Review

Effect of complete dentures on oral stereognostic ability in edentulous patients: A systematic review

Bappaditya Bhattacharjee, Ritu Saneja, Atul Bhatnagar

Department of Prosthodontics, Faculty of Dental Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Abstract

Aim: Oral stereognosis is an important sensation for a human being to percept any type of materials that are introduced in the oral cavity. It is defined as the ability of an individual to recognize objects using only tactile sensation without using vision, audition, balance, somatic function, taste, or smell. The primary purpose of this review was to evaluate the effect of complete dentures on oral stereognostic ability in edentulous subjects.

Settings and Design: Systematic review based on PRISMA guidelines.

Materials and Methods: A systematic search of the electronic databases like PubMed and Web of Science was done using keywords – "stereognosis," "oral stereognosis," "complete denture," and "complete edentulism." In addition to this, a manual search of references mentioned in the articles and gray literature was done. Data extraction and assessment were done by two independent reviewers.

Statistical Analysis Used: Qualitative analysis.

Results: The literature search yielded a total of 61 articles. Thirteen duplicate articles were removed and 36 articles were rejected after initial screening of titles and abstracts. A total of 12 articles were selected for full text reading and 5 of them were included for qualitative analysis.

Conclusion: All the included studies showed complete denture treatment therapy improved stereognostic ability in terms of correct identification of test pieces and time taken to identify the objects. There is also a direct relationship between the adaptability of dentures and stereognostic ability.

Keywords: Complete denture, oral stereognosis, stereognosis

Address for correspondence: Dr. Atul Bhatnagar, Department of Prosthodontics, Faculty of Dental Sciences, Banaras Hindu University, Near Trauma Centre-BHU, Lanka, Varanasi - 221 005, Uttar Pradesh, India.
E-mail: atuldent@hotmail.com

Submitted: 04-Aug-2020, **Revised:** 08-Sep-2020, **Accepted:** 27-Nov-2020, **Published:** 28-Apr-2021

INTRODUCTION

Perception is known as the ability to detect external stimuli through vision, audition, balance, somatic function, taste, or smell. Tactile function of teeth plays a major role in controlling movements of the jaw, mimicking the role of the somatosensory system in controlling limb movements.[1]

Access this article online	
Quick Response Code:	Website: www.j-ips.org
	DOI: 10.4103/jips.jips_401_20

Anatomical and physiological integration among jawbone, teeth, and periodontium is important for maintenance of integrity of stomatognathic system. Control of mandibular positioning and movement, masticatory forces, stereognosis, as well as interocclusal tactile sensibility are the various activities of the oral sensory system.[2] The oral cavity is one

How to cite this article: 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;21:109-15.

of the most densely innervated parts of the somatosensory system, in terms of peripheral receptors responsible for tactile perception and stereognostic abilities.[3]

Stereognosis may be defined as the ability to recognize objects using only tactile (somatic) sensation. The ability is well developed in blind people and depends on memory and on an intact somatic sensory system.[4] Tactile sensitivity also varies in different parts of the anterior oral cavity. The tip of the tongue and hard palate are the most sensitive regions for the detection of light touch.[5] The sensitivity of two-point discrimination (i.e., ability to discriminate smaller differences between two points) is greatest in the tip of the tongue followed by the lips and the hard palate.[6,7] Receptors present in periodontal tissues (i.e., gingiva and periodontal ligaments) and in the tooth pulp have also been extensively studied to evaluate their sensitivity.[8,9]

