

# Relation between oral stereognosis and masticatory efficiency in complete denture wearers: an *in vivo* study

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## Abstract

**Aim:** The purpose of the present study was to evaluate the possible association between the oral stereognostic ability and masticatory efficiency at the time of denture insertion and after 6 months in complete denture wearers. **Methods:** Sixty edentulous patients were selected. The study was conducted in two parts. First, on the day of denture fit-in oral stereognostic ability test was conducted, followed by masticatory efficiency was carried out. The patients were recalled for check up after 6 months and the same test was performed again. Data were tabulated and analyzed statistically by paired t-test and Pearson's correlation coefficient. **Results:** There was weak correlation between oral stereognosis and masticatory efficiency. Many opinions have been presented in the literature in the past regarding oral stereognosis. The issue whether oral stereognosis also helps in patients' adaptation towards complete denture prosthesis is still ambiguous. No consensus has been reached. This study is further an attempt to understand the basic physiology of oral stereognosis and whether there is any possible relation between oral stereognosis and masticatory efficiency. **Conclusions:** Within the limitation of this study, it can be concluded that oral stereognostic ability improves with time, which might be due to adaptation to the denture. As adaptation towards denture improves masticatory efficiency improves as well. This study showed that there might be a weak association between oral stereognosis and masticatory efficiency.

**Keywords:** oral stereognosis, oral perception, oral sensorimotor function, masticatory efficiency, masticatory performance.

## Introduction

The efficiency and success of complete dentures are difficult to measure objectively. It is important to be able to do so because patients sometimes complain with no clinical evidence. Most patients expect dentures to be comparable, both functionally and esthetically, to natural dentition<sup>1</sup>.

Several investigators have reported that the patient's adaptation to complete dentures may be predicted by oral stereognostic tests. Stereognosis has been employed to evaluate the integrity of sensory feedback and is used in neurological

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evaluation. It involves identification of forms of objects without the aid of vision by hand or oral manipulation.

The oral stereognosis test consists of placing objects into the mouth without being seen by the patient and having the patient identify the form. A correct identification of the form of the object is recorded as a score<sup>2-3</sup>.

The chief purpose of fitting oral prostheses is to enable the patients to recover their oral function. Therefore, to diagnose the effectiveness of the prosthesis, it is important to evaluate the oral function<sup>4</sup>. Masticatory performance and efficiency are defined as the capacity to reduce food during mastication, and by counting the number of masticatory strokes required to reduce food to a certain particle size reduction, respectively<sup>4</sup>.

The purpose of this study was to evaluate any possible association between the oral stereognostic ability and masticatory efficiency at the time of denture insertion and after 6 months in complete denture wearers.

## Material and methods

The present in-vivo study was conducted on sixty edentulous subjects reported to the Department of Prosthodontics A.B.S.M.I.D.S Mangalore.

The inclusion criteria were: completely edentulous patients with age ranging from 50 to 60 years, and with no past denture history. The exclusion criteria were: patients with mucosal lesions, under the influence of neurological drugs, under intoxications, and having any psychological problems or perverted habits. The various forms used in this study were: square shape form, rectangle shape form, triangle shape form, star-shaped form, circle shape form, semicircle shape form.

The test forms were fabricated from heat cured acrylic resin by conventional technique. The test forms used were 2-3mm in length. Six forms were used to prevent the fatigue. For identification purpose, similar but 5-6 times oversized test forms were fabricated with plaster of Paris. For evaluating masticatory efficiency, Wrigley's Orbit sugar free pellet form chewing gum was used. Measurement of the weight loss was carried out by electronic weigh balance (AXPERT ENTERPRISES ISO 9001) having max weigh limit of 2 kg and minimum 0.2 g standard error of 0.01 g.

Sixty edentulous subjects were selected. The aim of the study and the procedures were fully explained to the subjects and due written consent was obtained. This study was conducted in two parts. First, on the day of denture fit-in oral stereognostic ability test was conducted, followed by masticatory efficiency was carried out.

