

## Evaluation of oral stereognosis in completely edentulous patients with palatal tori.

Evaluación de la estereognosis oral en pacientes completamente edéntulos con toros palatinos.

Indumathi Sivakumar.<sup>1</sup>

Rachel Chua Hui Shien.<sup>2</sup>

Nur Lyanna Mahfuzah Binti Mohamad Johar.<sup>3</sup>

Sham Wern Xuan.<sup>4</sup>

Sin Pi Xian.<sup>5</sup>

### Affiliations:

<sup>1</sup>Faculty of Dentistry, SEGi University, Selangor, Malaysia.

<sup>2</sup>Klinik Pergigian Sultan Ismail Hospital, Johor, Malaysia

<sup>3</sup>Klinik Pergigian Kota Samarahan, Sarawak, Malaysia

<sup>4</sup>Klinik Pergigian Hospital Kuala Lumpur, Federal Territory of Kuala Lumpur, Malaysia

<sup>5</sup>Klinik Pergigian Simpang Lima, Klinik Pergigian Simpang Lima, Selangor, Malaysia

**Corresponding author:** Indumathi Sivakumar. Faculty of Dentistry, SEGi University, No. 9, Jalan Teknologi, Taman Sains Selangor, Kota Damansara PJU 5,47810 Petaling Jaya, Selangor Darul Ehsan, Malaysia. **E-mail:** cherub2008@gmail.com

Receipt : 06/24/2020 Revised: 10/26/2020

Acceptance: 02/28/2021

**Cite as:** Sivakumar I, Shien RCH, Johar NLMBM, Xuan SW & Xian SP.

Evaluation of oral stereognosis in completely edentulous patients with palatal tori.

J Oral Res 2021; 10(1):1-8.

Doi:10.17126/joralres.2021.009

**Abstract: Background:** The corollary is not investigated in the completely edentulous patients with palatal tori. **Objective:** The aim of this study was to assess the oral stereognostic ability in completely edentulous patients with palatal tori. **Material and Methods:** Thirty-four completely edentulous patients aged 50 to 89 years were allocated to Group 1 (without palatal tori, n=18) and Group 2 (with palatal tori, n=16). The oral stereognostic test was conducted using 6 intraoral test pieces (circle/square/rectangle/triangle/plus/toroid) that were fabricated to standard dimensions using the light cure acrylic resin. Each test piece was placed in the patient's mouth and was asked to manipulate the test piece between the tongue and the palate. The patients identified the shapes by matching them on a shape chart. Each correct identification was assigned a score of 1. The response time taken to identify each shape was recorded. Statistical computation was done using a chi - square test and Mann-Whitney U test. **Results:** Significant difference was observed in the overall scoring percentages between the 2 groups ( $p<0.05$ ). Group 2 had lower oral stereognostic scores compared to group 1 ( $p<0.05$ ). There was no statistically significant difference in the mean response time for identifying the shapes among the groups, however group 2 patients had longer response time. **Conclusion:** Oral stereognostic ability of the completely edentulous patients with torus palatinus was lower when compared to completely edentulous patients without tori.

**Keywords:** Stereognosis; form perception; exostoses; hard palate; edentulous mouth; complete denture.

**Resumen: Antecedentes:** el corolario no se investiga en los pacientes completamente desdentados con toros palatinos. **Objetivo:** El objetivo de este estudio fue evaluar la capacidad estereognóstica oral en pacientes completamente edéntulos con toros palatinos. **Material y Métodos:** Treinta y cuatro pacientes completamente edéntulos de 50 a 89 años fueron asignados al Grupo 1 (sin toros palatinos, n = 18) y al Grupo 2 (con toros palatinos, n = 16). La prueba estereognóstica oral se realizó utilizando 6 piezas de prueba intraorales (círculo / cuadrado / rectángulo / triángulo / cruz / aro) que se fabricaron a dimensiones estándar utilizando la resina acrílica fotopolimerizable. Cada pieza de prueba se colocó en la boca del paciente y se le pidió que manipulara la pieza de prueba entre la lengua y el paladar. Los

