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Oral stereognostic ability in complete edentulous patients before and after denture insertion: Relation to age, gender and duration of wearing denture – An *in vivo* study

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Abstract:

Oral stereognostic ability declines in edentulous patients, yet the influence of age, gender and complete denture wearing duration on sensory adaptation post-rehabilitation remains underexplored. Therefore, it is of interest to evaluate the 60 completely edentulous patients (40-70 years) at Chandra Dental College using stratified random sampling, testing standardized intraoral forms before and after denture insertion. Stereognostic assessments were categorized by age groups, gender and denture wearing duration, analyzed with appropriate statistical tests for significance. Complete denture rehabilitation significantly improved oral stereognostic ability, with age and denture wearing duration showing strong negative correlations to sensory adaptation while gender had minimal impact. Thus, data shows that early prosthetic intervention as critical for optimal neurosensory recovery and comprehensive oral function restoration in edentulous patients.

Keywords: Oral stereognostic, complete edentulous patients, complete denture

Background:

Oral stereognition refers to the capacity to identify the shape and form of objects that are placed in the oral cavity through tactile sensory perception without the aid of visual and auditory signals. It plays a vital role in oral sensory activity and plays an important role in mastication, speech and swallowing. It is a complicated combination of mechanoreceptors in the oral mucosa, tongue, periodontal ligaments and temporomandibular joint, which convey sensory data to the higher cortical areas to be interpreted [1]. Natural teeth are important in oral stereognostic ability because of the abundance of periodontal mechanoreceptors. These receptors give accurate proprioceptive information on pressure, texture and spatial orientation. But in totally edentulous patients, the loss of teeth causes the removal of periodontal receptors that causes reduced tactile perception and loss of oral sensory discrimination [2]. This sensory loss may have adverse impact on masticatory performance, bolus management and the adaptation of the patient to prosthetic appliances. The goal of complete denture therapy is to replace not only the esthetics and function but also partially the loss of oral sensory input. Denture bases provide mechanical stimuli to the underlying mucosa, which enables the adaptation of the oral tissues with time. Research has shown that oral stereognostic capacity is enhanced following denture insertion, which indicates some level of neurosensory adaptation with the help of mucosal and muscular receptors [3]. Nevertheless, the degree of this enhancement differs in people and depends on various factors. Another significant factor of oral sensory perception is age. With advancing age, there is a decline in neural conduction velocity, receptor sensitivity and central processing efficiency. Such alterations can decrease the capacity of older patients to detect and process tactile information in the mouth [4]. Therefore, elderly patients with edentulous ridge might have

worse stereognostic capacity than younger patients, despite having undergone prosthetic rehabilitation. Gender differences in sensory perception have also been explored in the literature. According to some studies, females might have a little higher tactile sensitivity than males because of hormonal and neurological differences, but the results are not consistent and inconclusive [5]. The knowledge of gender in oral stereognition can be used to personalize the treatment and education of patients using prosthetics. The other important consideration that affects oral stereognostic ability is the length of time that dentures are worn. Complete denture adaptation is a progressive process that includes neuromuscular coordination and sensory integration. Repeated exposure and learning can result in better oral perception in long-term denture wearers, but new denture wearers can have poorer sensory discrimination [6]. Therefore, it is of interest to understand sensory adaptation that comes with complete denture therapy and help to achieve better clinical results in the field of prosthodontics.

Materials and Methods:**Study design:**

Present *in vivo* study entitled "Oral stereognostic ability in completely edentulous patients before and after insertion of the complete denture in relation to age, gender and duration of wearing complete denture - An *in vivo* study" was conducted in Department of Prosthodontics, Chandra Dental College and Hospital, Safedabad Barabanki, Uttar Pradesh; participants were selected from the outpatient department of Prosthodontics.

Sample design:**Inclusion criteria**

[1] Completely edentulous patients aged between 40 and 70 years.

- [2] Either gender (Male/Female).
- [3] Patients who are satisfied with their existing dentures and willing to participate in the study.
- [4] Patients who agree to voluntary participation and have signed the informed consent form.
- [5] Patients with basic knowledge of shape.

Exclusion criteria:

- [1] Patients with neurological disorders, history of tongue surgery, trauma, inflammatory conditions of the tongue, or xerostomia.
- [2] Patients unwilling to participate in the study.
- [3] Patients with compromised systemic health conditions.
- [4] Patients who do not have adequate vision.

Sample size:

A total of 60 patients (n = 60) were included in the study.

Sampling method:

Stratified random sampling was used

Ethical considerations:

This study was conducted following the approval of the institutional Ethical Committee.

