

Original Article

Clinical Evaluation of The Maxillary Speech Obturator Constructed of Two Different Denture Base Materials in Patients with Soft Palatal Defects

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Abstract

Aim: This study intended to evaluate the retention and patient satisfaction of two different denture base materials in the maxillary speech obturator in patients with soft palatal defects. **Subjects and methods:** Ten patients with unilateral hard and soft palate defects were carefully chosen from the Maxillofacial Prosthodontic Unit, Faculty of Oral and Dental Medicine, Cairo University. The patients were randomly divided into two groups. Group I received maxillary speech obturators constructed with soft acrylic applied on the posterior part of the obturator. Group II: received maxillary speech obturators constructed with versacryl applied on the posteriort part of the obturator. **Results:** Regarding to the retention outcomes were revealed that (Group I) showed a statistically significant higher mean retention values than (Group II) in all intervals after 1week of insertion, 1month, 3 months and 6 months. while Regarding to the patient satisfaction results of this study was revealed that (Group I) showed a higher statistically significant mean values of patient satisfaction scores regarding evaluation of the masticatory efficiency, speech evaluation than (Group II) only after 6 months. On the other hand, regarding to stability and comfort evaluations there were no statistically significant difference between the two groups in the whole intervals.

Keywords: maxillary speech obturator, retention, patient satisfaction, flexible acryl.

I. INTRODUCTION

The main problem in patients with hard and soft palate resection, is the impairment of speech so that rehabilitation of those patients to restore a satisfactory degree of phonetics, mastication and deglutition is the purpose to be achieved in this study.¹

The soft palate is composed of several muscles: palatopharyngeus, palatoglossus, levator veli palatine,

tensor veli palatine, and musculus uvulae. These muscles are arranged on the right and left side and attached to the distal aspect of hard palate and then intermingle on the entire midline length of soft palate, forming an aponeurosis.²

The soft palate acts as a dynamic separator between oral and nasal cavity. The intimate velopharyngeal

closure occurs through a three-dimensional muscular valve between soft palate, lateral and posterior pharyngeal.³

Swallowing and creation most of speech sounds except the nasal consonants that required a complete velopharyngeal closure as the remaining part of velopharyngeal become open to allow transmission of sound into the nasal cavity, which is considered as a primary resonating chamber for these sounds.⁴

During Deglutition, the sphincter formed by the soft palate & pharyngeal walls tightly close and prevents any passage of liquid or food into the nasopharynx. ⁵

The change in the velopharyngeal mechanism may lead to velopharyngeal dysfunction this change might occur due to two causes, first of these causes is the (velopharyngeal insufficiency) in which there was deficiency of tissues for achievement of proper velopharyngeal closure, second cause is (velopharyngeal incompetence) in which there was lack of neuromuscular competence in the movement of velopharyngeal structures.⁶

Velopharyngeal insufficiency revealed mainly as hypernasality and air flow escape which can be notable by nasal resonance abnormalities and speech, while minor effects are speech articulation disorders.^{6,7}

The pharyngeal obturator is considered as a prosthetic management for the velopharyngeal insufficiency.⁸ It's a removable maxillary prosthesis either partial or complete denture base with a posterior extension used to reestablish the soft palatal defect and separate the nasopharynx and oropharynx during a deglutition and speech to ensure proper velopharyngeal closure.⁹

It also permits the patient to perform certain speech sounds such as plosives, consonants, or during blowing by controlling nasal emission during speech and moreover during deglutition it prevents the leakage of material into the nasal passage.¹⁰

So, the success of a prosthesis closing the soft palatal defect depends upon the proper adaptation of the uvular part of the obturator to the posterior and lateral pharyngeal walls. ^{4,11}

It is the reason why the use of flexible acrylic resin and resilient denture liners were advocated.

Versacryl with its flexible properties allow the dentist to apply dozens of new ways to improve retention. It can be incorporated using different rigidities for different purposes. This material can be softened in warm water and conform to the contours of soft tissue. When inserted and adapted in the mouth it will cool to body temperature and take a desired rigidity.¹²⁻¹⁹

Therefore, this study was conducted to evaluate the effect of constructing the uvular part of the prosthesis of two different denture base materials in maxillary definitive obturators constructed on the retention and the patient satisfaction outcomes for patients with hard and soft palatal defects using a patient satisfaction questionnaire.