pacientes identificaron las formas haciéndolas coincidir en un gráfico de formas. A cada identificación correcta se le asignó una puntuación de 1. Se registró el tiempo de respuesta necesario para identificar cada forma. El cálculo estadístico se realizó mediante la prueba de chi-cuadrado y la prueba U de Mann-Whitney. **Resultados:** Se observó una diferencia significativa en los porcentajes de puntuación generales entre los 2 grupos ( $p < 0,05$ ). El grupo 2 tuvo puntuaciones estereognósticas orales más bajas en comparación con el grupo 1 ( $p < 0,05$ ). No hubo

diferencia estadísticamente significativa en el tiempo medio de respuesta para identificar las formas entre los grupos, sin embargo, los pacientes del grupo 2 tuvieron un tiempo de respuesta más largo. **Conclusión:** La capacidad estereognóstica oral de los pacientes completamente edéntulos con torus palatino fue menor en comparación con los pacientes completamente edéntulos sin torus.

**Palabra Clave:** Estereognosis; percepción de forma; exostosis; paladar duro; boca edéntula; dentadura completa.

## INTRODUCTION.

Stereognosis has been defined as an appreciation of the form of an object by manual palpation without the use of eyesight. In the medical field, the stereognostic test has been used as a tool to determine the function of the parietal lobe of the brain.<sup>1</sup> The same concept was extended to dentistry by Berry and Mahmood as oral stereognosis (OS).<sup>2</sup> OS is defined as the neurosensorial ability of the oral mucous membrane to recognize and discriminate the forms of the objects in the oral cavity.<sup>2</sup>

Oral stereognostic tests are performed using test specimens to determine the extent to which a patient can distinguish various shapes and surface structures by oral manipulation.<sup>3</sup> The OS testing serves as an indicator for the overall sensory ability of the patient as the intraoral tactile sensation is conveyed through various cranial nerves.<sup>4</sup>

Various studies assessed the oral stereognostic ability (OSA) by using a variety of test pieces with different shapes, materials, textures, temperature and sizes.<sup>5-7</sup> Studies reported that OSA decreased with age,<sup>8,9</sup> and completely edentulous patients had lower OSA than the dentate patients.<sup>11</sup> Studies that evaluated the OS in patients who wear complete dentures reported that there was a significant relationship between the OSA scores and denture satisfaction.<sup>12-14</sup> Patients with poor OSA appeared to be more satisfied with their complete denture prosthesis than those with better stereognostic ability.<sup>13,14</sup> Studies have also indicated that the OSA could be useful in interpreting the edentulous patients' ability to adapt to a new prosthesis.<sup>11,12</sup>

Scientific literature reported that the mechanoreceptors located in the tongue and palate play a major role in oral tactile sensation.<sup>7,16</sup>

When the test pieces are manipulated by the tongue against the palatal surface, it activates the mechanoreceptors to send impulses to the brain cortex where the sensations produced are synthesized and compared with previous memories.<sup>4</sup> Thus it is possible to speculate, whether compromised palatal conditions like cleft palate or presence of torus palatinus could affect oral stereognosis. Among denture wearing cleft palate patients, the OS levels were lower than those observed in edentulous subjects without clefts.<sup>17-19</sup> However, there are no studies evaluating the effect of torus palatinus on OSA.