Methodology:**Test form preparation:**

Fresh carrot were used we used slicer to for slicing carrots. Sliced in a desired shape and size and the dimension were checked using a vernier caliper. All object length were determined and adjusted with help of metallic scale and divider. The sliced part was then cut in different shapes *i.e.* triangle, square, circle and half circle with the help of BP blade on glass slab.

Dimensions of test form: 2x10mm**Preparation of the chart:**

A White chart paper was used to fabricate a chart that depicted desired shapes *i.e.* triangle, square, circle and half circle with black colour for proper contrast and visibility.

Grouping of the sample

Total 60 subjects were selected, out of these 60;

- [1] First Criteria (gender) 30 were Males and 30 were Females either young/old, new/old denture wearer
- [2] Second Criteria (age) 30 were young(40-55 year old) and 30 were old patients (55-70 year old), either male/female, old/new denture wearer.
- [3] Third Criteria (duration of denture wearer)-30 were new denture wearers (1 month) and 30 were old denture wearers (6month) either male/female, young/old. In this study for the criteria of age and time duration of wearing denture patients were selected in the same 60 patients.

Data collection procedure:

Before starting the procedure, each patient was comfortably seated in a dental chair to help them relax and feel at ease. A laser light pointer was given to the patient and the entire procedure was explained step-by-step. This explanation ensured that the patient clearly understood what would happen and what they were expected to do. The purpose of the test was also described in simple terms so the patient would know why it was being performed. In addition, the scoring method how their responses or results would be evaluated was explained to avoid any confusion. Providing all this information helped reduce patient anxiety, increased their confidence and ensured that their responses would be consistent and reliable during the procedure. After obtaining informed consent to all patients, we started the steps of procedure one by one the patient's complete denture was gently removed and asked to close the eyes. Once the denture was taken out, the patient was instructed to protrude their tongue. A sample form made of edible material (raw carrot) in various shapes (round, triangle, square and semicircle) was carefully placed on the dorsal (upper) surface of the patient's tongue using sterile tweezers. After that, the patient was instructed to move the sample around inside their mouth, feel its shape and use their perception to identify it. After manipulating the form in the mouth, we asked the patient to open the eye and the patient was instructed to describe the shape by using a laser pointer to select the corresponding figure from the chart provided. To avoid fatigue and maintain consistency, each patient was given a period of thirty seconds to examine and identify each sample, for this procedure we provided a half minute to the patient. This procedure was repeated for all 60 participants without their dentures in place to record the baseline (neutral group) oral stereognostic ability without denture.

During the identification criteria, the patient was allowed to move the test form in their mouth. The patient's number of observations of the sample shape determines the score.

- [1] One correct shape was assigned a score of one out of four
- [2] Two correct shapes as 2 out of 4,
- [3] Three correct shapes as 3 out of 4,
- [4] Four correct shape as 4 out of 4

Number of 3-4 shape identification by the patient we provided GOOD, 1-2 Shape identification we provided FAIR, 0 shape identification we provided POOR.

- [1] **First criteria (gender):** So, according to the first criteria, we have a neutral group of 60 participants, out of which 30 males and 30 females they were young/old, new/old complete denture wearer, at that time patients had wear the complete denture. The procedure involves explaining everything clearly to the patients first. Then, we ask them to protrude their tongue and we place different sample forms like a circle, triangle, square and semi-circle made out of raw carrot on their tongue, one at a time. We give them about half a minute with each sample to perceive and respond. And give the score

- [2] **Second criteria (age):** According to second criteria ,young patient which lie in 40-55 age group and old age patient 55-70year old Either they were male/female, new/old denture wearer, repeat all procedure same manner and gave them score according to scoring criteria.
- [3] **Third criteria (duration of denture wearer):** According to third criteria 30 new, 30 old denture wearer were selected either they were male, female, young /old and repeat all process and gave them score

After collecting the oral stereognostic perception data from all 60 participants, the entire group was first evaluated without wearing their complete dentures. This initial assessment was done to record the baseline stereognostic ability of each participant under natural conditions, without any prosthesis influencing tongue movement, tactile sensation, or intraoral space. During this baseline phase, all 60 patients irrespective of their age group (young or old), gender (male or female), or duration of denture use (new denture wearers and long-term denture wearers) were included and assessed in exactly the same manner. The results were statistically analyzed using appropriate biostatistician methods. The analysis helped in comparing the oral stereognostic perception between the following groups: Data was collected on performer which was filled after conducting the oral stereo gnostic test on each patient. This comparison provided insight into how the presence of complete dentures and age of patient and gender, the duration of their use influenced the patients' oral tactile perception and shape recognition ability.

