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Original Article

EVALUATION OF ORAL STEREOGNOSTIC ABILITY IN RELATION TO COMPLETE DENTURE WEARERS

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ABSTRACT

Objectives: *To measure the mean difference of oral stereognostic ability (OSA) in edentulous patients before and one month after the time of denture insertion.*

Materials and Methods: *A total of 175 edentulous patients were included in the study. The OSA was assessed and recorded in two phases for each patient: first, at the time of primary impression and secondly, one month following denture insertion, respectively.*

Results: *Before insertion, the mean OSA score was 8.22±1.45, indicating lower sensory function. One month after denture insertion, the mean OSA score increased markedly to 11.44±0.66, reflecting enhanced oral sensory perception. The statistical analysis yielded a p-value of p<0.001, demonstrating that the observed improvement was statistically significant.*

Conclusion: *In conclusion, there was a significant improvement in oral stereognostic ability in edentulous patients one month after denture insertion, as evidenced by the increased mean score and highly significant statistical results.*

Key words: *Complete dentures; edentulous patients; oral rehabilitation; oral sensory perception; oral stereognosis; stereognostic ability*

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INTRODUCTION

Stereognosis is the ability to identify the form of an object by palpating it manually using only tactile sensation, without using the sense of sight. The ability of the oral mucous membrane to identify and distinguish between the shapes of objects in the oral cavity is known as oral stereognosis[1].

Edentulous patients are devoid of periodontal receptors, hence the perception function in these patients is reduced as compared to dentate patients. Restoring the form of the oral cavity is as important as restoring the masticatory function in a dental prosthesis[2,3].

Numerous methods to measure the Oral Stereognostic Ability (OSA) have been reported. The most widely used method reported in literature is to use test forms of different shapes and various materials to check the OSA by placing these objects in the mouth. Berry and Mahood were the first authors to demonstrate the importance of stereognostic ability[1,5]. Grossman is credited as the originator of this idea and established the use of stereognostic testing to evaluate OSA[4].

OSA and denture performance is reported to have a direct relationship[4]. A higher OSA score

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suggests that the wearer of a complete denture may be able to accurately detect what is happening in their mouth and may also show more complaints during the post-insertion phase. Most significantly, the patient is able to appropriately regulate a foreign body in the oral cavity by knowing where it is positioned. Patients with lower scores have fewer or no complaints during the insertion phase, which suggests that they have a worse perception of what is happening in their mouth[4,5].

Numerous studies have analysed the difference in OSA before and after rehabilitating edentulous patients with complete dentures. Mary et al[1]. evaluated the mean difference in OSA score in three phases; before, immediately after and six months after denture insertion. A 12-point scale was used to record the OSA score using various shapes intraorally. This showed a mean difference of 2.55 before and immediately after denture insertion, and a difference of 4.34 before and six months after denture insertion. Both these results were proved statistically significant after pairwise comparison using post hoc test with Bonferroni correction.

There is a dearth of data concerning this in the local population on this subject. We hypothesised that oral stereognostic ability in edentulous patients would improve significantly following rehabilitation with complete dentures, owing to the restoration of intraoral volume and stimulation of mucosal mechanoreceptors. The aim of this study is to evaluate the difference in OSA before and after rehabilitating edentulous patients with complete dentures and its relation to the patient's adaptability over time. This may provide useful information to the prosthodontist about the sensory adaptive capabilities of patients and aid in interpreting the role of adaption and adjustment in a successful complete denture therapy.

To measure the difference in Oral Stereognostic Ability (OSA) in edentulous patients before and one month after the time of denture insertion.

MATERIALS AND METHODS

This study was conducted at the Islamic International Dental Hospital, Islamabad, from June 2023 to May 2024. The ethical review board of Islamic International Dental Hospital approved this study, Ref. No. IIDC/IRC/2022/007/002, without restrictions and an informed consent was taken from all participants. This was a longitudinal descriptive study based on a non-probability consecutive sampling technique on participants visiting Islamic International Dental Hospital from June 2023 to May 2024. A sample size of 175 was calculated according to a confidence level of 95% ($\alpha = 0.05$) and a statistical power of 80% ($1-\beta = 0.80$), anticipating a population mean of 4.34, population standard deviation 1.0 with an absolute precision of 0.15[1].

Patients were selected based on the following criteria: male and female patients who have been completely edentulous for a minimum period of 3 months, are in the age group of 50-70 years and have no prior denture experience. Patients with any significant oral pathology, medical disorder, temporomandibular disorder and/or excessive parafunctional habits were excluded from the study. Uncooperative patients and/or patients under intoxication were also excluded.