Torus palatinus are bony protuberance commonly found along the midline of the hard palate, with a prevalence rate of 8% to 60 % among the global population.<sup>20-23</sup> While the exact pathogenesis of torus palatinus is unclear, researchers have identified that torus could have a multifactorial etiology. The torus palatinus may appear as a small elevation to large, multilobular swelling. Based on morphology, tori can be characterized as flat, spindle, nodular, and lobular subtypes.<sup>24</sup> Generally, tori remain asymptomatic and do not require any treatment. However, large tori are prone to trauma from eating, which could cause superficial abrasion or ulceration as the mucosa covering the tori would be thin and relatively avascular.<sup>25</sup>

The comfort and compliance of these patients to the denture therapy, in the long run, remains questionable. The complete denture in oral rehabilitation is an ever-increasing need for various global population, despite the recommendation of minimum standard of care with one or two implant supported overdentures in the developed nations.<sup>26</sup> So, analyzing the OSA status in completely edentulous patients with torus palatinus

will help to predict their adaptive capacity when these patients are rehabilitated with complete dentures. This study aimed to evaluate the oral stereognosis in completely edentulous patients with palatal tori. The null hypothesis was that, the presence of torus palatinus would not affect oral stereognosis in completely edentulous patients.

## MATERIALS AND METHODS.

At the outset, ethical clearance was obtained from the university ethics committee (Ref no: SEGIEC/SR/FOD/2018-19/10) and the study protocol was registered (ClinicalTrials.gov Identifier: NCT04254848).

The sample size was calculated using G power software considering 95% confidence level and 80% power with standard deviation of 1.63 and the expected difference in oral stereognosis score between the groups was 1.55. Accordingly, the sample size was 28.

An increase in sample size was decided to account for any dropouts (20%). Data regarding patients age, gender, period of edentulousness, history of denture wearing, presence or absence of tori was recorded.

The study group consisted of 18 completely edentulous patients without torus palatinus (Group 1) and 16 completely edentulous patients with torus palatinus (Group 2), and who were willing to participate in this study. The size of the tori ranged from small to large. Morphology of the tori in group 2 patients varied between flat, nodular, and lobular type. Location of the tori was observed to be in the center of the palate. Patients with swallowing and mastication dysfunctions, cognitive disturbances, oral lesions/pathologies, TMJ disorders, systemic diseases, history of medications that reduced the salivary flow, and allergic to acrylic resin were excluded from the study.

Thus, patients who fulfilled the inclusion and the exclusion criteria were selected from the outpatient department of the SEGi Oral Health Centre. Informed consent was obtained from each patient following a thorough explanation of the purpose and contents of the research.

### Fabrication of test samples

Six test pieces were selected from the 20 shapes of test pieces prescribed by the National Institute of Dental Research (NIDR).<sup>27</sup> The test pieces comprised six shaped forms which included circle, plus, square, rectangular, triangle, and toroid. Six test piece molds were made from 0.081 inch thick stainless steel wire,

conforming to the standard dimension (13mm length, 10mm wide and 2mm thickness) prescribed by NIDR.<sup>27</sup>

Using the six test piece molds, light cured acrylic resin test pieces were fabricated. The test pieces were trimmed and polished to meet the standardized measurements (Figure 1). A total of 204 test samples (6 samples for each patient) for 34 completely edentulous patients were made for the study. The dental floss was attached to each test piece to prevent any accidental aspiration during the maneuver.

### Assessment of oral stereognostic test

The OSA test was conducted in the SEGi Oral Health Centre under quiet conditions. The patient was seated comfortably in an upright position on the dental chair. A simple randomization technique was used to randomize the test pieces. Each test piece name was written on a piece of paper and folded into a small lot. The lots were shuffled and drawn by one of the research members. Accordingly, the order in which the test piece shape that should be used was determined. All the test pieces were kept out of the patient's sight before and during the test. With the patient's eye closed, a test piece was placed inside the patient's mouth. The patient was instructed to identify the shape of the test piece by manipulating them using tongue and palate.

A visual representation chart of all 6 shaped forms was provided to the patient for identification purposes. The patient identified the shape form by pointing out the corresponding shape form on the chart (Figure 2). There was no trial test held to avoid the learning effect. The procedure was repeated for all the 6 test pieces. The 6 test pieces were presented randomly to the patient and correct answers were not informed to them during the OSA test to minimize bias in the responses from the patient. All the responses from the patients were collected by a single operator (S.P.X).