II. SUBJECTS AND METHODS

A randomized clinical trial was used in this study. When patients were seen for initial records and consent, they were given a number from a sequence of opaque, sealed envelopes, and they were then assigned to one of the settings using a randomized table. The Prosthodontics Department personnel and the Research Ethics Committee at Cairo University's Faculty of Oral and Dental Medicine examined and approved the study's protocol.

A total of ten patients with unilateral hard and soft palate defects were carefully chosen from the Maxillofacial Prosthodontic Unit, Faculty of Oral and Dental Medicine, Cairo University, they are selected according to the following criteria:

- Both sexes were included.
- Patients exhibited hard and soft palatal defects with complete absence of the soft palate.
- The surgical wound should be completely healed.
- The upper arch with the maxillary defect was partially edentulous.
- The completely edentulous patients or patients with few remaining teeth were excluded from the study.
- Childrens were excluded from the study.
- Co-operative patients obeying instructions were selected.

Patients were informed about the research work, and consent was obtained. Only those who showed

cooperation and adherence to treatment and recall appointment were included. All the patients were randomly divided into two groups as mentioned before Group I received maxillary speech obturators constructed with soft acrylic application on the posterior part of the obturator. Group II: received maxillary speech obturators constructed with versacryl application on the posterior part of the obturator.

Steps of Definitive obturator construction

A perforated stock tray was selected and modified to record the whole defect either by reduction, bending or adding modeling wax* and a vaselinized gauze was used to block out the Undesirable undercuts in the defect.

Preliminary impression was finished with irreversible hydrocolloid impression material (Alginate)** using the previous modified stock tray and extended into the surgical cavity to replicate the undercuts of the surgical cavity as much as possible to the essential borders. Also, Mandibular preliminary impression was made with alginate impression.

After finishing the primary impression, it was removed and washed under running water and checked all the details and poured to obtain the diagnostic cast. The Diagnostic castes were surveyed to delineate the survey line, detect the guiding planes and measure the depth of the undercuts of the abutments then the suitable path of insertion was selected.

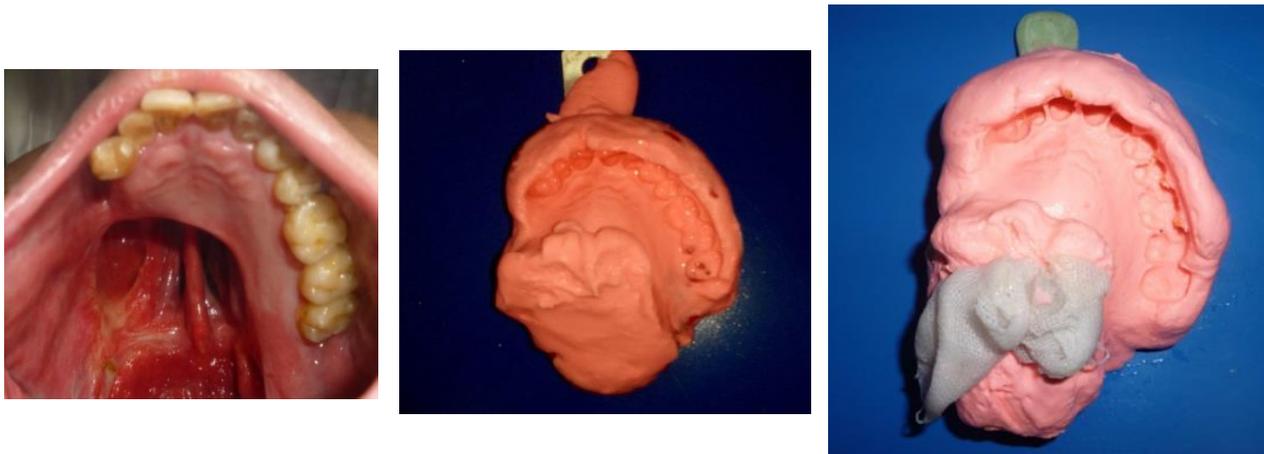


Figure (1) Left to right: Maxillary occlusal view; Maxillary primary impression; Maxillary secondary impression

Mouth preparation was done according to the planned design with Guiding planes were prepared on the distal surfaces of the abutments parallel to the selected path of insertion and the palatal tooth surface was modified to offer the proper better reciprocal clasps arms position.