Rehabilitation of a prosthodontic patient demands immense patience, training, and commitment from both the patient and the doctor. Neuromuscular conditions and mental attitude of the patients also modulate prosthodontic treatment procedures. Factors such as behavior, expectations, and adaptability of the patient play as major influential factors in predicting success of any dental prosthesis.[10] The study of the neuromuscular coordination during tactile sensation is called stereognosis.[11,12] In dentistry, the importance of stereognostic ability was first demonstrated by Berry and Mahood in 1966.[13] Various authors have used a variety of test shapes and materials to check the oral stereognostic ability (OSA). The National Institute of Dental Research has developed a range of 20 shapes and suggested to use test materials within this range during the evaluation of OSA. The overall sensory ability of the patient is assessed during stereognosis testing procedure rather a particular type of receptors.[14] Adaptation to new or replacement dentures, regardless of their experience of wearing dentures, is one of the major concerns for both patient and dentist after the treatment procedure. Therefore the aim of this systematic review is to see whether there is a difference between stereognostic abilities before and after rehabilitation with complete dentures in denture wearers. Evaluating OSA in patients after rehabilitation with complete denture prosthesis may provide useful information about the sensory abilities of denture patients and aid in interpreting the role of adaptation and adjustment to the complete denture prosthesis.

MATERIALS AND METHODS

Information source/search strategy

In vivo studies were searched to find relevant articles to evaluate the effect of complete denture therapy on OSA in comparison with previous edentulous state. A comprehensive search was done from January 2020 to May 2020 in the following electronic databases for published studies – PubMed and Web of Science. In addition to this, manual search of the references included in the study and manual search of gray literature were done. Published articles in English languages and *in vivo* human studies only selected in this review. Keywords used in this study were "stereognosis," "oral stereognosis," "complete denture," and "complete edentulism." The following combination of keywords was used to search the literature – Stereognosis AND complete denture, Oral stereognosis AND complete denture, Oral stereognosis AND complete edentulism, Stereognosis AND complete edentulism, and Stereognosis AND complete denture AND complete edentulism. Two independent reviewers (BB and RS) performed the literature search and any disagreements between reviewers were solved by discussion.

Preferred Reporting Items for Systematic Review and Meta-Analyses guidelines were used and the checklist was followed in this systematic review.[15] PROSPERO registration number for this systematic review is CRD42020202478.

Population, intervention, control, outcome, and study design (PICOS) strategy is as follows:
P: Patients with completely edentulous state
I: Rehabilitation done with complete dentures
C: Patient's previous edentulous state before the treatment procedure
O: Oral stereognostic ability
S: Randomized controlled clinical trials and prospective and retrospective studies

Focus question:
"Do OSA improves after rehabilitation of edentulous patients with complete dentures compared with previous edentulous state?"

Study design

Study designs used in this review were prospective and retrospective studies.

Objectives

The purpose of this present systematic review is to evaluate how OSA changes after rehabilitating edentulous patients with complete denture prosthesis compared to the previous edentulous state.

Inclusion and exclusion criteria

Eligibility criteria were determined before the literature search was performed.

The inclusion criteria were:

1. Published articles on oral stereognosis (OS)
2. Published articles comparing stereognosis in patients treated with complete denture
3. Published peer-reviewed articles between the years 1960 and 2020
4. Randomized control clinical trials
5. Prospective and retrospective studies
6. *In vivo* studies.

The exclusion criteria were:

1. Animal studies, *in vitro* studies, literature reviews
2. Case reports and case series
3. Published articles in non-English languages
4. Studies with incomplete data.

Data analysis

The data were extracted by two independent reviewers (BB and RS) from all the included studies and filled into predetermined forms. The form consisted of the following informations: study, year, country, study design, sample description, study groups, and test materials used. Any disagreements between the reviewers were solved by discussion.

Assessment of risk of bias in individual studies

The Newcastle–Ottawa Scale was followed to assess the risk of bias of the prospective studies.[16] The methodological quality was based on selection, comparability, and outcome domain. The study was classified to be of good quality if "3 or 4 stars in selection domain," "1 or 2 stars in comparability domain," and "2 or 3 stars in outcome/exposure domain" are obtained. The study was considered to be of fair quality if it secured "2 stars in selection domain," "1 or 2 stars in comparability domain," and "2 or 3 stars in outcome/exposure domain." The quality of the study was considered poor when it obtained "0 or 1 star in selection domain," "0 stars in comparability domain," or "0 or 1 stars in outcome/exposure domain."

The extracted data were stratified and tabulated according to chronological order. Information related to various characteristics of the included studies described as a summary like format to enumerate the information.