The test answers were recorded on an OSA evaluation form. A score of 1 was given for each correct identification. The maximum OS score was 6. The response time for recognition of each shaped form for each patient was recorded using a digital stopwatch. The response time was the time between the placement of the test piece in the oral cavity until identification of the test piece shape.

### Statistical analysis

The data was entered into a Microsoft Excel (Microsoft Corp., Redmond, WA) spreadsheet. Data analyses were conducted using SPSS version 22.0 software package

(SPSS Inc, Chicago, IL). Descriptive statistics were used to analyze the mean and standard deviation of the OSA test scores and the response time. Pearson's chi-Square test was used to compare the individual and

overall OSA scoring percentages between the 2 groups. Mann-Whiney U test was used to compare the mean OSA scores and response time taken between the two groups. Statistical significance was set at  $p < 0.05$ .

Figure 1. Search and selection flow chart.

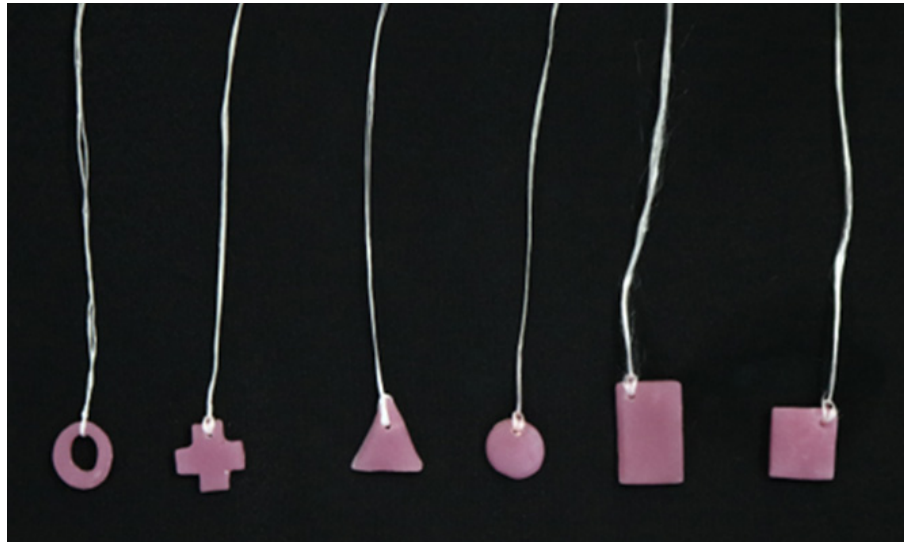
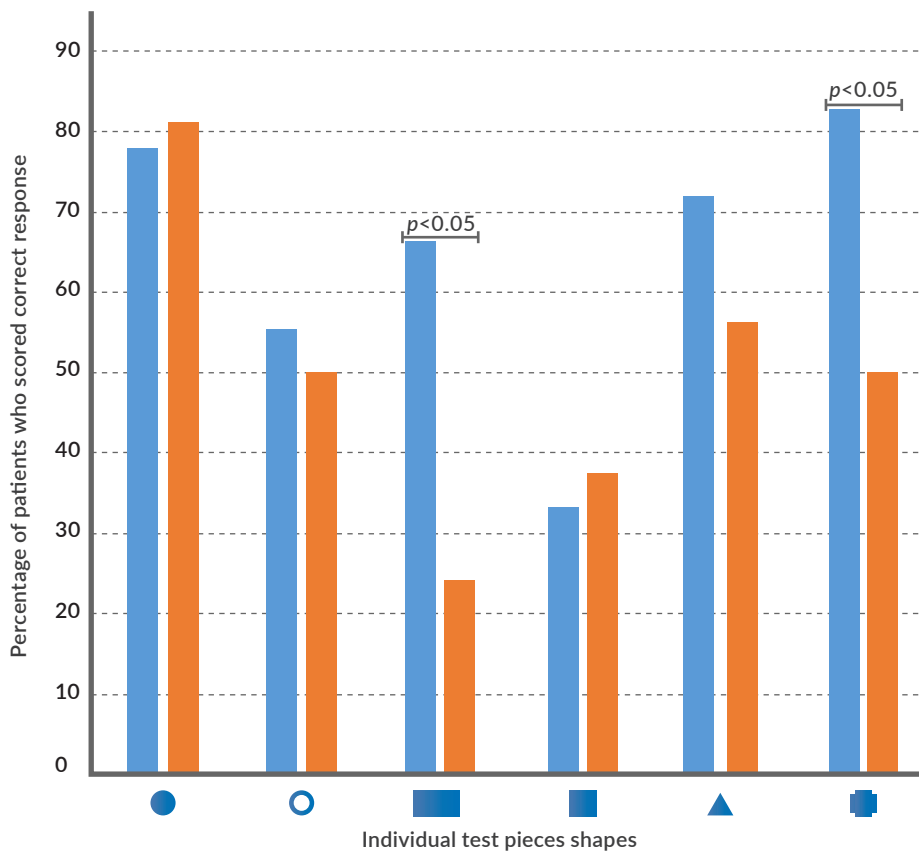