Final impression was constructed using a special tray with applied two layers of wax spacer with four windows in areas of first premolar and first molar. The Modeling wax was used for border molding at the surgical site after trimming the borders until approximately 2mm space existed between the tray and the peripheral soft tissues. Then, tray resin was adjusted so that its posterior and lateral wall doesn't

contact with the lateral and posterior pharyngeal walls as the patient says "AH", this is aided by disclosing wax. The Undesirable undercuts were blocked with vaselinized gauze in the patient mouth. Then, the final impression was made with alginate impression material. the patient was instructed during impression making to move his head forward 30 degrees with the Frankfort plane and in a circular motion from side to side and to extend his head as far backward as possible and to say "AH" and swallow to activate the remaining velopharyngeal musculature and mold the impression material. After complete setting, the impression was boxed and poured into extra hard

stone to obtain the master cast. The refractory cast and wax pattern were constructed, and obturator framework was planned to fulfill the required retention, stability, support and reciprocation, the Support was achieved through multiple rests which were designed to fit over prepared rest seats on the intact side. The complete palatal plate major connector was recommended to resist anteroposterior dislodgment and the double Aker's retainer on the molars and gingival approaching on the remaining premolar was used to provide the obturator retention then, the metal meshwork was constructed to cover the defect side to be ready to receive acrylic resin. Try- in of the metal framework was done. Disclosing wax was used to ensure that all the components were accurately seated in their positions and remove any premature contact then, jaw relation registration using wax wafer technique were constructed.

Processing of the definitive obturator

In both groups, maxillary obturators were processed using conventional compression molding technique. Including flasking and wax elimination. Polymethylmethacrylate (Vertex regular, Zeist, Netherlands) material was mixed at a polymer: monomer ratio of 3:1 by volume. Once the acrylic resin reached the dough stage, it was packed in the flask then the flask was opened and the posterior part of the maxillary obturator of the previously packed acryl was removed and applied either soft acryl Vertex Soft-Dental, Zeist, Netherlands or versacryl (Keystone Industries GmbH, Germany)

- Group I: received maxillary speech obturators constructed with soft acrylic applied on the posterior part of the obturator.
- Group II: received maxillary speech obturators constructed with versacryl application on the posterior part of the obturator.

After that all maxillary obturators were processed in the curing unit for 90 mins at 70°C then 30 mins

at 100°C, bench cooled to room temperature for 30 minutes then finally was immersed in cold water for 15 minutes. After deflasking, finishing and polishing of the appliance was done and examined in the patient's mouth for any over extension or pressure areas by pressure indicating paste (PIP) * (Protechno, Advanced Products for Dental Labs, VILAMALLA (Girona), SPAIN). Retention of the maxillary obturators were measured by using a Digital Force meter. For precise measurement the dislodging forces should be equal distribution and centralized over the maxillary obturator and the occlusal plane of the maxillary teeth was parallel to the floor as much as we can by instructing the patients to sit in the upright position on the dental chair and fix their heads during the steps of examination.



Figure (2): Metal framework on refractory cast; Finished versacryl obturator

** Alginate CA3: superior pink, alginate impression material cavex Holland, RW Haarlem (Holland)

The maximum vertical dislodgment force was recorded in Newtons (N); each measurement was repeated five times, and the mean of those measurements was calculated and tabulated to represent the recorded retention value. Patients of both groups were asked for recall appointments 1 months ,3 months and 6 months following maxillary obturator insertion for assessment of the obturator's retention. Then, the Patients' satisfaction was also measured after 1week of the obturator insertion that considered after complete adjusting all premature contacts and pressure areas at the time of delivery by utilizing a customized chart of question where; Patients allowed to answer a sequence of questions to evaluate the maxillary obturator in terms of: masticatory efficiency, speech evaluation, stability and finally comfort. Each patient had to give a number describing his general satisfaction (5= Excellent, 4=very good, 3= good, 2= fair, 1= working, 0= not satisfied) Regarding the questions related to evaluate the previous outcomes. Patients of both groups were asked for recall appointments 1 months ,3 months and 6 months following maxillary obturator insertion for assessment of the patients' satisfaction. All the results were calculated, tabulated and then statistically analyzed.

