Open Access

Original Article

Evaluation of Oral Stereognostic Ability in Completely Edentulous Patients

Fatima Rafiq, Salman Ahmad, Shoaib Rahim, Huda Khalid, Ayesha Mehak Saeed, Sana Afzal

Department of Prosthodontics, Foundation University College of Dentistry & Hospital, Islamabad Pakistan

ABSTRACT

Objective: To determine the mean oral stereognostic ability (OSA) score in fully edentulous patients.
Study Design: Cross-sectional Study.
Place and Duration of the Study: Department of Prosthodontics, Foundation University College of Dentistry & Hospital, Islamabad, Pakistan, from Sep 2024 to Feb 2025.
Methodology: A total of 145 patients aged 45 to 75 participated in the study. Four unfamiliar testing tools of different shapes were used to assess OSA, with patients manipulating them intraorally to select corresponding analogues on a table. Each tool was scored from 0 to 3 based on the time taken to recognize it. The study analyzed the relationship between OSA scores and various clinical and demographic characteristics using statistical modeling.
Results: The mean age was 59.28±8.19 years, of which 64(44.14%) were men, 81(55.86%), were women, and 87(60%) had experience with dentures. The mean stereognostic tool scores varied from 1.78±0.9 to 1.98±0.7. There were no significant differences in OSA scores according to gender or denture experience (p>0.05). A statistically significant difference was seen between age of the patient and total stereognostic score (p<0.001). A strong negative correlation was observed between OSA scores and period of edentulism (p<0.001).
Conclusion: OSA decreases with age and longer periods of edentulism, underscoring the value of early prosthetic rehabilitation. Gender and previous denture experience did not have a significant impact on OSA scores.

Keywords: Complete Dentures, Proprioception, Stereognosis.

How to Cite This Article: *Rafiq F, Ahmad S, Rahim S, Khalid H, Saeed AM, Afzal S. Evaluation of Oral Stereognostic Ability in Completely Edentulous Patients. Pak Armed Forces Med J 2026; 76(Suppl-1): S234-S238. DOI: https://doi.org/10.51253/pafmj.v76iSUPPL-1.13825*

INTRODUCTION

Stereognosis may be defined as the ability to discern an object's shape and form through manual palpation (solely through tactile perception) without auditory or visual aid.[1] The neurosensorial ability of the oral mucous membrane to recognize and distinguish between the size, shape, surface texture, and temperature of objects in the oral cavity is known as oral stereognostic ability (OSA).[2] Tactile sensitivity varies across the oral cavity, with sensory receptors mainly in the oral mucosa, tongue, periodontal membrane, muscle spindles, and tendon organs.[3] The OSA score is a reliable indicator of the patients' oral perception.[4] An optimal balance between the sensory and motor coordination of the nerves is required for ideal stereognosis.[5] In general, ageing is a risk factor for sensory and motor decline, though its extent varies between individuals.[6] Additionally, changes in oral status brought on by edentulism or rehabilitation with prosthetics may have an impact on OSA as well.[3]

Improved oral stereognosis after complete denture rehabilitation indicates success and can help determine oral function and therapy outcomes.[7] Patients with low oral stereognostic scores tend to be more satisfied with their dentures than those with higher scores.[8] This may be because individuals with heightened oral perception are less tolerant of denture construction flaws that go unnoticed by those with lower sensitivity; therefore, extra care will be required while fabricating technically correct prostheses to ensure better adaptability.[6]

The OSA of complete denture users has previously been extensively researched in relation to age, gender, length of edentulism, satisfaction with dentures, and systemic conditions like diabetes mellitus. A local study conducted by Ibrahim *et al.*, found significantly increased oral stereognostic dexterity in previous complete denture wearers as compared to the new complete denture wearers.[6] In a regional study conducted by Gnanasambanda *et al.*,[4] a significant difference was noted when OSA of diabetic and non-diabetic complete denture wearers was compared. A study conducted by Park JH9 found that older subjects more frequently misidentified test pieces, likely due to age-related declines in oral perception and motor function, and younger subjects

Correspondence: Dr Fatima Rafiq, Department of Prosthodontics, FUCD & Hospital, Islamabad Pakistan
Received: 08 Sep 2025; revision received: 10 Oct 2025; accepted: 14 Oct 2025

demonstrated faster response times, reflecting better oral stereognostic performance.

