

Oral stereognosis pattern in patients with dental prosthesis in the elderly population

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Abstract

Background and Aim: All medical and dental therapies to a large extent depend on patient's compliance for a successful treatment, especially in an organ like oral cavity that contains a complex sensory mechanism. This study is aimed to study the role of aging on sensory perception and the impact of loss of teeth and their prescribed prosthetic replacements on the oral stereognosis.

Methods: The study was conducted on 150 subjects who were divided into five groups with 30 subjects belonging to each group. The groups were categorized into dentulous, completely edentulous, edentulous wearing maxillary denture, edentulous wearing mandibular denture, and edentulous wearing both dentures. Subjects were asked to place test specimens of 12 different shapes and the same had to be identified in the oral cavity. Response time was determined as the time interval between placement and first sign of indication.

Results: After statistical analysis, results demonstrate that aging of an individual affects both oral stereognostic analysis score and response time. Presence of dentures also had a direct influence on the areas tested.

Conclusion: While prescribing complete denture prosthesis or orthodontic fixed appliances, one must take into consideration the state of dentulism and existing dental prosthesis if any, as it can enhance or ameliorate patients oral stereognostic ability.

Key words: Complete denture, oral proprioception, oral stereognosis score

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INTRODUCTION

Special senses play a significant role in survival of living beings. It allows one to perceive dangers besides maintaining other body requirements. Special senses, including those associated with natural teeth and periodontal structures provide sufficient information in the form of tactile sensory input to the central nervous system. In dentate individuals, periodontal mechanoreceptors play a key role in sensory discriminative capabilities and in the control of jaw function. Following tooth extraction, although

periodontal tissues breakdown, some amount of periodontal mechanoreceptors remain within the bone. Further, responses can be recorded following electrical, but not mechanical stimulation of the bone in the trigeminal mesencephalic nucleus.^[1] Moreover, most of the sensory abilities such as vision, hearing, and tactile and chemosensory perception appear to deteriorate almost inevitably with age in humans. In humans, these sensory abilities reach their optimum capacity during twenties, maintained for several years and then it declines with wide individual variation.^[2]

Oral sensory ability or an oral stereognosis is directly associated with masticatory performance,^[3-10] and, therefore, decline of the oral stereognosis is a significant factor linked to masticatory disorder in elderly.^[11-15] Oral stereognosis involves identification of the form of objects without the aid of vision, by hand or oral manipulation.^[16-19] Sensory function of the mouth includes the ability to access shape, size, surface texture, temperature, and taste. However, deterioration of this ability is difficult to

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recognize not only by patients themselves, but also by the dentists and general physicians.^[20-26]

For edentulous patients, dental prosthesis is perceived by the oral sensory apparatus as a foreign body once it is placed on edentulous residual alveolar ridges.^[27,28] Moreover, the prosthesis itself acts as a barrier between tongue and mucosa that further hampers the stereognostic ability.^[29-32] The ability of individual to adapt to complete denture prosthesis depends largely on the sensory functions of the structures that surround and support the prosthesis.^[33,34] The present study, therefore, was undertaken to analyze the effect of edentulism and the impact of wearing dental prosthesis on oral stereognostic ability of an individual. Age-related changes on the oral stereognosis would be evident by comparing dentulous and edentulous individuals, whereas, the impact of dental prosthesis would be quantitatively determined using reaction time to conclude its role.

MATERIALS AND METHODS

Before conducting this study, approval of the ethical committee of the university on human experimentation which falls in accordance with Helsinki declaration was obtained. Informed consent from all the subjects was also obtained after they agreed to participate in the study. The study was conducted on 150 subjects in the post graduate wing of Department of Prosthodontics of Teerthankar university in Northern India. Subjects were divided into two groups namely Group A (Dentulous) and Group B (Edentulous). Group B was further subdivided into subgroups namely Group B1 (Edentulous without wearing complete denture), B2 (Edentulous wearing maxillary denture only), B3 (Edentulous wearing mandibular denture only) and B4 (Edentulous wearing both the dentures). All five groups studied constituted 30 subjects in each group. The age of the subjects in both groups were in the range of 55–65 years with a mean age of 61 years. Selection (inclusion) criteria for Group A subjects included presence of a complete natural dentition without any abnormality in size, shape, relation and number of natural teeth without any evidence of stomatognathic disorder including those of temporomandibular joint. For Group B subjects, besides other standards for a completely edentulous patient who would receive complete denture prosthesis, only those subjects who had completely adapted to their existing dentures were selected. All the patients were instructed that only the tongue and palate should be used for the recognition of shape of test specimens without biting into the specimen.

