacement need much additional research and study.

References

[1] Ruth, T. Cl., and Patton, H. D.: Physiology and Biophysics, Philadelphia, 1966, W.B.Saunders Company, p. 302
[2] Ringel, R. L.: Studies of Oral Region Texture Perception, in Bosma, J. F.: Second Symposium on Oral Sensation and Perception, Springfield, 1970, Charles C Thomas, Publisher.
[3] Grossman, R. C.: Sensory Innervation of the Oral Mucosa: A Review, J. S. Calif. State Dent. Assoc. 32:128-133, 1964.
[4] Brill, N., Schiibeler, S., and Tryde, G.: Aspects of Occlusal Sense in Natural and Artificial Teeth, J. PROSTHET. DENT. 12: 123-128, 1962.
[5] Brill, N., Tryde, G., and Schiibeler, S.: The Role of Exteroceptors in Denture Retention. PROSTHET. DENT. 9: 761-768, 1959.
[6] Allen, W. F.: Application of the Marchi Method to the Study of the Radix Mesencephalic Trigeminal in the Guinea-pig, J. Comp. Neurol. 30: 169-216, 1919.
[7] Cooper, S., Daniel, P. M., and Whitteridge, D.: Nerve Impulses in the Brainstem of the Goat, Short Latency Responses Obtained by Stretching the Extrinsic Eye Muscles and the Jaw Muscle, J.Physiol. 128: 471-490, 1953.
[8] Gill, H. I.: Muscle Spindles in the Lateral Pterygoid Muscle, J. Dent. Res.48 (Suppl. j: 1084, 1969.
[9] Langworthy, 0. R.: Study of the Innervation of the Tongue Musculature With Particular Reference to the Proprioceptive Mechanism, J. Comp. Neurol. 36: 273, 1924.
[10] Hewer, E. E.: Development of Nerve Endings in the Human Fetus, J. Anat. Cooper, S.: Afferent Impulses in the Hypoglossal Nerve on Stretching the Cat's Tongue, J. Physiol. 126: 32, 1954.
[11] Kawamura, Y., and Adachi, A.: quoted in Kawamura, Y.: Neuromuscular Mechanisms of Jaw and Tongue Movements, J. Am. Dent. Assoc. 62: 545-551, 1961.
[12] Kawamura, Y.: Neuromuscular Mechanisms of Jaw and Tongue Movements, J. Am. Dent.Assoc. 62: 545-551, 1961.
[13] Matthews, B., and Yemm, R.: A Silent Period in the Masseter Electromyogram Following Tooth Contact in Subjects Wearing Full Dentures, Arch Oral Biol.15: 531-535, 1970.
[14] Kawamura, Y., and Majima, T.: The Role of Sensory Information from the TemporomandibularJoint in Jaw Movement, J. Dent. Res. 43: 813, 1964.
[15] Thiel E. Myofunktionelle Therapie: Katalog der Ubungen Zur Neuromotorischen Funktionsregulation. Vol.3, 199

[16] Kaas JH, Nelson RJ, Sur M, Lin CS, Mezemich MM: Multiple representations of the body within the somatosensorial cortex of primates. Science, 204: 521-523, 1979.
[17] Thiel, E.: Dtsch. Mschr. Zahnheilk. 49: 270-278, 1931, quoted in Shiill, H. S., and Laine, P.: The Tactile Sensibility of the Parodontium to Slight Axial Loadings of Teeth. Arta Odontol. Stand. 21: 415-429, 1963.
[18] Kraft: 1962, quoted in Shiila, H. S., and Laine, P.: The Tactile Sensibility of the Parodontiumto Slight Axial Loadings of the Teeth, Acta Odontol. Stand. 21: 415-429, 1963.
[19] Langer, A., and Michman, J.: Occlusal Perception after Placement of Complete Dentures. PROSTHET. DENT. 19: 246-251, 1968
[20] Kraft: 1962, quoted in Shiila, H. S., and Laine, P.: The Tactile Sensibility of the Parodontium to Slight Axial Loadings of the Teeth, Acta Odontol. Stand. 21: 415-429, 1963
[21] Manly, R. S., Pfaffman, C., Lathrop, D. D., and Keyser, J.: Oral Sensory Thresholds of Persons With Natural and Artificial Dentitions, J. Dent. Res. 31: 305-312, 1952.
[22] Munch, J. V., and Schriever, H.: Die ZHhne ais Sinneswerkzeug, Z. Biol. 91: 75, 1931.
[23] Adler, P.: Sensibility of Teeth to Loads Applied in Different Directions, J. Dent. Res.26: 279-289, 1947
[24] Loewenstein, W. R., and Rathkamp, R.: A Study of the Pressoreceptive Sensibility of the Tooth, J. Dent. Res. 34: 287-294, 1955
[25] Wilkie, J. K.: Preliminary Observations on Pressor Sensory Thresholds of anterior Teeth. Dent. Res. 43: 962, 1964.
[26] Pfaffman, C.: Afferent Impulses from the Teeth Due to Pressure and Noxious Stimulation. Physiol. 97: 207-219, 1939.
[27] Loewenstein, W. R., and Rathkamp, R.: A Study of the Pressoreceptive Sensibility of the Tooth, J. Dent. Res. 34: 287-294, 1955
[28] Berry DC, Mahood M: Oral stereognosis and oral ability in relation to Prosthetic Treatment. Br Dent J, 120: 179-185, 1965
[29] Smith PW, McCord JF: Oral stereognostic ability in edentulous and dentate individuals. Eur J Prosthodont Restor Dent, 10:5356, 2002.
[30] Mantecchini G, Bassi F, and Pera P, Preti G: Oral stereognosis in edentulous subject rehabilitated with complete removable dentures. J Oral Rehabil, 25: 185-189, 1998
[31] Leung KC, Pow EH, McMilliam AS, Wong MC, Li LS, HoSL: Oral perception and oral motor ability in edentulous patients with stroke and Parkinson's disease. J Oral Rehabil, 29:497-503, 2002.
[32] Arpad, T.: The Distribution of the Last l-4 Teeth in the Oral Cavity, Fogorv Sz. 63:180-186, 1970.