Statistical Methods

Data was analyzed using Statistical Package for Social Science software computer program version 26 (SPSS, Inc., Chicago, IL, USA). Shapiro-wilk test was used to detect normal distribution of data. Quantitative parametric data was presented in mean and standard deviation while quantitative non-parametric data was presented in median & interquartile range (IQR). Student's t-

test(unpaired) was used for comparing two different groups of parametric data & repeated measures ANOVA (Analysis of variance) followed by post-hoc Bonferroni was used for comparing more than two related groups of parametric data while Mann Whitney was used for comparing two different groups of non-parametric data & Friedman's was used for comparing more than two related groups of non-parametric. *P* value less than 0.05 was considered statistically significant.

III. RESULTS

A. Retention results

Regarding the retention (force meter) measurements, the retention changes by time it was revealed between baseline and each interval in all groups were presented in figure (3). In this study the retention outcomes were revealed that (Group I) maxillary speech obturators constructed with soft acrylic applied on the posterior part showed a statistically significant higher mean retention values than (Group II): received maxillary speech obturators constructed with versacryl applied on the posterior part of the obturator in all intervals after 1week of insertion, 1month, 3months and 6months.

Within each group

Group I and Group II there were statistically significant decrease of the retention mean values after 6 months when compared with the retention mean value of 1 week after insertion , 1month and 3months within each group Also, there were statistically significant decrease of the retention mean values after 6 month when compared with all previous intervals in each group.

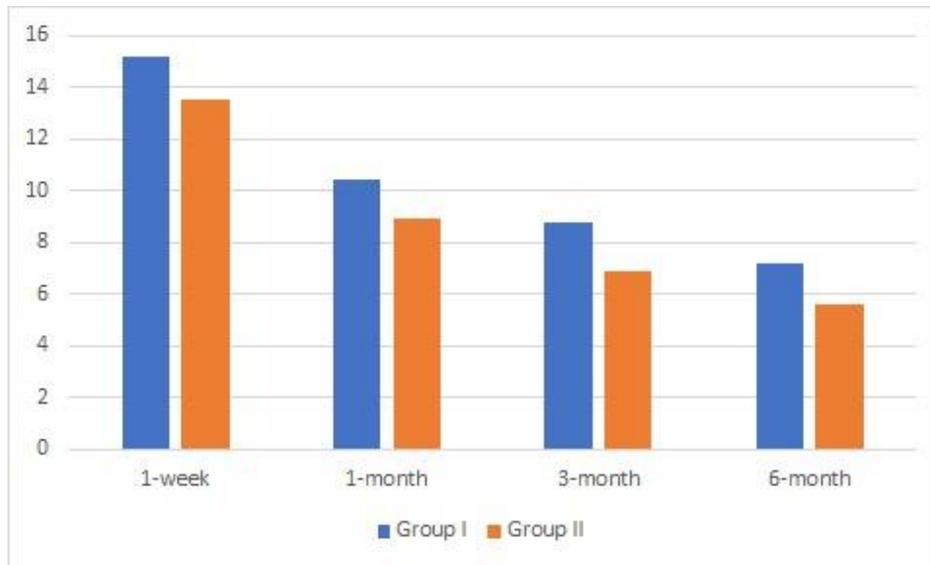


Figure (3): Comparison of retention data between Soft Acryle GROUP I and Versacryle GROUP II within different time periods

B. Patient satisfaction results

The Comparison between different groups in patient satisfaction was performed using Mann Whitney test followed by Friedman's in all intervals test Data expressed as Median (IQR) interquartile range. For multiple comparisons which revealed significant difference in means with different small superscript letters as $P < 0.05$, while revealed insignificant difference in means with the same small superscript letters as $P > 0.05$. The Comparison between the two groups revealed that (Group I) maxillary speech obturators constructed with soft acrylic applied on the posterior part showed a statistically significant higher mean values of patient satisfaction scores regarding evaluation of the masticatory efficiency, speech evaluation than (Group II): received maxillary speech obturators constructed with versacryl applied on the posterior part of the obturator only after 6 months as seen in table (1). On the other hand, regarding stability and comfort evaluations there were no statistically significant difference between the two groups in the whole intervals.

Within each group

Within group I there was high significant difference in all parameters.