Six metallic test forms in the shape of a square, rectangle, triangle, star, circle, and oval were used to evaluate the OSA of each patient (Figure 1). Wax patterns for these test forms were developed from inlay wax (Bego, Germany). The test forms were cast in the cobalt-chromium alloy (Bego, casting alloy Type 5, Germany) measuring 5mm in thickness and 10-14mm in length. A 1 mm circular punch was fabricated in each shape during wax-up and casting. This was used to tie the test forms with dental floss to prevent accidental aspiration on ingestion during evaluation. Test pieces were autoclaved at 121°C at 15 PSI for 30 minutes before evaluation with each patient. For identification, the shapes of the test forms were printed on an A4 sheet and handed to the patient beforehand to familiarize with the test forms (Figure 2).

The OSA was assessed and recorded by one single examiner in two phases for each patient: first, at the time of primary impression and secondly, one month following denture insertion, respectively. It was made sure that the same examiner carried out all observations of each patient. This was an unblinded (open-label) observational study; the examiner was aware of the patients' baseline scores at the time of follow-up assessment. The use of a single examiner for all evaluations was a deliberate measure to eliminate inter-examiner variability.

After recording the OSA initially, conventional

complete acrylic dentures were fabricated with the same clinician and lab technician for each patient, using identical materials. Primary impressions were taken with alginate (CavexCA37, Cavex) in a stainless-steel metallic tray (Stardent). Secondary impressions were taken with zinc oxide eugenol impression paste (Cavex) in custom trays fabricated from self-cure acrylic resin (HDS), after molding the border of the tray with impression compound (Type 1, Kerr). Maxillomandibular relations were recorded with a bite registration material, zinc oxide eugenol impression paste (Cavex) in a base fabricated with heat-cure acrylic resin (HDS), with occlusion rims fabricated from modelling wax (Metrodent). A trial was done and the denture was processed with a standardized acrylization method. The patient was recalled for a follow-up appointment one month after the date of insertion during which the OSA was measured and recorded again, in the same setting with the same examiner.

The patient sat comfortably in the dental chair in an upright position while the tests were conducted in a quiet and peaceful setting. The patient was briefed about the procedure in detail with a standard set of instructions given to each patient and was given the printed sheet for identification of the test forms (Figure 2). The patient was instructed to close their eyes, after which one of the six metallic test forms were introduced into patient's oral cavity in a random order with a dental floss tied to each test form and placed on the mid dorsum of the tongue (Figure 3). The patient was allowed to freely manipulate the test forms and then was instructed to point at the matching shape on the printed page to identify the shape (Figure 4). The process was repeated for each of the six test forms. The patient was unaware of correct or incorrect identification during testing, whilst encouragement was given to remain calm throughout the procedure. The Oral Stereognostic Score of the patient was recorded, one by one, for each test form based on the following criteria:

0 – Failure to identify test form within 1 minute.

1 – Incorrect identification within the same group of test forms. For example, if a subject answers oval for a circular test form, 1 point will be scored.

2 – Correct identification of the test sample.

Thus, the possible range of score for six test forms ranged from 0 (all incorrect and dissimilar) to 12 (all correct).

Data accumulated was tabulated and analyzed statistically by means of SPSS software (version 23). Descriptive statistics was calculated for qualitative and quantitative variables. Quantitative variables like OSA was calculated in terms of Mean±SD (standard deviation). Mean difference pre and post-treatment was compared by paired sample t-test. Shapiro-Wilk test was applied to check the normality of data. If data was not normal, median or IQR was reported.

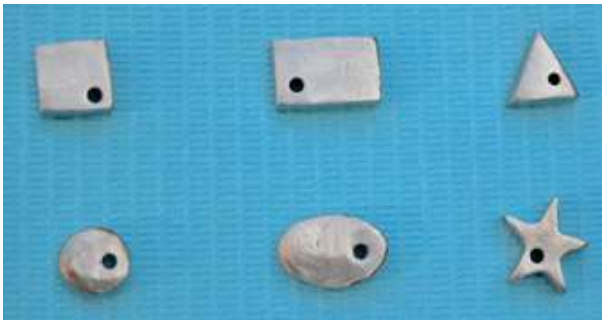

Fig 1: Test Forms

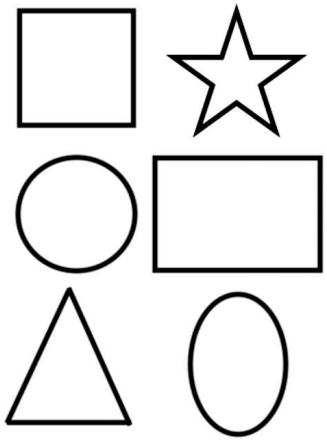

Fig 2: Test Forms Identification Sheet

Fig 3: Test Forms Identification Sheet

A p-value ≤0.05 was taken as significant.