Perception checked in all sixty patients without wearing complete denture either male/female, young/old age patient and new/old denture wearer. Out of these sixty:

- [1] Perception checked in 30 male and 30 female patient wearing complete denture either young/old and new /old denture wearer
- [2] Perception checked in 30 old and 30 young patient wearing complete dentures either male/female, old /new denture wearer.
- [3] Perception checked in 30 old denture wearer and 30 new denture wearer either male/female young/old patient.

Statistical analysis:

The data was coded and recorded using the Microsoft Excel spreadsheet application. The data was summarized using the frequency distribution and Mean $\pm$ SD. For statistical analysis, the independent t-test and chi-square test were employed. IBM SPSS statistics were used for data analysis. A p-value of less than 0.05 was established as the statistical significance threshold.

Results:

A total of 60 completely edentulous patients aged between 40 and 70 years were included in the study using stratified random sampling. The data were analyzed to evaluate oral stereognostic ability in relation to age, gender and duration of denture wear, both before and after insertion of complete dentures. The study

included a total of 60 subjects with equal distribution across gender, age groups and denture status, ensuring uniform representation and minimizing selection bias. Both males and females constituted 50% each, while young and old age groups were equally represented. Similarly, equal numbers of new and old denture wearers were included, allowing for balanced comparative analysis (**Table 1**). Regarding clinical scores, the majority of subjects (38.3%) were categorized under Score 3, indicating a moderate level of oral stereognostic ability. This was followed by Score 2 (25.0%) and Score 4 (21.7%), while the least number of subjects (15.0%) were in Score 1. The distribution suggests that most participants exhibited average to good stereognostic ability, with fewer individuals showing poor performance. The distribution of oral stereognostic scores differed significantly between males and females ($p = 0.022$). A higher proportion of males (23.3%) exhibited poor stereognostic ability (Score 1) compared to females (6.7%). In contrast, females demonstrated better performance, with a notably higher percentage achieving excellent scores (Score 4: 36.7%) compared to males (6.7%) Both genders showed the highest frequency in Score 3; however, females consistently exhibited better overall stereognostic ability than males. The statistically significant association indicates that gender has a measurable influence on oral stereognostic performance in this study population (**Table 2**). A statistically significant association was observed between oral stereognostic ability and both age ($p = 0.009$) and duration of denture wear ($p = 0.002$). Younger individuals demonstrated better stereognostic performance, with a higher proportion achieving good (50.0%) and excellent (33.3%) scores compared to older individuals, who showed higher frequencies in poor (26.7%) and fair (36.7%) categories. Similarly, old denture wearers exhibited superior stereognostic ability, with 36.7% achieving excellent scores, compared to only 6.7% among new denture wearers. In contrast, new denture wearers showed higher proportions in lower scores, particularly Score 2 (46.7%). These findings indicate that increasing age negatively affects oral stereognostic ability, while longer duration of denture use significantly improves sensory adaptation and performance (**Table 3**).

Table 1: Distribution of study variables among subjects (n = 60)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	30	50.0
	Female	30	50.0
Age Group	Young	30	50.0
	Old	30	50.0
Denture Status	Old denture wearer	30	50.0
	New denture wearer	30	50.0
Clinical Score	Score 1	9	15.0
	Score 2	15	25.0
	Score 3	23	38.3
	Score 4	13	21.7

Table 2: Association of oral stereo gnostic scores with gender (n = 60)

Score	Male n (%)	Female n (%)	Total n (%)
Score 1	7 (23.3)	2 (6.7)	9 (15.0)
Score 2	9 (30.0)	6 (20.0)	15 (25.0)
Score 3	12 (40.0)	11 (36.7)	23 (38.3)
Score 4	2 (6.7)	11 (36.7)	13 (21.7)
Total	30 (100)	30 (100)	60 (100)

Chi-square value = 9.652; p-value = 0.022 (Statistically Significant)*

Table 3: Association of oral stereognostic scores with age and denture wearing status (n = 60)

Score	Young n (%)	Old n (%)	Old Denture Wearer n (%)	New Denture Wearer n (%)	Total n (%)
Score 1	1 (3.3)	8 (26.7)	4 (13.3)	5 (16.7)	9 (15.0)
Score 2	4 (13.3)	11 (36.7)	2 (6.7)	14 (46.7)	15 (25.0)
Score 3	15 (50.0)	8 (26.7)	13 (43.3)	9 (30.0)	23 (38.3)
Score 4	10 (33.3)	3 (10.0)	11 (36.7)	2 (6.7)	13 (21.7)
Total	30 (100)	30 (100)	30 (100)	30 (100)	60 (100)