Figure 2. Comparison of mean OSA scores for individual test piece shapes between group 1 and group 2.



**Table 1.** Standard descriptive statistics for Group 1 and Group 2.

Group	N	Mean age	Age Median	SD	Sex	Previous denture wearers %	Mean OSA score	SD	Standard error mean	Mean response time (seconds)	SD	Standard error mean
1	18	67.8	64	9.99	M-8 F-11	55.5	4.0	1.57	.370	64.87	30.47	7.183
2	16	63.8	65	9.95	M-7 F-9	50	3.0	2.06	.516	87.08	37.89	9.474

SD: Standard Deviation. OSA: Oral stereognosticability. M: Male. F: Female.

**Table 2.** Overall OSA scoring percentages for Group1 and Group 2.

		OSA score							Total	p-value <sup>†</sup>
		0	1	2	3	4	5	6		
<b>Overall sample</b>	Number of patients	1	7	3	3	7	8	5	34	
	% of overall score	2.9	20.6	8.8	8.8	20.6	23.5	14.7	100	
<b>Group 1</b>	Number of patients (%)	0 (0)	1 (14.3)	3 (100)	3 (100)	2 (28.6)	6 (75)	3 (60)	18	0.03*
	% of overall score	0	2.9	8.8	8.8	5.9	17.6	8.8	52.9	
<b>Group 2</b>	Number of patients (%)	1 (100)	6 (85.7)	0 (0)	0 (0)	5 (71.4)	2 (25)	2 (40)	16	
	% of overall score	2.9	17.6	0.0	0.0	14.7	5.9	5.9	47.1	

†: Pearson chi square. OSA: Oral stereognostic ability. \*: Significant at 0.05 level.

**Table 3.** Response time for the individual OSA test piece for both groups.

OSA test piece	Group	N	Mean (seconds)	SD	Standard error mean	p-value <sup>†</sup>
Circle	1	18	9.42	9.48	2.23	.443
	2	16	9.86	6.61	1.65	
Toroid	1	18	11.91	6.63	1.56	.384
	2	16	14.36	9.53	2.38	
Rectangle	1	18	9.15	4.83	1.13	.050*
	2	16	15.55	9.92	2.48	
Square	1	18	12.04	5.74	1.35	.144
	2	16	17.67	10.12	2.53	
Triangle	1	18	11.18	10.02	2.36	.281
	2	16	12.92	8.17	2.04	
Plus	1	18	11.15	10.31	2.43	.198
	2	16	16.70	12.17	3.04	

SD: Standard Deviation. † : Mann-Whitney U test. \*: Significant at p<0.05.