RESULT

The study showed a significant improvement in Oral Stereognostic Ability (OSA) in edentulous patients after denture insertion. Before insertion, the mean OSA score was 8.22±1.45, indicating lower sensory function. One month after denture insertion, the mean OSA score increased markedly to 11.44±0.66, reflecting enhanced oral sensory perception. The statistical analysis yielded a p-value of P<0.001, demonstrating that the observed improvement was statistically significant. These findings highlight the positive impact of denture insertion on oral stereognostic function in edentulous individuals (Table-1).

The Shapiro-Wilk test of normality was performed to assess the distribution of variables in the study. The test revealed that age, pre-treatment Oral Stereognostic Score and post-treatment Oral Stereognostic Score deviated significantly from normality. These results indicate that the data for these variables are not normally distributed (Table-2). Median value of before insertion of denture (pre-treatment) was 8.00 while after 1 month of insertion of denture (post-treatment) median value was 12.0 (Table-3).

DISCUSSION

The population of older individuals in both developed and developing nations is likely to rise rapidly in the next few decades[6]. Today, 600 million people are over 60 years old and this figure is expected to rise to 1.2 billion by 2025[7]. In 2050, there will be 2 billion older adults, of whom approximately 80% will be living in developing countries[8].

Table 1: Comparison of mean Oral Stereognostic Ability (OSA) scores (Mean ± Standard Deviation) in 175 edentulous patients before denture insertion and one month after denture insertion, assessed using a paired sample t-test (significance threshold: p ≤ 0.05)

Time of denture insertion	Oral Stereognostic Score	
	Mean	Standard deviation
Before insertion of denture	8.22	1.45
After 1 month of insertion of denture	11.44	0.66
T value	-26.710	
P value	P < 0.001	

With the continuously rising population of elderly people and the increasing average life expectancy in the world, edentulism has become a common chronic condition[5].

Special senses are necessary for survival by living organisms[9]. In the oral cavity, these senses are intimately associated with the periodontal tissues, and natural teeth play a crucial role in providing sensory and tactile inputs to the central nervous system[10].

Stereognosis is understood as the ability to know and identify the shape of an object by a perceptive sensation through the touching sense using manual palpation in the absence of vision[11]. Likewise, when any objects are placed inside an oral cavity, and such patients identify them with a hand or oral manipulation independent of vision, then the term "Oral Stereognosis" applies[12].

The OSA was related to several functional activities such as mastication, swallowing and identification of taste, shape and size of food bolus[13].

Previous oral denture wearers were significantly improved in both the sensory and stereognostic abilities within a month compared to the baseline compared to non-users. Mucosal receptors that can stimulate the mucosa with various harmful stimuli are crucial patients' factors in this sense. This innate ability lets the mucosa feel something wrong with the prosthesis, if any existed. The margin of error

Table 2: Shapiro-Wilk test of normality for age, pre-treatment Oral Stereognostic Score, and post-treatment Oral Stereognostic Score among 175 edentulous patients (df = degrees of freedom; Sig. = p-value)

Variables	Shapiro-Wilk		
	Statistic	df	Sig.
Age	.930	175	.000
Pre-treatment Oral Stereognostic Score	.936	175	.000
Post-treatment Oral Stereognostic Score	.740	175	.000

Table 3: Median Oral Stereognostic Scores before denture insertion (pre-treatment) and one month after denture insertion (post-treatment) in 175 edentulous patients, reported due to non-normal data distribution as confirmed by the Shapiro-Wilk test

Time of denture insertion	Median
Before insertion of denture (pre-treatment)	8.00
After 1 month of insertion of denture (Post-treatment)	12.00

decreases in the patients with a higher oral sensory capacity. Surprisingly, the major intraoral location for identification of a substance or food bolus is not interdental but inter-tongue-palate. A significant increase in the stereognostic function of the oral cavity was found in elderly edentulous patients after receiving their dentures[14].