## Oral Stereognostic Ability test

On day 1, oral stereognosis test was carried out after denture fit and insertion. Day 1 means the day of final delivery of the prosthesis as this is the first day the patient will experience the new prosthesis. Thus on day 1 always slight amount of discomfort patient will experience. To correct this discomfort and to make them adjusted to this

new prosthesis, the term fit and insertion was used. Initially, patients were made familiarized with plaster forms with digital manipulation and then acrylic test forms were placed in the mouth and movements like sucking, pressing against the palate and lips were advised to help them in identification. After identification, subjects were advised to point towards one of the plaster forms. Sterilization was carried out by autoclaving these test forms. The readings hence recorded were grouped in three categories (2 point if the answer was correct, 1 point if the answer was partly correct, 0 point if the answer was wrong). Patients' oral stereognostic scores were collected in the following way at denture insertion and after 6 months of denture usage<sup>2</sup>.

## Measuring Masticatory Efficiency of The Patient

Masticatory efficiency of the subject was carried out with the help of chewing gums, which were pre-weighed by using electronic (axpert) weighing balance. For each subject Four Orbit chewing gums were used for 5, 10, 20 and 30 strokes. The chewing gums were then desiccated and the total weight loss of the sweetener chewed out was recorded. The same procedure was followed after a period of 6 months. Thus the weight loss of the chewing gum was recorded at the time of insertion and 6 months after denture usage<sup>4</sup>. Data were tabulated and analyzed statistically by paired t-test and Pearson's correlation coefficient.

## Results

From the on-going study the results obtained shows that: The mean value for oral stereognostic ability testing for 60 edentulous subjects was  $7.133 \pm 1.39$ , and for 30 subjects after 6 months of denture usage it was  $8.9000 \pm 1.295$ . Of the 60 subjects only 30 subjects returned after 6 months of denture usage, and so the study was conducted with 30 patients only (Table 1). Comparative analysis of these subjects was conducted by paired sample t-test. The results suggested that the mean value for oral stereognostic ability on the day of denture fit and insertion was  $6.6667 \pm 1.51$ , and the mean value after 6 month of denture usage was  $8.9000 \pm 1.295$ . The mean difference of oral stereognosis between day 1 and after 6 months of denture usage was 2.233, which is highly significant ( $p=0.001$ ) (Table 2). Masticatory efficiency of the thirty denture subjects who returned after 6 months of denture usage. The mean value for weight loss of the sugar content on the day of denture fit and insertion from the chewing gum was  $4.806 \pm 0.766$  and after 6 months of denture usage was  $4.623 \pm 0.669$ . There was a decrease in value after 6 months of denture usage with a mean difference of  $-0.183$  ( $p=.003$ ), which shows high significance (Table 3

**Table 1.** Mean and standard deviation for oral stereognostic ability of subjects on the day of denture fit and insertion and after 6 months of denture usage

TEST DAY	N	Mean	Standard deviation
Day 1	60	7.133	$\pm 1.39$
After 6 months	30	8.9000	$\pm 1.295$

**Table 2.** A comparative analysis of oral stereognostic ability test on the day of denture fit and insertion and after 6 months of denture usage by using paired sample t-test

Pair 1	N	Mean	Mean Difference	Standard deviation	Significance
Day 1	30	6.6667	2.233	±1.516	0.001
After 6 months	30	.9000		±1.295	

**Table 3.** Mean and standard deviation for masticatory efficiency of subjects on the day of denture fit and insertion and 6 months of denture usage

	N	Mean	Standard deviation
Day 1	60	4.78	±0.651
After 6 months	30	.623	±0.669

and 4). The Pearson’s correlation coefficient obtained (-0.066) suggests weak correlation that exists between oral stereognosis and masticatory efficiency.