RESULTS

Study selection

The literature search yielded a total of 61 articles from two electronic databases (PubMed – 46 and Web of Science – 15). After removal of the duplicates (n = 13), initial screening of titles and abstracts was performed by two independent reviewers (BB and RS). In this stage, 36 articles were removed after screening the title and abstracts. A total of 12 articles were selected for full-text reading; of these 12 articles, 5 studies[17-20] were included for qualitative analysis and 7 studies were excluded due to various reasons [Table 1].[21-27] Any disagreements between reviewers during the study selection process were solved by discussion. The study selection procedure is shown in Figure 1.

Assessment of risk of bias

The quality of the included studies was determined by Newcastle–Ottawa Scale. Among the included studies, three studies obtained three stars in the selection domain, two stars in the comparability domain, and three stars in the outcome domain.[17,19,20] Two other studies acquired two stars in the selection domain, one star in the comparability domain, and three stars in the outcome domain. Three studies got three stars in selection domain as the intervention cohort was somewhat representative of accountable care organizations, selection of nonintervention cohort was from the same community, and ascertainment of the intervention was from a secure record. Two stars were given in the comparability domain for three of the included studies, as the study cohort was comparable to controls such as age, gender, and additional factors. Three stars in the outcome domain were given to all the studies for the assessment using record linkage and for enough follow-up duration. Two studies[14,18] selected the

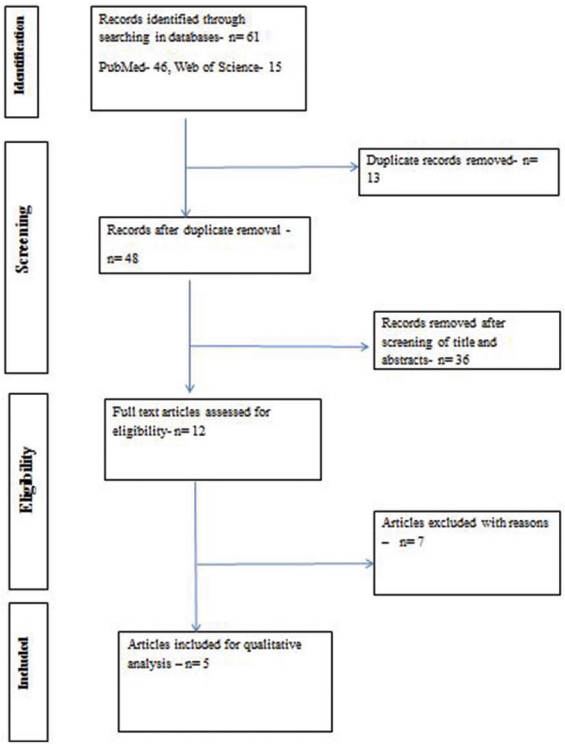

Figure 1: Study selection process

nonexposed cohort from a different source. Ikebe *et al*.[14] selected dentate subjects as a control group and compared their stereognostic ability with edentulous subjects. Leung *et al*.[18] similarly selected subjects with different medical histories for test and control groups. These two studies were classified as fair quality because of obtaining two stars in the selection domain and one star in the comparability domain due to the above reason. Qualities of the included studies are shown in Table 2.

Characteristics of the included studies

Five studies included in this study used different shapes of test materials made up of acrylic resin, raw carrot, etc., OSA was determined either by checking the correct identification score and mean time to give the answer. Different authors evaluated stereognostic ability in different follow-up periods after completion of treatment. One of the studies selected edentulous subjects with unilateral stroke and Parkinson's disease in which they executed complete denture treatment therapy. One study selected younger dentate subjects as the control group and edentulous subjects wearing complete dentures for >3 months as the test group. Characteristics of the included studies are elaborated in Table 3.