To determine the oral stereognostic ability of individuals, specimens for testing included specimen shaped in circle, ellipse, square, rectangle, triangle and semicircle

of both large (12 mm × 12 mm × 3 mm) and small dimensions (8 mm × 8 mm × 2 mm). Test specimens were prepared from heat cure denture base acrylic resin (DPI, Mumbai, India) by using compression molding technique^[35] using the method described by Ikebe *et al.*^[36] Test specimens were sterilized by placing in 2% glutaraldehyde (Cidex) for 15 min. While performing the tests, the specimens were kept out of subject's sight and tests were performed in calm and quiet environment that would enhance the subject to focus rather than distract. Pictures of all 12 test pieces were shown to the subject, and the subject was asked to point at the corresponding picture, which he/she thought was correct. Each of the shape in both sizes was tested twice. The 24 presentations were made in random order. The six different shape forms were grouped into three pairs of similar forms:

- Group I: Circles and ellipses (red color)
- Group II: Squares and rectangles, (green color)
- Group III: Triangles and semicircles (blue color).

A three-point scale (0, 1 and 2) was used for scoring of the oral stereognostic analysis (OSA) score.^[37] Response time was set as the "time between the subject initiation of perception on a signal from the observer and the subjects judgment at the completion of perception." After the shape was recognized, the duration time was noted by the stopwatch and the answers were recorded using a three-point scale.

Statistical analysis of data

Statistical analysis of the data was carried out using the SPSS (Statistical Package for System Software, version 12.0). Intergroup (A and B) and intragroup (B1–B4) comparison was done by application of one-way ANOVA and the test results for both intergroup and intragroup comparisons were inferred from Tukey's *Post-hoc* analysis.

RESULTS

The present study was conducted to examine the relative differences in oral sensory function in dentulous and edentulous individuals within the same age range and compare the effect of wearing complete dentures on the oral stereognostic ability of completely edentulous patient. Mean value for OSA score was found to be highest in Group A (42.2) followed by Group B2 (35) and B4 (33.7) with least score in Group B1 (24.95) [Table 1]. The *P* value for Group A (Dentulous) was significant when compared to Group B1 (edentulous), Group B2 (edentulous with maxillary denture) and B4 (edentulous with both dentures). Group B2 (edentulous with maxillary only) was significant when compared with Group B1 (edentulous)

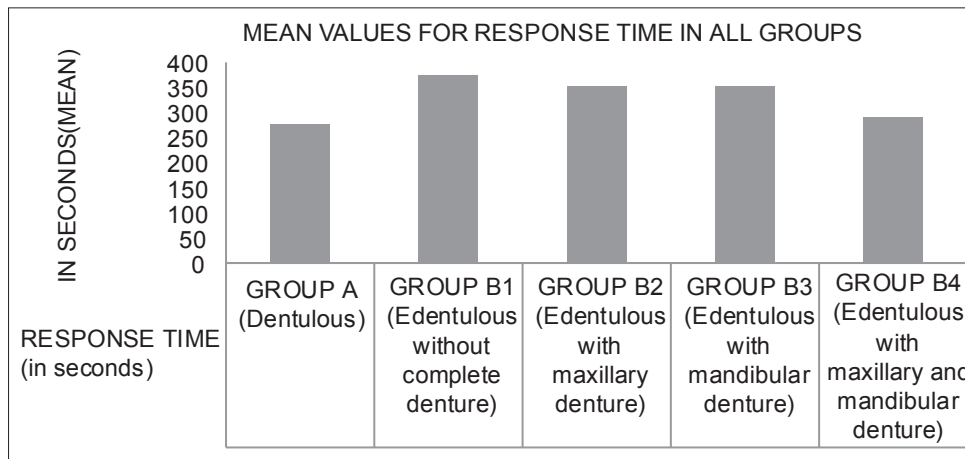
and Group B4 (edentulous with both dentures) was significant when compared with Group B1 (edentulous). The intragroup comparison within Group B was not found to be statistically significant.

Response time was less in Group A (277) than any of the subgroups in Group B as depicted in Graph 1. Significant values for *P* were obtained when comparisons were made of Group A (277.45) with Group B1 (372.4) and of Group B1 (372.4) with B4 (292.8). There was no significance between Group A and B4, B1 and B2 or B1 and B3. Within Group B, none of the groups showed any significance for response time [Table 1].