This study aimed to assess oral stereognostic ability in completely edentulous patients based on gender, duration of edentulism, and prior denture experience. The findings can help categorize patients' oral perceptibility, guiding dentists, especially prosthodontists, to adopt appropriate measures during the denture fabrication process to improve acceptance of the treatment and adaptability to the prosthesis, particularly in highly sensitive individuals.

METHODOLOGY

After obtaining approval from Institutional Review Committee (via letter no. FF/FUCD/632/ERC/59, dated 21st February 2023) and R&RC at CPSP, this cross-sectional study with a non-probability convenient sampling technique was conducted in the Department of Prosthodontics at Foundation University College of Dentistry & Hospital (FUCD&H), Islamabad, Pakistan, from Sep 2024 to Feb 2025. Sample size of 145 patients was calculated using the WHO calculator, with a confidence level of 95%, population standard deviation of stereognostic tools of 0.9, and an absolute precision of 0.15. The test value of population means of stereognostic tools 3.0 is taken from the study of Qureshi *et al.*,

Inclusion Criteria: Completely edentulous males and females aged 45–75 years, wearing complete dentures for over 6 months.

Exclusion Criteria: Patients with psychiatric or neurological disorders, craniofacial anomalies, visual or hearing impairments, inflammatory or cancerous oral lesions, and a period of edentulism exceeding 20 years.

All patients reporting to the Prosthodontics Department at FUCD&H who met the previously stated inclusion criteria were enrolled in the study after addressing their presenting complaints and obtaining written informed consent. Participation was strictly voluntary, and the entire data collection process, including each step involved and the estimated time required, was explained to them in detail to ensure full understanding and cooperation. Data was collected on a simple Performa along with basic demographic information of each participant.

Oral stereognosis was assessed using four acrylic testing tools (cube, triangle, one-end pointed ovoid, and two-end pointed ovoid; 10mm^3), fabricated with self-cure acrylic resin (Kooliner, Hard Chairside Denture Reline, GC America Inc.). Dental floss was attached to each tool to prevent aspiration. Corresponding 30mm^3 analogues were placed on the dental unit tray for visual reference before testing (Figure-1). Patients were first familiarized with the analogue shapes placed on the dental unit tray. During testing, each patient closed their eyes while the examiner placed a stereognostic tool on the dorsum of the tongue using tweezers. The patient then opened their eyes, manipulated the tool with their tongue, and identified the matching analogue without visual aid. A digital stopwatch recorded the time taken for each identification. Standard protocols for ensuring aseptic testing environment to all the patients were followed during the testing phase.

Figure-1: Stereognostic tools and their analogues used in the study

Each response was scored as follows: 0 for incorrect or >90 seconds, 1 for 60–90 seconds, 2 for 30–60 seconds, and 3 for <30 seconds. With four tools, the maximum possible score was 12 and minimum possible score was zero. Standard aseptic protocols were followed, including disinfection of tools between patients using a 1:3 solution of 5% Sodium Hypochlorite (HiCleanMultisurface Disinfecting Cleaner, ATCO Laboratories Ld.) for 10 minutes, followed by gentle brushing with a soft toothbrush (Colgate Extra Clean). Tools were disinfected again after use, and patients were discharged upon completion.

Data was analyzed using Statistical Package for Social Sciences v21. Descriptive statistics were calculated for both qualitative and quantitative variables; Mean±SD for quantitative variables (age, edentulism period, oral stereognostic score) and Frequency and Percentages for qualitative variables

(gender, past denture experience). An independent samples t-test compared stereognostic scores by gender and past denture experience. Paired samples t-test assessed differences between age and total stereognostic score. Pearson's correlation was used to determine the correlation between stereognostic scores and period of edentulism. *p*-values of less than 0.05 were considered significant.

RESULTS

A total of 145 patients were included in the study and had a mean age of 59.28±8.19 years. 64 (44.14%) of the patients were male and 81(55.86%) were female. 87(60%) of the patients had prior denture experience and 58(40%) had no such experience. The mean edentulism time period among the patients was 3.05±1.61 years. The Stereognostic testing tools had the following mean scores: Tool 1 = 1.78±0.9, tool 2=1.83±0.9, tool 3=1.98±0.7, and tool 4=1.85±0.9. The total mean score of all the test tools was 7.43+2.58.