C. Evaluation of Masticatory efficiency

(Group I) maxillary speech obturators constructed with soft acrylic applied on the posterior part showed high statistically significant difference after 3month when compared with the patient satisfaction after the insertion by 1week, also there was high statistically significant difference after 6 months when compared with the patient satisfaction after the insertion by 1week and 1month.

(Group II) Maxillary speech obturators constructed with versacryl applied on the posterior part of the obturator showed statistically significant increase after 3 months and 6 months while compared with the patient satisfaction after the insertion by 1week.

D. Speech Evaluation

(Group I and Group II) showed statistically significant increase after 3 months and 6 months when compared with the patient satisfaction records after 1week of the insertion.

E. Stability

There was statistically significant increase in patient satisfaction in each group after 6months when compared to the score records after 1week of the insertion and 1month.

F. Comfort

There was statistically significant increase in patient satisfaction in each group after 1, 3 and 6

months compared to the comfort of the obturator after the insertion by 1 week of insertion.

Table (1): The mean, standard deviation (SD) values and results of Mann-Whitney U test for comparison between patient satisfaction scores in the two groups. table (1)

		Group I	Group II	P1
Evaluation of Masticatory efficiency	After 1 week insertion	3.0(3.0-4.0)	3.0(2.0-3.0)	0.3
	1-month	4.0(3.0-5.0)	3.5(3.0-4.0)	0.3
	3-month	4.5(4.0-5.0) ^a	4.0(3.0-5.0) ^a	0.35
	6-month	5.0(5.0-5.0) ^{ab}	4.0(4.0-5.0) ^a	0.02*
	P2	<0.001*	0.01*	
Speech Evaluation	After 1 week insertion	2.0(2.0-3.0)	2.0(2.0-2.0)	0.35
	1-month	3.0(2.0-4.0)	2.0(2.0-3.0)	0.14
	3-month	4.0(3.0-5.0) ^a	3.0(2.0-3.0) ^a	0.06
	6-month	5.0(5.0-5.0) ^{ab}	4.0(3.0-4.0) ^{ab}	0.009*
	P2	<0.001*	0.009*	
Stability	After 1 week of insertion	3.0(2.0-4.0)	3.0(2.0-3.0)	0.57
	1-month	3.5(3.0-4.0)	3.0(3.0-4.0)	0.68
	3-month	4.0(4.0-5.0)	4.0(3.0-5.0) ^{ab}	0.85
	6-month	5.0(5.0-5.0) ^{ab}	5.0(4.0-5.0) ^{ab}	0.14
	P2	0.001*	0.001*	
Comfort	After 1 week of insertion	3.0(2.0-4.0)	2.5(2.0-3.0)	0.48
	1-month	4.0(4.0-5.0) ^a	4.0(3.0-5.0) ^a	0.8
	3-month	5.0(4.0-5.0) ^a	4.5(4.0-5.0) ^a	0.6
	6-month	5.0(5.0-5.0) ^a	5.0(4.0-5.0) ^a	0.28
	P2	<0.001*	0.001*	

Data expressed as Median (IQR); IQR: interquartile range; P: Probability; *: significance <0.05;

Test used: P1: Mann Whitney; P2: Friedman's

a: significance vs after 1 week of insertion, b: significance vs 1 month, c: significance vs 3 months, d: significance vs 6 months.

IV. DISCUSSION

Patients with acquired hard and soft palatal defects were participated in this study after maxillectomy operation for complete healing of the surgical site where the remaining tissues offer better retention and stability of the obturator. ²⁰

Patients with soft palatal remnants were excluded from the study because these remnants affect the intimate contact between the posterior part of the obturator with the posterior and lateral pharyngeal walls. Completely edentulous patients were excluded from the study because absence of teeth

affect the retention of the obturator which subsequently affect the speech intelligibility). ²¹

Only cooperative patients were selected for this study as they could be able to follow the instructions, especially the oral hygiene measures as well as the follow –up visits. The metal framework was properly designed to provide retention and stability from their different elements as multiple occlusal rests were included in the design to fulfill the stability and support for the obturator prostheses and to minimize the tissue ward movement and also alternating buccal and lingual retention to gain maximum retention from

the remaining natural teeth and prevent the tissue away movement.²²

During the metal try-in stage, disclosure of the binding areas was very important to minimize the torque and tilting of the abutments, to maintain the forces along the long axis and to ensure the passivity of the definitive obturator. An acrylic resin extension must be formed functionally. This extension must be in static contact with the soft tissues and must not affect the stability of the prosthesis.²² The extension must be positioned at the level of the hard palate during the most active movement of the pharyngeal sphincter.