DISCUSSION

Oral stereognosis is the neurosensorial ability of the oral mucous membrane to recognize and discriminate the forms of objects in the oral cavity. Stereognosis can be classified into four different types – general stereognosis (overall capacity to recognize the shape of the objects), homostereognosis (self-body recognizing capacities, such as the teeth, tongue, and palate), organ stereognosis (capacity to recognize muscular units as target areas, concomitant to a conscious projection of organism in the environment), and heterostereognosis (capacity to recognize foreign body inside the oral cavity).[28] Different studies have been conducted till now to check the relation of stereognostic ability with the age and presence of removable prosthesis in the mouth. The experimental setup is a key factor for the psychophysical test. To accurately assess the sensory function of subjects, instruments should be capable of producing quantifiable and reproducible stimuli. Besides, all the psychophysical methods are influenced by many parameters. Experiments should be carried out with an appropriate psychophysical approach.[29]

Table 1: List of the excluded studies with reason

Excluded studies	Reason for exclusion
Litvak *et al*.[21]	Compared oral stereognosis in dentulous and edentulous individuals. Complete denture therapy not used as interventional procedures
Müller *et al*.[22]	Checked the stereognostic ability in relation to adaptation to dentures, stereognostic ability in pretreatment edentulous condition was not evaluated
Pow *et al*.[23]	Compared oral stereognostic ability in patients with Parkinson's disease and stroke with the control group
Ikbal *et al*.[24]	Compared stereognostic ability in between complete denture group and implant supported complete denture group
Fukutake *et al*.[25]	Evaluated stereognostic ability in complete denture patients in relation to dietary intake
Gnanasambandam *et al*.[26]	Compared stereognostic ability in between diabetic complete denture wearers and nondiabetic complete denture wearers
Figueredo *et al*.[27]	Evaluated oral stereognostic ability in completely edentulous patients in relation to frailty phenotypes (frailty determined by weight loss, exhaustion, physical activity level, weakness, and slowness to the evaluation)

Table 2: Newcastle–Ottawa Scale for quality assessment of prospective studies

Study	Representativeness of the exposed cohort (star)	Selection of the nonexposed cohort (star)	Ascertainment of exposure (star)	Demonstration that outcome of interest was not present at the start of the study (star)	Comparability of cohorts on the basis of the design or analysis controlled for confounders (star)	Assessment of outcome (star)	Was follow-up long enough for outcomes to occur (star)	Adequacy of follow-up of cohorts (star)
Mantecchini *et al*.[17]	1	1	1	-	2	1	1	1
Leung *et al*.[18]	1	-	1	-	1	1	1	1
Ikebe *et al*.[14]	1	-	1	-	1	1	1	1
Meenakshi *et al*.[19]	1	1	1	-	2	1	1	1
Mary and Cherian[20]	1	1	1	-	2	1	1	1

Table 3: Characteristics of the included studies

Study	Country	Study design	Sample description	Test materials used in stereognosis
Mantecchini *et al*.[17]	Italy	Prospective study design	Sample size – Thirty-seven individuals Median age – 62 years Gender - (Male patients – 22, female patients – 15)	Five different shapes – square, triangle, semi-circle, rectangle, and circle, were used. The first series was 4 mm thick and 10 mm in diameter (or length); the second was 2 mm thick and 5 mm in width or diameter
Leung *et al*.[18]	Hong-kong	Prospective study design	Sample size – Stroke group (15 individuals) Mean age – 71.7 years Gender – Stroke group (seven males and eight females) Sample size – Parkinson's group (fifteen individuals) Mean age – 71.8 years Gender – Parkinson's group (seven males and eight female patients) Sample size – Control group (15 individuals) Mean age – 69.9 years Gender – Control group (11 males and 4 females)	Ten solid objects were fabricated from radiopaque acrylic resin. The shapes were approximately 4 mm thick and 10 mm in diameter or length. Square and rectangle, cross and star, and oval and pill-shaped test materials were used
Ikebe *et al*.[14]	Japan	Prospective study design	Sample size – Test group (thirty individuals), control group (Twenty individuals) Age range – 57–76 years Gender – Control group (male 12, female 8), test group (male 13, female 17)	The test pieces comprised 2 shaped form – Circles, ellipses, semicircles, squares, rectangles, and triangles of both large (12 mm×12 mm×3 mm) and small (8 mm×8 mm×2 mm) types. The test pieces were made of acrylic resin
Meenakshi *et al*.[19]	India	Prospective study design	Sample size – Thirty edentulous individuals who were edentulous for a period of >3 months Age – 55–60 years Gender – Not mentioned	Square, rectangle, circle, oval, triangle, and star shape were chosen from 20 items used at the National Institute of Dental Research for stereognostic tests Test specimens were made from raw carrots. Six standardized shapes (10–14 mm) were obtained by using stainless steel punches (Micro Excellers, Mysore)
Mary and Cherian[20]	India	Prospective study design	Sample size – Seventy edentulous patients Age range – 50–70 years Gender – Not mentioned	The various forms used were square, rectangle, triangle, star, circle, and oval. The test forms used were of 5 mm in thickness and 10 mm in diameter. The test pieces were made of heat cure acrylic resin to which dental floss was attached to prevent accidental aspiration of the test pieces. Test pieces were autoclaved at 121°C at 15 psi for 30 min