From a total of 580 test scores obtained from all four tools, score 0 was recorded in 48(8.28%) patients, score 1 in 119(20.52%), score 2 in 280(48.28%) patients, and score 3 in 133(22.93%) patients. (Table-I).

Table-I: Score distribution of Stereognostic Testing Tools in patients (n = 145)

Tools	Scores			
	0	1	2	3
Tool 1	14 (9.7%)	40 (27.6%)	55 (37.9%)	36 (24.8%)
Tool 2	13 (8.97%)	33(22.76%)	65(44.83%)	34(23.45%)
Tool 3	6(4.14%)	24(16.55%)	82(56.55%)	33(22.76%)
Tool 4	15(10.34%)	22(15.17%)	78(53.79%)	30(20.69%)

p-value of >0.05 was observed in the tool scores according to gender, and past denture experience (Table-II).

Table-II: Score Distribution of Stereognostic Testing Tools According to Gender and past Experience of Denture

Variables	Tools			
	Tool 1 Mean±SD	Tool 2 Mean±SD	Tool 3 Mean±SD	Tool 4 Mean±SD
Gender				
Male	1.79±0.9	1.84±0.96	1.98±0.8	1.82±0.78
Female	1.76±0.9	1.75±0.9	1.97 ± 0.7	1.87±0.9
p-Value	0.734	0.755	0.525	0.22
Past Denture Experience				
Yes	1.81±0.8	1.61±0.9	1.83±0.8	1.81±0.9
No	1.89±0.8	1.53±0.9	1.97±0.7	1.99±0.9
p-Value	0.573	0.777	0.072	0.573

In relation to age of the patient and total stereognostic score, *p*-value <0.000 was observed. A significant correlation (p-value<0.001) between time period of edentulism and stereognostic testing tools (tool 1, tool 2, tool 3 and tool 4) was observed. (Table-III).

Table-III: Correlation between each Stereognostic Testing Tool and time period of edentulism.

Tools	Correlation coefficient (r)	*p*-value
Tool 1	-0.584	< 0.001
Tool 2	-0.464	< 0.001
Tool 3	-0.414	< 0.001
Tool 4	-0.386	< 0.001

DISCUSSION

In the present study, a decline in oral stereognostic ability (OSA) was observed among older patients, aligning with existing evidence that aging negatively impacts oral sensory function. While no significant gender-based differences in OSA were found, the results did show that experienced denture wearers had slightly higher mean scores compared to those with less experience, suggesting some degree of adaptation over time. However, overall mean OSA scores were lower, indicating a general decline in oral stereognostic ability, particularly among long-term edentulous individuals.

The oral cavity is highly innervated, and tactile sensation aids in the identification of structures within oral cavity, thereby aiding in the chewing and grinding of food bolus to initiate swallowing. Multiple methods have been employed in order to determine the oral stereognostic ability in edentulous patients with the help of testing tools.[11]

A study conducted by Mehwish *et al.*, demonstrated that materials have been used to fabricate testing tools of different shapes to determine the stereognostic ability of the patients. The tools employed have different textures to help patients differentiate the tool.[12] The author also employed the use of metal tools to determine whether thermal conduction had any role in stereognosis. On contrary to this, in our study, we used self-cure acrylic resin to make the testing tools due to ease of fabrication, to reduce material cost and to keep the testing tools a constant variable, thus eliminating chances of any variation. Another study by Gadonski *et al.*, used ball bearings of five sizes and four materials with different densities to assess the effect of weight on oral sensory perception.[13]

Costa *et al.*, defined aging may affect the oral cavity's ability to identify objects due to sensory nerve

degeneration, which impacts both stereognostic ability and overall neural function.[14] In the present study, older patients showed reduced oral stereognostic ability. These findings collectively suggest that oral stereognostic proficiency decreases as individuals grow older.

Similarly, in the study conducted by Saravankumar *et al*., older individuals scored lower than younger ones, especially when dentures were removed.[15] This conclusion requires further research to ascertain how the patient's stereognostic ability is positively impacted by the use of complete dentures. Fufutake *et al*., also mentioned that aging influences the relay of oral sensory information by reducing nerve conduction velocity in sensory and motor fibers.[16] This slowing of neural transmission can reduce the brain's ability to interpret oral tactile signals, leading to decreased oral stereognostic ability. Our study found no gender-based differences in oral stereognosis, consistent with a literature review by Gonzalez *et al*., who reported that gender does not significantly influence oral stereognosis.[17] Although further studies on a larger sample size need to be conducted to confirm this outcome, since there is very limited research on oral stereognosis in relation to gender in the recent past.