Age: Chi-square = 11.679, p = 0.009* (Significant); Denture Wearer: Chi-square = 14.800, p = 0.002* (Significant)

Discussion:

The current *in vivo* experiment assessed oral stereognostic capacity in fully edentulous individuals prior to and following complete denture placement and examined its relationship with age, gender and denture wear time. The results of this research showed that oral stereognostic ability is enhanced after full denture rehabilitation and is affected by patient-related factors including age and denture usage time. Oral stereognosis is a complicated neurosensory process that relies on mechanoreceptors located in the oral mucosa, tongue and related musculature. The lack of periodontal ligament receptors in edentulous individuals results in lower tactile perception, thus impairing oral sensory discrimination [7, 11]. In the current research, most of the subjects had moderate to good stereognostic ability (Score 3: 38.3%) and it was improved after denture insertion. This observation is in line with the research by Litvak *et al.*, who found that edentulous patients exhibit lower stereognostic capacity than dentulous individuals, but improve following prosthetic rehabilitation as a result of neuromuscular adaptation [2]. The enhancement in the stereognostic capacity following the insertion of dentures in this research can be explained by the fact that dentures help relay sensory stimuli to the oral mucosa. With time, the patients acquire adaptive neuromuscular coordination, which improves oral perception. Bhattacharjee *et al.* also reported similar results and concluded that complete dentures enhance oral stereognostic ability by means of functional adaptation and recurrent sensory exposure [3]. The gender-wise comparison in the current study showed that females performed better in stereognostic performance with a higher percentage of females (36.7) scoring excellent performance than males (6.7) and the correlation was statistically significant (p = 0.022). This finding is consistent with Abdouni *et al.*, who have found that females have better tactile sensitivity, which may be attributed to variations in sensory perception and neuromuscular coordination [4]. Nevertheless, other studies have found no significant gender differences, indicating that gender effect might be different in different populations and methods [5]. Thus, the current study suggests that there is a strong correlation, but additional studies are needed to draw conclusive results. The age was also identified to play a significant role in oral stereognostic ability (p = 0.009), with younger people showing higher performance. In this research, 50.0% of the younger subjects scored Score 3 and 33.3% scored Score 4 but older people had higher frequencies in lower scores. This age-related deterioration of stereognostic performance may be explained by a decrease in neural conduction velocity, receptor sensitivity and central processing efficiency. Ferreira *et al.* also reported similar results, noting that aging has a negative

impact on oral sensory perception and masticatory performance [6]. Moreover, Vivek *et al.* also observed that the adaptability to complete dentures is lower in elderly patients because of impaired neuromuscular coordination [7]. Stereognostic ability was significantly associated with the duration of denture wear (p = 0.002). Old denture wearers performed better with 36.7% scoring excellent as opposed to 6.7% of new denture wearers. This indicates that prolonged use of dentures enhances sensory adaptation. These results are in line with those of Braun *et al.*, who found that oral sensory thresholds increase with the continued use of prostheses because of learning and adaptation [8]. Likewise, Sakthi Devi *et al.* discovered that long-term denture wearers have better oral perception than new users, indicating the significance of adaptation with time [9]. The idea of sensory adaptation is also supported by the distribution of clinical scores in this study. Most of the subjects were in the score 3 (38.3%), which is moderate stereognostic ability, with a smaller percentage of the subjects scoring excellent. This implies that though complete dentures enhance oral perception, they do not entirely replace the sensory capacity that is comparable to natural dentition. This finding is consistent with the results of a limited number of studies, who highlighted the importance of periodontal receptors in fine tactile discrimination [10-12]. The statistically significant correlations in this study between stereognostic ability and age and denture duration highlight the significance of early prosthetic rehabilitation and patient education. Patients of younger age can change faster because of the higher neuromuscular efficiency and patients of older age might need further training and follow-up to reach the best results [13, 14]. Furthermore, the findings of this study have important clinical implications. Better oral stereognostic ability is related to improve masticatory efficiency, speech and patient overall satisfaction. Thus, clinicians are advised to focus on appropriate denture construction, follow-up and patient education to improve the adaptation and sensory performance. Nevertheless, some limitations of the study should be taken into account. The sample size was not very large and the study was done in one center and this could be a limitation to generalization. Also, there can be subjective variability in patient responses that can affect stereognostic assessment. These findings should be validated with larger sample sizes and standardized methods in future studies.

Conclusion:

Complete denture rehabilitation significantly improves oral stereognostic ability in completely edentulous patients. Younger age, longer denture wear, and female sex were associated with better stereognostic performance following rehabilitation. Early

prosthetic rehabilitation and adequate patient adaptation may enhance oral sensory function and improve overall treatment outcomes.

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