Mantecchini *et al*.[17] conducted a study in Caucasian edentulous subjects. The test procedure was done before beginning of treatment, 1–3 months after completion of treatment with new dentures, and 1 month after beginning of treatment with the patient wearing old dentures. The subject's view of the tray holding the 10 objects was obstructed and the first object was placed on the mid-dorsum of the tongue. The subject was allowed to move the tongue around the object to identify it. Test pieces were presented in a random order. Patients were asked to manipulate the test pieces inside the mouth and point out the correct figure from a chart of figures. Scoring was done in between 0 and 10 according to the number of correct answers. The results showed that the mean score was 5.78 without dentures and 7.65 with new dentures which was statistically significant. There was also a statistically significant difference in terms of the mean score when using newer dentures compared to older dentures. Overall, the new complete denture wearers showed improved stereognostic ability compared to the previous edentulous state and old denture wearing state.

Leung *et al*.[18] recruited edentulous patients with stroke and Parkinson's disease as a test group and age and gender-matched edentulous patients without these disorders as a control group to conduct a similar study. The test pieces were placed in a random order on the dorsum of the tongue using tissue forceps when the patient's eye was closed. Subjects were asked to determine the shape of the object then point to the corresponding picture

in a diagram. A correct identification was rated "0," an incorrect identification when an object of similar shape was chosen was rated "1," and an incorrect identification when an unrelated object was selected was rated "2." The tests were conducted with and without dentures. The time taken to identify the object was obtained using a stopwatch, within a maximum trial period of 180 s. A 3-point scale was used to determine the magnitude of the stereognostic error. Stereognostic ability test was carried out in between both the groups and the results were compared. Intragroup comparison was also done when patients were with or without dentures. In patients with stroke, there was no difference in mean response time with and without dentures. However, the difference was shown in the mean number of correct identifications ($P < 0.026$) with a higher number observed when dentures were worn, also a difference in the mean error score ($P < 0.015$) with fewer errors when dentures were worn. The mean oral motor ability time was also not significantly different in both the conditions. Patients with Parkinson's disease had significantly shorter mean response times when dentures were worn ($P < 0.017$). Control subjects also had significantly shorter mean response times in denture wearing conditions ($P < 0.001$). Overall results showed that OSA was better in all groups of patients with different medical histories when dentures were worn in terms of mean response time and mean errors during identification.

OSA in dentate persons and edentulous persons wearing complete dentures for >3 months was compared in another study.[14] Test pieces were presented in a random order and subjects were asked to identify correct test pieces from a picture of twelve similar figures. Time taken to identify the test pieces was noted and identification score was determined using 3-point scale like previous studies. A significantly higher score was obtained in younger dentate subjects (42 ± 6) compared to older dentate subjects (33 ± 7) and complete denture wearers (34 ± 9). Time taken to identify the test pieces was also shorter in case of younger dentate group compared to other groups. In edentulous subjects, test was performed in two conditions: one with the denture and other without dentures. The mean OSA score was lower ($P = 0.001$) and time taken to identification was longer ($P = 0.040$) when patients were without dentures. Older individuals showed lower score after removal of dentures compared to denture wearing conditions.