The molding was accomplished by asking the patient to say 'ahh', the patient is also trained to move his head forward 30 degree with the Frankfort plane and in a circular motion from side to side and to extend his head as far backward as possible and to speak and swallow to activate the remaining velopharyngeal musculature and mold the impression material or by touching the posterior wall of the pharynx with an instrument to initiate gag reflex.²³ The impression should be examined for contact with the pharynx bilaterally and posteriorly to ensure adequate velopharyngeal closure. Wax wafer technique was used for jaw relation registration as the easily disposable wax offers little trauma to the underlying mucosa and little effort to the patients while recording centric occluding relation.²⁴

For all patients, the selected teeth material was cross-linked acrylic resin with excellent wear band hardness values whenever opposed by natural teeth, and they are more resilient and can be ground easier. The lingualized concept of occlusion was used for setting up of teeth so that the forces were directed toward the long axis of the teeth which enhanced the obturator stability.

Acrylic resin denture base material was chosen for the obturators processing, as it's the most widely used denture base material. This could be attributed to the many advantages reported by *Craig and Ward*, such as excellent esthetics, acceptable dimensional accuracy and stability, as well as being

easily repaired and rebased. Acrylic resin denture base is also well tolerated by the tissues, insoluble and non-corrosive, color stabilities, easy for the patient to clean, inexpensive and of adequate strength except on sudden impact.²⁵ The obturator was hollowed to aid speech resonance and to reduce the weight on the unsupported side, however it should not be so large in order not to interfere with its insertion if the mouth opening is restricted.²⁶

Regarding the retention results, revealed that (Group I) maxillary speech obturators constructed with soft acrylic applied on the posterior part showed a statistically significant higher mean retention values than (Group II): received maxillary speech obturators constructed with versacryl applied on the posterior part of the obturator in all intervals that may coincide with other study that reported that the versacryl is a thermoplastic material it should be warmed to be flexible by immersing in warm water 50 c for 5 minutes to be in intimate contact with the posterior and lateral pharyngeal walls and when it cool to the body temperature it become rigid although it fulfill its function but it cause a great gap away from the tissue and loss its retention.^{27,28}

On the other hand, the soft acrylic is considered as permanent heat cured resilient liner with highly adaptation property to the underlying structure and it is perfect for the patients who cannot tolerate hard denture bases as maxillofacial patients with hard and soft palatal defects.^{29,30}

Also, the results of this study were showed a reduction of retention values with time for both groups that may attributed to the mucosal sensitivity that may be assigned to many reasons as the general and oral health condition of these patients in conjunction with the postsurgical chemo- or radiotherapy that may directly break down and damage the oral mucosa, salivary glands. Also, the changes in lining mucosa of the mouth and reduce the secretion of salivary glands may lead to bacterial imbalance, mouth soreness, infections, and increase the sensitivity of the mucosa. This mucosal sensitivity directly affects the retention of

the obturator.³¹ On the other hand, in this study a traditional way to attain the retention was used in partial dentures are utilizing in maxillary obturators such as using the suitable clasps in the obturator at the intact side and engagement of the retentive under cuts. These Clasps have a low capacity for retention, and they exhibited a plastic deformation with the insertion/removal of the obturator with the time that may also lead to a rapid loss in retention and results in liquid and air leakages in addition to discomfort.³² Regarding the patient satisfaction results that revealed (Group I) maxillary speech obturators constructed with soft acrylic applied on the posterior part showed a statistically significant higher mean values of patient satisfaction scores regarding evaluation of the masticatory efficiency, speech evaluation than (Group II): received maxillary speech obturators constructed with vers acryl applied on the posterior part of the obturator only after 6 month and that coincide with the retention results showed (Group I) has higher statistically significant mean retention values than (Group II) so increase the appliance retention that will indirectly increase chewing efficiency, speech ability, stability and comfortability of the final obturator and increase patient satisfaction over all by time that revealed to the adaptation of the patient with the obturator by time.³³

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Ethics: This study was approved by ethical committee of faculty of dentistry Cairo University on: 27/9/2022, approval number: 29-9-22

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