## RESULTS.

Eighteen completely edentulous patients without torus palatinus (group 1) and 16 completely edentulous patients with torus palatinus (group 2) participated in the study. Descriptive data regarding the OSA test scores for both the groups were tabulated (Table 1).

The mean OSA score for group 1 was 4, and group 2 was 3. The mean response time for group 1 and 2 were 64.87 and 87.08 seconds, respectively. The percentage of OSA scores within the group and between the two groups for individual test shapes were determined. The overall scoring percentage for both groups was calculated. The data were analyzed and compared using Pearson's chi-square test (Table 2).

The OSA scores for group 2 were lesser compared to group 1 and were statistically significant ( $p < 0.03$ ). In group 1, 9 patients (50%) had a score of either 5 or 6 compared to 4 patients in group 2 (25%). Six patients in group 2 (37.5%) scored only 1 in OS score compared to 1 patient in group 1. Thus, the oral stereognosis in completely edentulous patients with tori was found to be lower than the patients without tori. The rectangle shape showed a statistically significant difference ( $p < 0.039$ ), when the mean OSA score of individual shapes were compared between the groups (Figure 2).

Mean and standard deviations were listed for the response time and Mann-Whiney U test was used to compare the response time between the two groups (Table 3).

There was no statistically significant difference between the mean scores of the response time between the two groups. However, patients in group 2 had a longer response time when compared to group 1 for all the 6 test shapes. When the response time of individual shapes were compared between the groups, the rectangle shape had a statistically significant difference ( $p < 0.02$ ). Higher response time indicated a lower oral stereognostic ability.

## DISCUSSION.

Oral stereognosis has been noted as a predictor for determining the edentulous patients' ability to adapt to a new prosthesis.<sup>11,12</sup> The status of OSA in compromised palatal conditions like torus palatinus is unknown. Patients with torus palatinus are reported to have questionable satisfaction with complete dentures owing to trauma or ulceration of the mucosa covering the tori, speech difficulties due to limited tongue

movement, and poor biomechanical design of the dentures.<sup>28,29</sup> Investigating the OSA status of this cohort group could provide important data when rehabilitating these patients with complete dentures. So, the stimulus of the present study was an idea to explore the OSA in completely edentulous patients with torus palatinus that can help to predict their adaptive capability to the new prosthesis.

Scientific literature reported that the midline and perioral structures have high mechanoreceptor innervation density.<sup>30,31</sup> The tip of the tongue and the hard palate were found to display a low threshold for a light touch. Additionally, these areas were also highly sensitive for two-point discrimination (the ability to differentiate between smaller differences between two points) test.<sup>31</sup> This implied that higher the mechanoreceptor density better the oral tactile perception. In the present study, which evaluated the OSA in the torus patients found the OSA scores to be lower, indicating a poor oral tactical perception in these patients. This could probably be attributed to the lower mechanoreceptor innervation density on the palatal mucosa covering the tori. Another possible reason could be attributed to the size of the receptive field of the mechanoreceptors.<sup>31</sup> Probably, the mechanoreceptors on the mucosa covering the torus palatinus have large receptive fields that can perceive changes over a wider area, but are less precise in perception.

Studies that evaluated the oral stereognosis in edentulous patients rehabilitated with complete dentures reported that patients with lower OSA had fewer denture-related problems and were found to be more satisfied with the dentures.<sup>12-15</sup> Patients who demonstrated high OSA scores presumably perceive more accurate sensorial data about their mouth as a whole and the objects placed in their mouth than the patients with lower scores.

Accordingly, they were reported to have more complaints and needed more denture adjustments during the post-insertion phase. In the present study, the completely edentulous patients with torus palatinus had a lower overall percentage of OSA scores compared to edentulous patients without tori. This could indicate that the completely edentulous patients with torus palatinus can easily adapt to the denture.