In the present study, it was noted that the mean scores for OSA were somewhat greater in experienced denture wearers compared to patients with less experience. Gupta *et al*., established that after at least one month of wearing complete dentures, oral stereognosis scores significantly improved compared to the initial assessments without dentures.[18] The difference may be due to study design and patient adaptability with the new dentures; both cited studies compared changes after prosthetic treatment, while the present study employed a cross-sectional design to compare patients with existing denture experience and non-experienced individuals. Moreover, oral stereognosis scores improved over time after prosthesis use.

Ali *et al*., from Baghdad, edentulous patients reported significantly lower mean stereognostic scores than dentate individuals, thereby reiterating the findings in present study regarding the negative effect of edentulism on oral stereognostic function.[19] Additionally, a much lower mean values representing a declining oral stereognostic ability, from which it can be inferred that the longer a patient remains edentulous, the lower the resulting oral tactile perception. It was also revealed that a significant negative relationship existed between the duration of edentulism and stereognostic ability across all tools and those correlation coefficients were r=-0.584, -0.464, -0.414, and -0.386 in Tools 1-4 respectively (p<0.001 for each) which also demonstrated decreased stereognostic performance with longer edentulous duration, possibly because of reduced neural stimulation and sensory deprivation of the oral mucosa with time. Similar findings have also been noted in a study by Bandela *et al*., highlighting that longer edentulism periods may lead to gradual decrease in sensation.[20]

With the advancements in digital dentistry, digitally designed tools printed directly with a 3D printer can be used for the same purpose. The findings of the present study suggest that loss of proprioceptive input following tooth loss adversely affects oral stereognostic ability. Neuroplastic alterations in mastication-related motor neurons, combined with reduced functional stimulation, may contribute to atrophy of oral mucosal receptors and diminished neural feedback. Prolonged edentulism, therefore, results in compromised oral neurosensory function. These observations highlight the clinical significance of early prosthetic rehabilitation in restoring functional stimulation and maintaining oral neurosensory integrity in edentulous patients.

LIMITATIONS OF STUDY

The size and morphology of the tools used in the present study were difficult to standardize due to their manual fabrication. There was a possibility that patients could develop familiarity with the tools, which may have facilitated learning and improved their ability to recognize the tools after each use. A large sample size is recommended for affirmation of the study findings in various contexts.

CONCLUSION

Within the limitations of the present study, it is concluded that edentulous individuals show a decline in oral stereognostic ability. OSA decreases with longer periods of edentulism, thereby stressing the importance of early prosthetic rehabilitation, as the use of dentures have positive influence on the stereognostic ability.

Conflict of Interest: None.

Funding Source: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

FR & SA: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

SR & HK: Data acquisition, data analysis, approval of the final version to be published.

AMS & SA: Critical review, concept, drafting the manuscript, approval of the final version to be published.

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.

