



## International Journal of Applied Dental Sciences

ISSN Print: 2394-7489  
ISSN Online: 2394-7497  
IJADS 2016; 2(2): 24-27  
© 2016 IJADS  
www.oraljournal.com  
Received: 06-02-2016  
Accepted: 07-03-2016

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## Use of innovative suction device to improve the retention in denture wearer patients - A pilot study

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### Abstract

**Introduction:** Denture technology is constantly moving forward and providing denture wearers with better and better options for denture comfort and fit. There are some products and systems in the market that will raise the denture retention

**Aim:** (1) To fabricate an innovative suction device [Unidirectional air flow device]  
(2) To assess the effectiveness of innovative suction device on retention of maxillary complete denture.  
**Materials and methods** Materials and equipments were used in this study are commonly used for the fabrication of complete denture prosthesis in dentistry like autopolymerizing acrylic resin (DPI-RR cold cure, Denture base polymer resin), Nickel titanium (Ni-Ti) spring, medicated silicone rubber disc, digital spring weighing machine (gauge), micromotor, straight handpiece, porcelain jar, wax knife, bard Parker knife, straight bur, alpine stone and sand paper.

**Result:** The mean of retentive force in control group (without suction device) is 2.3 kg and the mean of retentive force with suction device cases is 2.7 kg. The mean were compared by using two tailed paired t test. The results showed that retention in the maxillary complete denture is significantly improved with the use of custom made suction device with a p value of 0.039.

**Conclusion:** Within the limitation of this study it can be concluded that the custom made suction device improved the retention of the maxillary complete denture. Custom made fabrication of suction device was very cost effective and methodology of this study was very much comfortable for the patient.

**Keywords:** Denture wearer, Suction device, Retention in CD, Dental technology

### Introduction

Majority of geriatric patients suffer a great deal of discomfort as a result of loose or ill-fitting dentures, many denture wearers simply withdraw from any type of social engagement as a result of being compelled to wear them. A significant number of these patients have ill-fitting dentures with diminished or poor function due to a variety of reasons. The increased stability and retention allow denture wearer patients to increase the force they can apply during mastication. Improving retention and stability of denture is of a considerable interest in prosthetic dentistry.

The resorption of alveolar ridge due to complete denture wearing leads to the loosening of the denture in due course of time. Initially soft tissue remodeling can be expected to maintain mucosal contact on both the tissue surface and at the borders<sup>[1]</sup>. In the longer term, resorption and remodeling of the hard tissue may exceed the adaptive capacity of overlying soft tissues and retention may eventually be lost<sup>[2]</sup>. Various contributing physiologic factors could lead to resorption of alveolar bone. Residual ridge resorption has been considered a continuous process. Therefore the periodic recall of the patient should be an integral part of the prosthodontic treatment.

Denture technology is constantly moving forward and providing denture wearers with better and better options for denture comfort and fit. There are some products and systems in the market that will raise the denture retention.

To improve denture retention various methods has been attempted, but this custom made suction device is innovative device which is easy to fabricate, cost effective and may improve the denture retention.

This project was attempted to check the effect on retention of maxillary complete denture by using custom made suction device in denture wearer patients.

Suction device was fabricated that allows unidirectional flow of air. When this suction device was attached to palatal side of maxillary denture and the patient was asked to clench the denture it removed air between denture and mucosa. Hypothesis was that once the air is removed between the denture and mucosa through this custom made suction device, vacuum will be created which may not improve retention in old denture wearer.

### Review of Literature

Various materials and devices have been used since long time to increase the retention of old dentures, but they have their own advantages and disadvantages.

The use of dental adhesives began in the 18th century. This product was prepared by pharmacists who mixed plant gums to produce a material that could absorb the humidity of saliva and swell to form a mucilaginous layer adhering to the oral mucosa and dentures. Denture adhesive is a soluble and sticky material that can be applied over tissue surface of the denture to fill the space between denture base and tissue surface in order to enhance the quality of denture retention.<sup>[3-5]</sup> But the smell and taste of denture adhesive is mostly not accepted by the patients.

Ultra suction system increases the retention of mandibular complete dentures. Their retentive capacity in comparison to conventional dentures has been positively claimed<sup>[6,7]</sup>. But the cost of this system cannot be afforded by the patient.

Denture mini cups – Suction cups dentures are small suction cups made with a soft rubber that attaches gently inside the mouth without irritation. This type of denture can be used for various types of tooth replacement in patients with flat ridges.<sup>[8,9]</sup> But it is difficult to clean due to multiple mini rubber cups.

Also complications like fibrosis have been reported.