The assumption based on this study result could be validated only when these patients are rehabilitated with complete dentures and oral stereognosis is evaluated

with and without a complete denture prosthesis. This could be the future scope of the present study.

Engelen et al reported that oral size perception resulted from a combination of sensory inputs from the palate and the tongue.<sup>16</sup> Though the tongue plays a vital role, the palate provides a surface against which the object is manipulated.<sup>18</sup> When OSA was evaluated in similar compromised palatal conditions like cleft palate, the OSA was found to be lower compared to patients without a cleft.<sup>17-19</sup> Authors believed that in cleft palate conditions the absence of palatal completeness, and deficient surface area could be some of the possible reasons for lower oral stereognosis.<sup>18</sup> The results of the present study are in agreement with the results of the studies which evaluated OSA in cleft palate patients.

Epidemiological data indicates a growing need for rehabilitation among the elderly edentulous population.<sup>26</sup> Despite the phenomenal success of implant supported prosthesis, complete denture is the preferred treatment choice in most developing countries. Even though the patients experience difficulty in adapting to complete denture, majority are satisfied.<sup>26</sup> Torus palatinus is considered as an impediment to complete denture therapy.<sup>25</sup> Given the prevalence of 8 to 60% among the global population, elderly edentulous population with torus cannot be neglected.<sup>20-23</sup>

The results obtained from the present study, which is first of its kind, may help predict the adaptive capability of the completely edentulous patients with torus palatinus who would eventually undergo complete denture therapy. This method can be a tool to evaluate the adaptability and future prognosis of the prosthesis in completely edentulous patients. The findings may be applicable to the global population who have similar sociodemographic characteristics of the present study sample. However, some methodological limitations must be contemplated when inferring the study outcomes. First, the present study did not consider the size of the tori. Whether the effect of a large tori on the OSA has a similar effect as a small tori, is unknown. Further research is needed to validate this assumption with adequate segregation of the samples based on the size of tori. Second, surface texture recognition and weight perception were not considered in the study design.

## CONCLUSION.

Within the limitations of the study, the following conclusions could be drawn: The OSA was significantly reduced in completely edentulous patients with torus palatinus. Additionally, completely edentulous patients with torus palatinus had longer response time than patients without tori, though statistically insignificant.

---

**Conflict of interests:** The authors report having no conflicts of interest.

**Ethics approval:** Approved by the SEGi University Ethics Committee, authorization code: SEGiEC/SR/FOD/2018-19/10.

**Funding:** None.

**Authors' contributions:** Sivakumar: Conceptualization, Methodology, Writing- Original draft preparation, Investigation. Shien: & Xuan: Writing- Original draft preparation, Investigation, formal analysis. Binti, Xuan & Xian: Writing- Review & Editing.

**Acknowledgements:** The authors would like to thank all the participants of this study for their cooperation and support.