Meenakshi *et al*.[19] evaluated OSA of patients of the Indian population with an edentulous period of >3 months. The test was carried out just before denture insertion, 30 min after denture insertion, and 1 month after denture insertion. The mean OSA score was higher when measured 1 month of denture fabrication (OSA-11.86) compared with the condition before denture insertion (OSA– 9.33). Time taken during identification of test species also decreased to 5.57 (2.91) s from 13.38 (8.21) s 1 month after denture insertion. Overall, edentulous individuals without dentures scored low in terms of stereognostic ability when compared with the condition 30 min post insertion and 1 month post insertion of complete dentures.

Another prospective study checked the ability of the patients in three different conditions – before denture insertion, after denture insertion, and 6 months after denture insertion.[20] A 3-point scale (0, 1, and 2) was used for recording the oral stereognostic analysis score. Variation in OSA at different stages was measured by one-way repeated-measure ANOVA test. F value (187.49, $P < 0.01$) showed that the variation in OSA score at different intervals of time was significant at 0.01 level. The mean difference of score between before denture insertion and after denture insertion assessment was 2.55. Pairwise comparison using *post hoc* test with Bonferroni correction showed that the difference was statistically significant. The results showed that stereognostic ability improved after denture insertion, and after 6 months, stereognostic ability further increased statistically significantly.

Strength of this systematic review

This review is based on a well-defined PICOS question and inclusion and exclusion criteria. Assessments of the included studies have done according to the Newcastle–Ottawa Scale.

Limitations of this systematic review

Limitations of the study were like nonavailability of randomized controlled clinical trials and inclusion of literatures on English languages only.

Oral sensory and motor sensation got more attention in recent times beside from other parts of the body, which led investigators to extend the exploration of tactile perception of form intraorally. Reprograming of the masticatory system occurs due to tooth loss in oral health of edentulous subjects. The loss of sensory ability related to age may co-relate with the fact that edentulous patients become willing to swallow larger food boluses, implying that ability of estimation of the bolus size and shape decreases after transforming into a edentulous state.[11,30] All the studies supported the fact that complete dentures improved the mean oral stereognostic score than the edentulous condition and complete denture wearers took lesser time to correctly identify the test pieces. However,

due to heterogeneity of the study population and different scoring systems used in different studies, well-balanced randomized controlled clinical trial with a standardized design will further generate scientific evidence in this topic which can be updated by future systematic reviews.