### Discussion

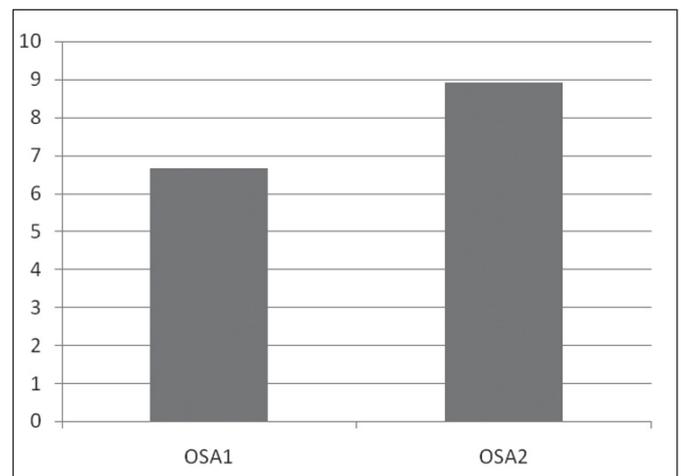
Oral stereognosis is the neurosensorial ability of the oral mucosa to recognize and discriminate the forms of objects in the oral cavity<sup>3,5-7</sup>. Oral stereognostic ability has been employed in many studies to evaluate oral perception. Altered masticatory efficiency with age again is a multifactorial problem which may or may not be associated with loss of teeth<sup>8-10</sup>. The relationship between oral stereognosis and masticatory efficiency has not been clearly identified. This study is further an attempt to understand any possible relation that exists between these two conditions.

In the present study, 6 forms were used. The study was conducted with dentures on the day of denture fit-in and 6 months after denture usage<sup>11-12</sup>. To measure masticatory efficiency, the technique as proposed by Heath et al. has been followed, which uses chewing gum as a test material. The possible advantages of using chewing gum over other materials are that kneading and folding are easily done with chewing gum and no fracture of particles occurs on chewing, which causes no discomfort for the patient<sup>4</sup>.

The mean oral stereognostic ability scores obtained on the day 1 of denture fit and insertion was  $7.133 \pm 1.39$  (Table 1). This when compared with the maximum value the subject could have scored [12 points (2 points each for 6 forms)] suggested that the mean oral stereognosis score was 58.3% for 60 edentulous subjects. This decreased oral stereognostic scores may be explained due to loss of natural teeth as proprioception from the periodontal ligament was lacking, or increased age, or patient’s satisfaction<sup>13</sup>.

The 30 subjects out of 60, who returned after 6 months of denture usage showed a mean oral stereognostic ability score of  $8.9000 \pm 1.295$ . The mean oral stereognostic ability score of these 30 subjects on the day of denture fit and insertion was  $6.666 \pm 1.516$ . By comparing the mean of oral stereognostic ability for day 1 and 6 months after denture usage a highly significant improvement has been noticed ( $p=0.001$ ) (Table 2) (Figure 1).

The above results demonstrate that as the time elapsed there was an highly significant improvement in oral stereognostic ability. This improvement may be due to improved adaptability with the dentures with due course of time<sup>7,14-16</sup>.



**Fig. 1.** Comparison between oral stereognostic ability on day 1 and after 6 months of denture usage  
OSA DAY-1 (Oral Stereognostic Ability On Day 1)  
\*\*OSA -2AFTER 6 MONTHS( Oral Stereognostic Ability after 6 months)

Regarding the neurological mechanism involved in recognizing various forms, the oral phenomenon known as stereognosis involves elaborate functions of the parietal cortex. Received sensations are synthesized in the cortex and compared with previous sensorial memories. Part of the somatosensorial cortex (2) is composed of Broadmann areas (3a, 3b, 1, 2). Sensorial input of muscle and articulations are

**Table 4.** A comparative analysis of masticatory efficiency on the day of denture fit and insertion and after 6 months of denture usage by using paired sample t-test