## REFERENCES.

1. Silvestri LA, Silvestri AE. Saunders Comprehensive Review for the NCLEX-RN® Examination. 8th Edition. Saunders. 2020
2. Berry DC, Mahood M. Oral stereognosis and oral ability in relation to prosthetic treatment. Br Dent J. 1966;120(4):179-85.
3. Chauvin JO, Bessette RW. Oral stereognosis as a clinical index. NY State Dent J 1974;40:543-546.
4. Capra NF. Mechanisms of Oral Sensation. Dysphagia. 1995;10:235-247.
5. Landt H. Oral and manual recognition of forms. Part I. Test results based on the test pieces. Swed Dent J. 1976;69:15-23.
6. Landt H. Oral and manual recognition of forms. Part I. Test results based on the test pieces. Sven Tandlak Tidskr. 1976;69(1):15-23
7. Jacobs R, Bou Serhal C, van Steenberghe D. Oral stereognosis: a review of the literature. Clin Oral Investig. 1998;2:3-10.
8. Landt H, Fransson B. Oral ability to recognise forms and oral muscular coordination ability in young and elderly adults. J Oral Rehabil. 1975;2:125-38.
9. Park JH. Changes in oral stereognosis of healthy adults by age. J Oral Sci. 2017;59:71-6.
10. Litvak H, Silverman SI, Garfinkel L. Oral stereognosis in dentulous and edentulous subjects. J Prosthet Dent. 1971;25:139-51.
11. 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.
12. 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.
13. 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.
14. 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.
15. Singh V, Mattoo KA. Oral Stereognosis pattern in patients with dental prosthesis in the elderly population. Int J Clin Exp Physiol 2014;1(3):211-5.
16. Engelen L, Prinz JF, Bosman F. The influence of density and material on oral perception of ball size with and without palatal coverage. Arch Oral Biol. 2002;47:197-201.
17. Bakhtiyari J, Dadgar H, Sadolahi A, Khatoonabadi AR. Oral Stereognosis in children with cleft palate and normal children. Middle East J Rehabil Health. 2014;1:e20840.
18. Hochberg I, Kabcenell J. Oral stereognosis in normal and cleft palate individuals. Cleft Palate J. 1967;4:47-57.
19. Pedreira APRV, Bonachela WC, Rossetti PHO, Pinto JHN. Oral stereognosis in dentate and edentulous subjects with and without cleft lip and palate before and after chewing. Int J Oral-Med Sci. 2004;3:61-5.
20. Sathya K, Kanneppady SK, Arishiya T. Prevalence and clinical characteristics of oral tori among outpatients in Northern Malaysia. J Oral Biol Craniofac Res. 2012;2:15-19.
21. Kumar Singh A, Sulugodu Ramachandra S, Arora S, Dicksit DD, Kalyan CG, Singh P. Prevalence of oral tori and exostosis in Malaysian population- A cross-sectional study. J Oral Biol Craniofac Res. 2017;7:158-60.
22. Chohayeb AA and Volpe AR. Occurrence of torus palatinus and mandibularis among women of different ethnic groups. Am J Dent. 2001;14(5):278-80.
23. Garcia-Garcia AS, Martinez-Gonzalez JM, Gomez-Font R, Soto-Rivadeneira A, Oviedo-Roldán L. Current status of torus palatinus and torus mandibularis. Med Oral Pathol Oral Cir Bucal. 2010;15:353-60.
24. Kilic K, Kurtulus I L, Eraslan R, Zararsiz G, Kesim B. Effects of attachment type and palatal coverage on oral perception and patient satisfaction in maxillary implant-supported complete denture patients. Niger J Clin Pract. 2019;22:669-74.
25. Loukas M, Hulsberg P, Tubbs RS. The tori of the mouth and ear: a review. Clin Anat. 2013;26:953-60.
26. Carlsson GE, Omar R. The future of complete dentures in oral rehabilitation. A critical review. J Oral Rehabil 2010;37:143-56.
27. Oral Pharyngeal Development Section, National Institute of Dental Research of Health NIDR1980. Available at: <https://www.nih.gov/about-nih/what-we-do/nih-almanac/national-institute-dental-craniofacial-research-nidcr>.
28. Neville BW, Damm DD, Allen CM, Chi AC: Oral and Maxillofacial Pathology (Ed 4). London, Elsevier Inc ,2016
29. Forghani, Smoker WRK, Curtin HD: Pathology of the oral region in Son PM, Curtin HD (Eds): Head and Neck Imaging. (Ed 5). London, Mosby Inc, 2011
30. Trulsson M, Johansson RS. Orofacial mechanoreceptors in humans: encoding characteristics and responses during natural orofacial behaviors. Behav Brain Res. 2002; 135:27-33.
31. Haggard P, Boer L. Oral somatosensory awareness. Neurosci Biobehav Rev. 2014;47:469-84.