A significant challenge for denture wearers, regardless of their prior experience with dentures, is adapting to new or replacement prosthetics[11].

Many researchers have tested oral stereognostic ability through various testing methods. Though the tests varied in the number, shapes, sizes, and materials of the objects, they all had a common purpose: to test the subject's ability to identify an object placed in the mouth without using vision[11,15].

The present study showed an immense improvement in Oral Stereognostic Ability (OSA) in edentulous subjects after the placement of a denture. At pre-denture, the average OSA score was 8.22±1.45, which indicated low levels of oral sensory function. One month after the placement of a denture, the average score increased significantly to 11.44±0.66, thereby denoting better sensory perception. With t-value of -26.710 and p-value of <0.001, it demonstrated that this was a strongly significant improvement. These findings highlight the good effect dentures have on oral sensory capacities among individuals with missing natural teeth.

The percentage of patients identifying shapes of objects correctly significantly improved one month after the insertion of the denture compared to the baseline, irrespective of the shape type. This conclusion is supported by Amarsena et al.'s study in 2010, wherein each subject's OSA was determined as a percentage of correct answers relative to all responses, concluding that the OSA significantly increased in edentulous patients after wearing new dentures, from 47.5% to 58.75%[16].

Oral stereognosis score can thus be used as an appropriate indicator of the quality of dentures. Meenakshi reported OSA a reliable marker to determine how satisfied individuals are with their dentures[11].

On the contrary, Shetty et al recorded a significant negative correlation (p-value < 0.05) between oral stereognostic ability and denture satisfaction[17]. This reveals that, with increasing OSA, the corresponding level of denture satisfaction became lower[28].

Multiple studies also reported an inverse relationship between oral sensory ability and the degree of denture acceptance[18-20,29].

Interestingly, Garret et al[15] reported the oral stereognostic ability, in dentate and edentate patients rehabilitated with dentures, as similar in his study, as both groups were able to correctly identify 68% of the test specimens. On the other hand, Qureshi et al. reported that edentulous patients have substantially worse oral stereognosis levels as compared to levels reported in the literature for dentate subjects. This was also previously concluded by Smith and McCord[22]. Similarly, Choudhary et al[23,30] highlighted that age, gender, and mental attitude were major influencing factors on the success of dentures. The overall denture satisfaction of the participants had an OHIP score of 15.77 ± 3.15 for males and 19.55 ± 4.33 for females. Ibeke et al[24] also studied the effect of age-related effects on oral sensory functions of dentate and edentulous patients, with the OSA of younger dentate subjects (42 ± 6) significantly higher than in older dentate subjects (33 ± 7) and complete denture wearers (34 ± 9), concluding that with increasing age, oral perception was significantly reduced. This conclusion was also previously supported by Litvak[25], Mantecchini[26] and Grasso and Catalanatto[27]. Furthermore, recent evidence from the Global Burden of Disease Study 2021 confirms that edentulism continues to rise in absolute terms globally, driven by population growth and ageing, disproportionately affecting older adults and low-middle income regions[31]. Complete denture rehabilitation has also been demonstrated to significantly improve chewing efficiency in edentulous patients, further underscoring its clinical importance[32].

One limitation of this study is the relatively limited sample size, which may not fully capture the diversity of the target population. Additionally, the data used in this research was collected over a limited timeframe, which may not reflect long-term trends. Future studies could explore a broader sample and extend the analysis to a wider geographical scope to improve the generalizability of the findings. The absence of a randomised controlled trial (RCT) design is acknowledged as a further limitation. While

an RCT would represent a higher level of evidence, withholding prosthetic rehabilitation from edentulous patients in a control arm would be ethically unjustifiable; the longitudinal observational design employed was therefore the most appropriate methodology for this clinical question. Additionally, the use of non-probability consecutive sampling restricts the generalisability of the findings to the broader edentulous population. Future studies employing probability-based sampling strategies across multiple centres would strengthen the external validity of these findings.

CONCLUSION

Within the limitations of this study, a remarkable change was noted in the Oral Stereognostic Ability of edentulous patients before and one month following complete denture insertion; highly significant statistical results were recorded. This concludes that oral sensory perception does enhance following rehabilitation with complete dentures.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	MHA, MAGC, HR, SAK, GA, PA
Acquisition, Analysis or Interpretation of Data:	MHA, MAGC, HR, SAK, GA, PA
Manuscript Writing & Approval:	MHA, MAGC, HR, SAK, GA, PA

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.