Pair 1	N	Mean	Mean Difference	Standard deviation	Significance
Day 1	30	4.806	-0.183	±0.766	0.003
After 6 months	30	4.623		±0.669	

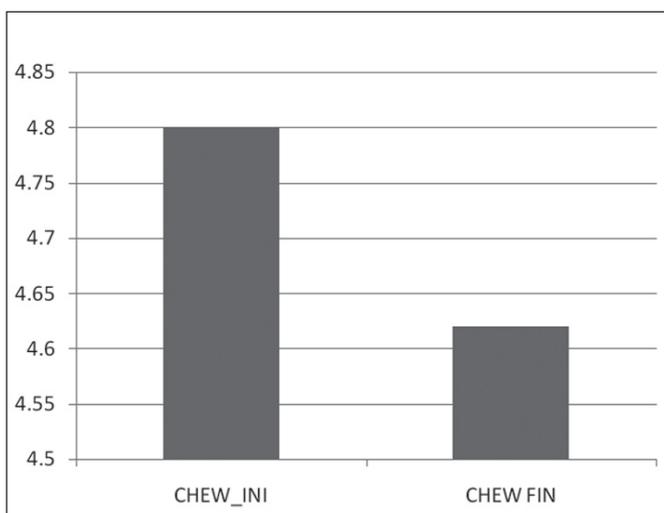
conducted to 3a, whereas skin sensorial input is conducted to 3b and processed in area 1, combined with other information in area 2. The S-I area projects the signal to other locations of the parietal lobe, where the somatosensorial impulses are used for the learning of new discriminatory sensations. The sensorial area for the tongue, lips, thumbs and index fingers is greater than other sensorial parts for the rest of the body. Testing one's Oral Stereognostic level can involve some motor activity and manipulation of test pieces inserted into the oral cavity and their interactions with lips, tongue, and teeth. Oral Stereognostic testing can also measure recognition times, surface texture of objects, and sensibility thresholds<sup>17</sup>.

The mean score for masticatory efficiency after 6 months of denture usage was  $4.62 \pm 0.66$ . When this value is compared to the initial score of masticatory efficiency on the day 1 of denture fit and insertion ( $4.80 \pm 0.766$ ), a significant improvement in masticatory efficiency is noticed ( $p=0.003$ ) (Table 3 and 4) (Figure 2). The results obtained were in accordance with Muller et al.<sup>14</sup>, who stated that as the adaptation towards the prosthesis improves, masticatory efficiency also improves with time. Those authors suggested that good oral motor ability supports the adaptation to new dentures<sup>7,14-16</sup>.

When the results were analyzed altogether, it could be noted that over a period of 6 months there was an improvement in masticatory efficiency with improved oral stereognostic ability.

However, Pearson's correlation coefficient denotes that there was a weak association exists between oral stereognosis and masticatory efficiency (-0.066). A possible explanation for this co-relation can be based on multiple factors (age, neurosensory ability, patients' psychological status, salivary flow rate) which exists and are subjective in nature<sup>12,18-19</sup>.

The results obtained in this study are suggestive but



**Fig. 2.** Comparison between weight loss on the day 1 of denture insertion and after 6 months of denture usage.

CHEW\_INI: initial weight loss of chewing gum on the day 1 of denture fit and insertion

CHEW\_FIN: final weight loss of chewing gum after 6 months of denture usage

not conclusive because of the relatively small sample size, the infrequent follow-ups, and the lack of standardization of the sweetener lost to determine good, intermediate or poor masticatory efficiency. The initial dissolution of the sweetener in the saliva was also a limitation of the study. Following conclusions were drawn from this study: By comparing the mean of oral stereognostic ability for day 1 and 6 months after denture usage a highly significant improvement has been noticed. By comparing the mean of masticatory efficiency for day 1 and 6 months after denture usage, a highly significant improvement has been noticed. There was a weak association between oral stereognosis and masticatory efficiency, but further studies are still required to evaluate this association.

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