DISCUSSION

Adaptation to prosthesis in the oral cavity depends on many factors.^[37] One of the significant patient-related factor is the ability of the specialized sensory mucosal detectors to warn the mucosa of harmful stimuli. This inherent ability also allows the same mucosa to identify the defect if any present in the prosthesis. The higher the oral sensory function of a particular patient, the lesser the margin of error making on the part of the dentist. Oral sensory function can be examined by different methods that include two-point discrimination, oral stereognosis, vibro-tactile detection, somesthetic sensitivity, proprioception and

thermal sensitivity.^[2,3] The oral sensory function and proprioception of the oral structures play a major role in adaptation of the patient to a prosthesis, especially complete denture. Both the abilities are affected by the process of ageing.^[38] OSA score for dentulous subjects in this study with a mean of 42.2 was higher than for edentulous subjects with a mean of 24.9 which are in accordance with previous studies.^[2,9,38] However, in another study, OSA score in older dentate participants and complete denture wearers was significantly higher than in younger dentate subjects, although no significant difference was found in the OSA score between older dentate participants and complete denture wearers.^[39] It should be ascertained among dentulous subjects that they should not use their teeth to determine the various shapes as the OSA score and the response time will be less if they do so. Main intra oral site for detection of a food particle or bolus is not between the teeth but on the oral mucous membrane especially between the tongue and the palate. Tongue has detection and a recognition threshold which enables it to perceive test pieces with accuracy.^[21] Results of Group B2 (edentulous with maxillary denture) suggest role of the tongue in stereognosis is far more important than the input of the palatal receptors. The OSA score for Group B2 was higher than any of a subgroup within the edentulous group. Increase in OSA, as opposed to denture, may thus be attributed to the increased ability to manipulate test pieces. Mantecchini *et al.* concluded the



Graph 1: Relationship of response time between different groups

Table 1: Comparison of oral stereognostic ability score and response time between various groups studied along with their relative significance between and within various groups

Parameters	Group A (dentulous) (n=30)	Group B1 (edentulous) (n=30)	Group B2 (edentulous with maxillary denture) (n=30)	Group B3 (edentulous with mandibular denture) (n=30)	Group B4 (edentulous with maxillary and mandibular denture) (n=30)
OSA score	42.2±3.94 ^{###,***,***}	24.95±8.37 ^{***}	35.1±6.91 ^{***,##}	27.95±6.90 ^{***}	33.7±7.58 ^{**,###}
RT	277.45±36.35 ^{##}	372.4±125.01	351.57±108.90	353.25±124.68	292.8±105.27 [*]

Number of patients studied in each group is designated as "n". Data expressed as mean±SD comparison of data between various groups as compared by one-way ANOVA. Signs for significance: *Comparison with group A, #Comparison with group B1, °Comparison with group B2, °Comparison with group B4. Level of significance: **P*<0.05, ***P*<0.01, ****P*<0.001, ###*P*<0.001, °°°*P*<0.001, °°°°*P*<0.001. SD: Standard deviation, OSA: Oral stereognostic analysis, RT: Response time in seconds

same results in their study.^[29] Ikebe *et al.* suggested that the role of the tongue in stereognosis was far more important than the input of the palatal receptors in this regard^[36] and that dentures made to the appropriate occlusal vertical dimension and proper arch forms confine the tongue within a normal space, allowing it to more easily recognize test pieces.^[40]

The present study is also able to determine that of all the different shapes tested it was the shape of an ellipse that was consistently and frequently identified more in Group A and Group 4 within group B. The presence of a hard surface allows the tongue to sense the boundaries of the test pieces more clearly. The older edentulous individuals wearing complete denture demonstrated a higher OSA score in less time when compared with edentulous patient who did not wear dentures. These results are similar to previous studies done by Litvak *et al.*^[12]

Overall OSA score when on the higher side concludes that the particular individual has high oral perception and therefore such individuals with higher levels of oral perception can be intolerant to even minor errors in denture construction and denture occlusion. The edentulous subjects who reported the greatest number of post-insertion problems and who expressed the lowest level of satisfaction demonstrates higher level of oral perception than those subjects who reported few or no problems,^[2] but some studies have found no positive correlation of the relationship between oral stereognosis and satisfaction with complete dentures.^[41,42]

Limitations of the study

We have not followed up the patients with dental prosthesis for at least a period of 1 year, to assess the difference in pre and post dental prosthesis use.

CONCLUSION

Within the scope and limitations of this study, it can be concluded that the level of oral perception, that is, OSA score is higher in dentulous state, which, usually, decreases as the state of edentulism sets in. Also, OSA scores in edentulous subjects are highest when the subjects wear both maxillary and mandibular dentures. It can also be concluded that covering of the palatal mucosa with a denture does not reduce subject's oral stereognostic ability.

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