Dental implants or mini implant are to be gently screwed into the front of a patient's lower jaw, requiring only a mild anesthesia. The patient's denture is then carefully adjusted by the dentist to allow it to snap onto the four implants. The result is tight fitting denture which allows a patient to speak and eat with confidence<sup>[10]</sup>. The dental implants are costly and require surgical procedure.

### Aims and Objectives

Aim of the study was to fabricate and to assess the efficiency of innovative custom made suction device in retention of maxillary complete denture.

### Objectives are

- (1) To fabricate an innovative suction device [Unidirectional air flow device]
- (2) To assess the effectiveness of innovative suction device on retention of maxillary complete denture.

### Material and Methods

#### Materials

Materials and equipments were used in this study are commonly used for the fabrication of complete denture prosthesis in dentistry like autopolymerizing acrylic resin (DPI-RR cold cure, Denture base polymer resin), Nickel titanium (Ni-Ti) spring, medicated silicone rubber disc, digital spring weighing machine (guage), micromotor, straight handpiece, porcelain jar, wax knife, bard Parker knife, straight bur, alpine stone and sand paper.

### Methodology

To fabricate new unidirectional suction device, two auto-polymerizing (self-cure) acrylic plates of 7mm and 5mm

diameter were fabricated. Ni-Ti (Nickel-titanium) spring (4mm diameter and 4mm length) and silicone rubber disc of 5mm diameter was enclosed between two acrylic plates. 4mm length of Ni-Ti spring was attached to lower 7mm of acrylic plate and other end is attached to silicon rubber disc. This assembly was then enclosed with another auto-polymerizing acrylic plate on top of it. Thus a custom made suction device of 5mm thickness was fabricated. Two small holes of approximately 1mm diameter were prepared on top and bottom plates. Holes were provided to escape the excess air between the tissue and denture. Silicon rubber and spring allows the escape of air in one direction only. Thus a unidirectional custom made suction device was fabricated and attached to the denture for evaluation of efficacy of retention in maxillary complete denture. Cross sectional diagram of the suction device is shown as below (Fig no. 1)

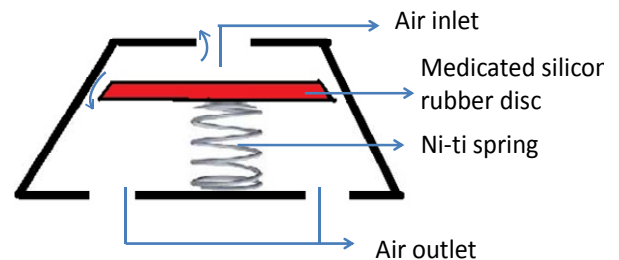


Fig 1: showing cross sectional view of suction device.

This study was undertaken to assess the efficiency and to compare the retention of the maxillary denture with and without innovative suction device by an in vivo method. For the purpose of this investigation, retention has been expressed in terms of the force required to dislodge vertically a maxillary complete denture<sup>[11]</sup> using a digital spring weighing machine. (Photo no. 1)



Photo 1: Digital spring weighing machine

Three patients with age range between 42-55 years out of them two were male and the one was female, who wore an old maxillary and mandibular complete denture. The study was carried out in three patients with removable complete dentures, independently of how long the dentures had been worn, or of their quality and retention performance.

The patients who were in a waiting list for the construction of new dentures in department of prosthodontics, School of Dental Science, Krishna institute of medical sciences university Karad, were selected for study. As those patients were complaining of poor retention in their existing (old) complete dentures. All experimental procedures were approved by the Institutional Ethical Committee of Krishna institute of medical sciences university, Karad. Patients with medically compromised conditions, any physical disability, class II and class III jaw relationship were excluded from the

study. All of the participants were willing to participate and co-operate throughout the study. The informed consent from all patients was obtained.

Patient's old maxillary denture preparation was required to attached a digital spring gauge to measure pulling force require to dislodge in grams. A 19 gauge wire was taken and loop was prepared for the attachment of digital spring weighing machine to the maxillary denture. A groove was drilled with the straight handpiece and straight bur from labial to palatal surface just above the two central incisors in maxillary denture. The wire loop was inserted into the groove and was anchored (Photo no 2).



**Photo 2:** Maxillary denture with wire loop

The upper and lower dentures were inserted into the patient's mouth. Patient was instructed to maintain maximum, non-forced intercuspation for 5 minutes. After that the patient was asked to open the mouth and relax the lower lip in order to avoid losing the peripheral seal.

The tip of digital spring weighing machine was hooked up into the loop of wire. Traction was then applied until the dentures detached (Photo no. 3). The maximum retention force was recorded by the digital spring weighing machine. The patients were asked to close in occlusion and wait for 5 minutes after each measurement. This procedure was repeated three times for each patient and mean was calculated. Quantification of retention without suction device was carried out and considered as control group.