REFERENCES

1. Mary KM, Cherian B. Evaluation of oral stereognosis, masticatory efficiency, and salivary flow rate in complete denture wearers. J Indian Prosthodont Soc. 2020; 20(3): 290-296. https://doi:10.4103/jips.jips_453_19
2. Cummine J, Huynh TKT, Cullum A, Osevik A, Hodgetts W. Chew on this! Oral Stereognosis predicts visual word recognition in typical adults. Curr Psychol 2023; 42(4): 3305-3318. https://doi:10.1007/s12144-021-01647-1
3. Bhattacharjee B, Saneja R, Bhatnagar A. Effect of complete dentures on oral stereognostic ability in edentulous patients: A systematic review. J Indian Prosthodont Soc 2021; 21(2): 109-115. https://doi:10.4103/jips.jips_401_20
4. Gnanasambandam K, Karthigeyan S, Ali SA, Govindharajan M, Raj K, Murugan R. Comparative study of evaluation of the oral stereognostic ability between diabetic and nondiabetic complete denture wearers with and without denture. J Dent Res 2019; 16(2): 122-126.
5. Schumann-Werner B, Schaefer S, Schramm S, Patel HJ, Binkofski FC, Werner CJ. Neural correlates of oral stereognosis—An fMRI study. Dysphagia 2023; 38(3): 923-932. https://doi:10.1007/s00455-022-10517-2
6. Ibrahim S, Ijaz M, Sharafat A, Younis S, Mukhtiar N, Zaigham AM et al. Comparison of Oral Stereognostic Proficiency Between New and Previous Complete Denture Wearers. J Bahria Uni Med Dental Coll 2022; 12(1): 8-12. https://doi:10.51985/JBUMDC2021096
7. Sivapathasundharam B, Biswas PG. Oral stereognosis-A literature review. *Eur J Mol Clin Med* 2020; 7(9): 1053-1063.
8. Devi S, Akshayalingam M, Chandran P. Evaluation of Correlation between Oral Stereognosis Ability and Satisfaction in Complete Denture Patients. Indian J dent Res 2025; 36(1): 60-63. https://doi:10.4103/ijdr.ijdr_360_23
9. Al-Azzawi AJ, Mahmood MA. Assessment of oral stereognostic ability and cognitive status in edentulous and dentulous subjects. J Bagh Coll Dent 2025; 37(1): 1-8. https://doi.org/10.26477/jbcd.v37i4.4092
10. Qureshi AW, Rahim R, Abbasi MS, Akhtar Q, Qureshi SW. Oral stereognostic score in edentulous patients. Pak Oral Dent J 2019; 39(3): 309-313.
11. Smirnov V, Khramova D, Chistiakova E, Zuena N, Vityazev F, Velskaya I, et al. Texture Perception and Chewing of Agar Gel by People with Different Sensitivity to Hardness. Gels 2024; 11(1): 5. https://doi.org/10.3390/gels11010005
12. Mehwish U, Siddiqui A, Rehman A, Hussain M, Khan M, Nafees H. Oral stereognostic ability of edentulous patients before and after rehabilitation with complete denture. Pak Oral Dent J 2022; 42(3): 168–173.
13. Gadonski AP, Ferreira GF, Carletti TM, Marañón-Vásquez GA, Magno MB, Maia LC, et al. Palatal coverage and oral stereognosis: a systematic review and meta-analysis. J Prosthet Dent 2024; 132(3): 553–561. https://doi.org/10.1016/j.prosdent.2022.09.009
14. Costa RTF, Limirio JPJO, Vasconcelos BCE, Pellizzer EP, Moraes SLD. Rehabilitation with dental prostheses and its influence on brain activity: A systematic review. J Prosthet Dent 2024; 131(3): 403-409. https://doi:10.1016/j.prosdent.2022.02.007
15. Saravanakumar P, Madhankumar S, Mani U, Athiban. I, Karthigeyan.J. Evaluation of Oral Stereognosis In Maxillectomy Patients With Definitive Obturators- An In-Vivo Study. Afr J Biomed Res 2024; 4207-4212. https://doi:10.53555/AJBR.v27i4S.4233
16. Fukutake M, Ikebe K, Okubo H, Matsuda KI, Enoki K, Inomata C, et al. Relationship between oral stereognostic ability and dietary intake in older Japanese adults with complete dentures. J Prosthodont Res 2019; 63(1): 105-109. https://doi.org/10.1016/j.jpor.2018.10.001
17. González-Gil D, Dib-Zaitun I, Flores-Fraile J, López-Marcos J. Active Tactile Sensibility in Implant Prosthesis vs. Complete Dentures: A Psychophysical Study. J Clin Med 2022; 11(22): 6819. https://doi:10.3390/jcm11226819
18. Gupta A, Modi T, Gosavi S, Bhatnagar P, Gupta G, Vaishnav G et al. Evaluation of time-dependent oral stereognostic ability in resorbed edentulous cases with and without complete denture: a clinical study. IOSR J Dent Med Sci 2024; 23(5 Suppl 9): 47–51. https://doi:10.9790/0853-2305094751
19. Ali RA, Diab BS, Ali LS. Assessment of oral stereognostic ability and cognitive status in dental implant patients compared to partially edentulous and fully dentate individuals. J Bagh Coll Dent 2025; 37(4): 1–9. https://doi.org/10.26477/jbcd.v37i4.4092
20. Bandela V, Sonune S, Nandalur KR, Alruwaili EM, Alnuman AA, Alahmed MA, et al. A clinical study to evaluate the effect of umami taste on the oral stereognostic ability of complete denture patients. Braz Dent Sci 2025; 28(1): e4297. https://doi.org/10.4322/bds.2025.e4297