CONCLUSION

All the included studies showed complete denture treatment therapy improved stereognostic ability in terms of correct identification of test pieces and time taken to identify the objects compared to the edentulous state. Stereognostic ability improved as the adaptation period increased after the rehabilitative procedure.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Lang NP, Lindhe J. Clinical Periodontology and Implant Dentistry. 6th ed. Chichester: Wiley Blackwell; 2015.
2. Henry EC, Marasco PD, Catania KC. Plasticity of the cortical dentition representation after tooth extraction in naked mole-rats. J Comp Neurol 2005;485:64-74.
3. Haggard P, de Boer L. Oral somatosensory awareness. Neurosci Biobehav Rev 2014;47:469-84.
4. Irving JB. Stereognosis. Res Medica 1968;6:1-5.
5. Jacobs R, Wu CH, Goossens K, Van Loven K, Van Hees J, Van Steenberghe D. Oral mucosal versus cutaneous sensory testing: A review of the literature. J Oral Rehabil 2002;29:923-50.
6. Nordin M, Hagbarth KE. Mechanoreceptive units in the human infra-orbital nerve. Acta Physiol Scand 1989;135:149-61.
7. Trulsson M, Johansson RS. Orofacial mechanoreceptors in humans: Encoding characteristics and responses during natural orofacial behaviors. Behav Brain Res 2002;135:27-33.
8. Miyamoto JJ, Honda M, Saito DN, Okada T, Ono T, Ohyama K, *et al*. The representation of the human oral area in the somatosensory cortex: A functional MRI study. Cereb Cortex 2006;16:669-75.
9. Habre-Hallage P, Dricot L, Jacobs R, van Steenberghe D, Reychler H, Grandin CB. Brain plasticity and cortical correlates of osseoperception revealed by punctate mechanical stimulation of osseointegrated oral implants during fMRI. Eur J Oral Implantol 2012;5:175-90.
10. Khajuria RR, Safaya R, Singh R. Comparative evaluation of oral stereognosis in dentulous and edentulous patients: An original research. Ann Dent Spec 2017;5:107-9.
11. Garrett NR, Kapur KK, Jochen DG. Oral stereognostic ability and masticatory performance in denture wearers. Int J Prosthodont 1994;7:567-73.
12. Boliek CA, Rieger JM, Li SY, Mohamed Z, Kickham J, Amundsen K. Establishing a reliable protocol to measure tongue sensation. J Oral Rehabil 2007;34:433-41.
13. Berry DC, Mahood M. Oral stereognosis and oral ability in relation to prosthetic treatment. Br Dent J 1966;120:179-85.
14. Ikebe K, Amemiya M, Morii K, Matsuda K, Furuya-Yoshinaka M, Nokubi T. Comparison of oral stereognosis in relation to age and the use of complete dentures. J Oral Rehabil 2007;34:345-50.
15. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, *et al*. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. PLoS Med 2009;6:e1000100.
16. Lo CK, Mertz D, Loeb M. Newcastle – Ottawa scale: Comparing reviewers' to authors' assessments. BMC Med Res Methodol 2014;14:45.
17. Mantecchini G, Bassi F, Pera P, Preti G. Oral stereognosis in edentulous subjects rehabilitated with complete removable dentures. J Oral Rehabil 1998;25:185-9.
18. Leung KC, Pow EH, Mcmillan AS, Wong MC, Li LS, Ho SL. Oral perception and oral motor ability in edentulous patients with stroke and Parkinson's disease. J Oral Rehabilitation 2002;29:497-503.
19. Meenakshi S, Gujjari AK, Thippeswamy HN, Raghunath N. Evaluation of oral stereognostic ability after rehabilitating patients with complete dentures: *In vivo* study. J Indian Prosthodont Soc 2014;14:363-8.
20. Mary KM, Cherian B. Evaluation of oral stereognosis, masticatory efficiency, and salivary flow rate in complete denture wearers. J Indian Prosthodont Soc 2020;20:290-6.
21. Litvak H, Silverman SI, Garfinkel L. Oral stereognosis in dentulous and edentulous subjects. J Prosthet Dent 1971;25:139-51.
22. Müller F, Link I, Fuhr K, Utz KH. Studies on adaptation to complete dentures. Part II: Oral stereognosis and tactile sensibility. J Oral Rehabil 1995;22:759-67.
23. Pow EH, Leung KC, McMillan AS, Wong MC, Li LS, Ho SL. Oral stereognosis in stroke and Parkinson's disease: A comparison of partially dentate and edentulous individuals. Clin Oral Investig 2001;5:112-7.
24. Ikbal LK, Kerem K, Ravza E, Damla U, Ahmet Ç, Bülent K, *et al*. Evaluation of oral stereognosis in relation to tactile ability and patient satisfaction. J Oral Implantol 2017;43:468-75.
25. 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;63:105-9.
26. Figueredo OM, Camara-Souza MB, Carletti TM, RosariodeSousa MD, Garcia RC. Mastication and oral sensory function in frail edentulous elderly: A case-control study. Int Dent J 2020;70:85-92.
27. 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. Dent Res J (Isfahan) 2019;16:122-6.
28. Rossetti PH, Bonachela WC, Nunes LM. Oral stereognosis related to the use of complete dentures: A literature review. Int J Oral-Med Sci 2004;2:57-60.
29. Jacobs R, Wu CH, Van Loven K, Desnyder M, Kolenaar B, Van Steenberghed D. Methodology of oral sensory tests. J Oral Rehabil 2002;29:720-30.
30. Jacobs R, Bou Serhal C, van Steenberghe D. Oral stereognosis: A review of the literature. Clin Oral Investig 1998;2:3-10.