**Photo 3:** Checking the retentive force of maxillary denture in patient

A small perforation was prepared on the deepest portion of palatal surface of maxillary denture. The custom made suction device was then fixed to maxillary denture with the help of autopolymerizing acrylic resin. The excess acrylic resin was removed, finishing and polishing was done. The above mentioned procedure was repeated and pulling force was recorded for three times with the digital spring gauge and mean was calculated.

After completion of study, custom made suction device was removed from the maxillary denture and repaired was done with autopolymerizing resin. The denture was finished, polished with the alpine stone and sand paper. The polished denture without suction device was returned back to the patient.

**Observations and Results**

A specially designed digital spring gauge was used to record forces that were needed to dislodge the maxillary denture from the palate. Forces were recorded in kilogram for three times in each subject. The mean of three reading was calculated as shown in table no 1.

**Table 1:** Showing the three readings for each patient without and with suction device.

Study groups	Without suction device (Control group) In Kilograms	With Suction device In Kilograms
Case 1	1.9	2.7
	1.4	1.8
	1.8	2.5
Mean	1.7	2.3
Case 2	2.4	2.8
	2.7	2.9
	2.1	2.4
Mean	2.4	2.7
Case 3	2.5	2.9
	3.2	3.4
	2.7	3.3
Mean	2.8	3.2

In this study to eliminate the possible error repeated measurements were taken with and without suction device to check retention capacity of the same. Calculations were made of the arithmetic means of the three retention force measurements (in kilogram) corresponding to each patient without suction device (control group) and with suction device.

The mean of retentive force in control group (without suction device) is 2.3 kg and the mean of retentive force with suction device cases is 2.7 kg. The mean were compared by using two tailed paired t test. The results showed that retention in the maxillary complete denture is significantly improved with the use of custom made suction device with a p value of 0.039 (table no. 2).

**Table 2:** Showing Mean, SD and p value.

Study groups	Without suction device (Control group)	Suction device	Paired t test t value	p value
Case 1	1.7	2.3	4.914 With 2 degree of freedom	0.039*
Case 2	2.4	2.7		
Case 3	2.8	3.2		
Mean	2.3	2.7		
Standard deviation	0.55	0.45		

\*p value is 0.039, considered significant at 95% confidence interval.

**Discussion**

The denture suction device was mainly used to improve fit, comfort, chewing ability and confidence of the patient. The availability of different types of adhesives and suction device are available to improve the retention in complete denture.

Dentists are aware that the success of removable dentures is fundamentally dependent upon the achievement of adequately balanced occlusion affording stability, together with maximum extension of the bases to secure the key to retention, i.e.,

adequate peripheral sealing. In any case, many clinicians are uncertain about the true efficacy of such products, and are not sure about which materials and system offer the best retention performance. Many authors attempt various materials and methods have been trying to improve the retention in complete denture [11-13]. But it has their own advantages and disadvantages. In developing country like India, the population relies on the cost effective means of treatment. So our attempt to fabricate the suction device is fulfilling these criteria. Hypothesis was that the custom made suction device will not affect the retention in old denture. The custom made suction device was cost effective and result shows the significant improvement in the retention of the old maxillary denture, which reject our hypothesis.

In this study, we used custom made suction device, which was fabricated from the routinely used materials for fabrication of complete denture. Also, the device which was used to access the efficiency of suction device that is digital spring weighing machine was not costly.

### Conclusions

Within the limitation of this study it can be concluded that the custom made suction device improved the retention of the maxillary complete denture. Custom made fabrication of suction device was very cost effective and methodology of this study was very much comfortable for the patient.

Further research is required to fabricate custom suction device of smaller dimensions with more retentive efficiency. Also long term follow up study is require in large number of complete denture wearer patient with suction device to check its efficiency and durability in the patient's mouth.

### Summary

Most of the geriatric patients are having problem with the retention of complete denture. The purpose of this study was to fabricate the unidirectional air flow suction device and check its efficacy in retention of maxillary complete denture. The custom made suction device was fabricated and it was attached to the maxillary complete denture. The digital spring weighing machine was used to check the retention of the maxillary denture without and with custom made suction device.

The mean of retentive force without and with custom made suction device is recorded in kilograms and it was compared by using paired t test. Result showed that the retention of the maxillary complete denture is significantly improved ( $p=0.039$ ) with the custom made suction device.

But further long term study is required to check the retention efficacy in mandibular denture and durability of the custom made suction device in patient's mouth.

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