

The Effect of Denture Adhesive on Bite Force in Patients with Complete Denture Wearer Based on Gender at University of Sumatera Utara Dental Hospital

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Abstract:

Background: The use of complete denture has an important purpose for articulation, aesthetic and mastications functions. Some factors that affect the masticatory system are malocclusion, posterior tooth loss, posterior tooth restoration, occlusion contact area, facial shape, muscle activity, and bite force. Bite force in dentulous patient is greater than complete denture wearer. Bite force in complete denture wearer can be increased by using denture adhesive. Bite force is affected by gender, while men have greater bite force than women. The purpose of this study was to evaluate the effect of denture adhesive on bite force in patients with complete denture wearer based on gender.

Materials and Methods: In this experimental study with pre and post control group design, 10 patients (5 men, 5 women) were randomly selected from patients with complete denture wearer at University of Sumatera Utara Dental Hospital. Bite force was measured with and without denture adhesive application by means of pressure transducer. Unilateral bite force measurement was repeated 3 times (left and right side). The average of right and left side of maximum bite force value was taken.

Results: The average value of bite force and standard deviation (SD) in men without denture adhesive was 36.03 ± 9.25 N and with denture adhesive was 56.40 ± 25.80 N, in women without denture adhesive was 23.97 ± 7.71 N and with denture adhesive was 31.33 ± 8.07 N. There was statistically no significance difference based on gender with and without denture adhesive ($p > 0.05$). There was statistically no significance difference in men with and without denture adhesive with p -value = 0.083 ($p > 0.05$), but there was significance difference in women with and without denture adhesive with p -value = 0.008 ($p < 0.05$).

Conclusion: Denture adhesive can increase bite force in complete denture wearer although significant statistical result only found in women.

Key Word: Denture adhesive; Bite force; Complete denture

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I. Introduction

Edentulous is a limitation or disorder related to oral function and psychological impact.¹ There are several options for full edentulous treatments, such as complete dentures and dental implant, but complete denture selection is more frequent than dental implants.^{2,3} The use of complete denture has an important purpose for articulation, aesthetic and masticatory functions. Some factors that affect the masticatory system are malocclusion, posterior tooth loss, posterior tooth restoration, occlusion contact area, facial shape, muscle activity, and bite force.⁴ Bite force is an important element and a key indicator of the functioning of the masticatory system.⁵ Bite force is affected by several factors such as craniofacial morphology, body mass index, temporomandibular disorders, dental status, periodontal support, age and gender.⁵ As complete denture usage increases, there will be a decrease in retention and stability due to physiological resorption. If the retention and stability of complete denture in patient decreases it will cause a decrease in bite force. One of the temporary treatments in such conditions is to use denture adhesive to improve retention and stability.⁶ The application of denture adhesive will make the adhesive material spread across the surface of the complete denture in contact with the mucosa of the oral cavity. The empty space between denture and mucosa of the oral cavity is filled by denture adhesive which will also increase viscosity and interfacial force so that retention and stability will increase. Increased retention and stability eventually cause the bite force to increase⁷⁻⁸

II. Material And Methods

This experimental study was carried out on patients with complete denture wearer at University of Sumatera Utara Dental Hospital, Medan, Indonesia from October 2019 to November 2019. A total 10 patients (5 men and 5 women) of aged 45-70 years, were for in this study.

Study Design: Pre and post control group

Study Location: This was a Prosthodontics Clinic in University of Sumatera Utara Dental Hospital, Medan, Indonesia.

Study Duration: October 2019 to November 2019.

Sample size: 10 patients (5 men, 5 women).

Sample size calculation: The sample size was estimated on the basis of a purposive sampling. The target population

from which we randomly selected our sample was considered all patients in Prosthodontics Clinic. We assumed that the confidence level of 95%. The sample size actually obtained for this study was 5 patients for each group. We planned to include 10 patients (Group I- men without and by using denture adhesive, Group II- women without and by using denture adhesive for each group).

Subjects & selection method: The study population was drawn from patients with complete denture wearer in Prosthodontics Clinic in University of Sumatera Utara Dental Hospital, Medan, Indonesia from October 2019 to November 2019. Patients were divided into two groups (each group had 5 patients) according to gender.

Inclusion criteria:

1. Patients with complete denture wearer at University of Sumatera Utara Dental Hospital.
2. Usage of complete denture at least for 6 months.
3. Patients aged 45-70 years.
4. Bilateral balanced occlusion scheme.
5. Patients without temporomandibular disorder.

Exclusion criteria:

1. Patients with uncontrolled systemic disease.
2. Patients with xerostomia.
3. Patients allergic to zinc.
4. Patients with chewing side preference.
5. Decreased of vertical dimension.
6. Denture teeth abration.

Procedure methodology

A total of 10 patients (5 men, 5 women) with comple denture wearer were included in this study. The research was accepted and approved by the Ethics Committee, University of Sumatera Utara, Medan, and written consent was obtained from each suject.

The research was divided into two groups. Group 1 consisted of men with and without denture adhesive; Group 2 consisted of women with and without denture adhesive. The patients were seated in a dental chair with the frankfurt plane position parallel to the floor. The patient's complete dentures were removed and cleaned using a brush and then dried. Then, the complete dentures were re-paired in the patient. Pressure transducer was placed between the second premolar tooth and the first molar and bited as strong as possible. Bite force measurements were performed 3 times at intervals of 2 minutes in each measurement. Measurements were performed on the left and right side and the average value was taken.

The complete dentures of the patient were again removed and the denture adhesive cream were applied in the form of a thin layer on the surface of complete denture that was in contact with the mucosa of the patient's oral cavity. Then, a complete denture that had been applied denture adhesive cream was attached to the patient. After 15 minutes, again, the pressure transducer was placed between the second premolar tooth and the first molar and bited as strong as possible. Bite force measurements were performed 3 times at intervals of 2 minutes in each measurement. Measurements were performed on the left and right side and the average value was taken.

Statistical analysis

Data was analyzed using SPSS version 20. Univariat analysis was used to measure the average of bite force from group I and II. In addition, paired t-test was used to determine the difference between bite force in men and women with and without denture adhesive. Then, unpaired t-test was used to determine the effect of denture adhesive on bite force in patients with complete denture wearer based on gender.

III. Result

In this study obtained the average value of bite force in the group of men without denture adhesive 36.03 ± 9.25 N, and with denture adhesive 56.40 ± 25.80 N. Average value of bite force in the group of women without denture adhesive 23.97 ± 7.71 N, and with denture adhesive 31.33 ± 8.07 N (Figure no 1).

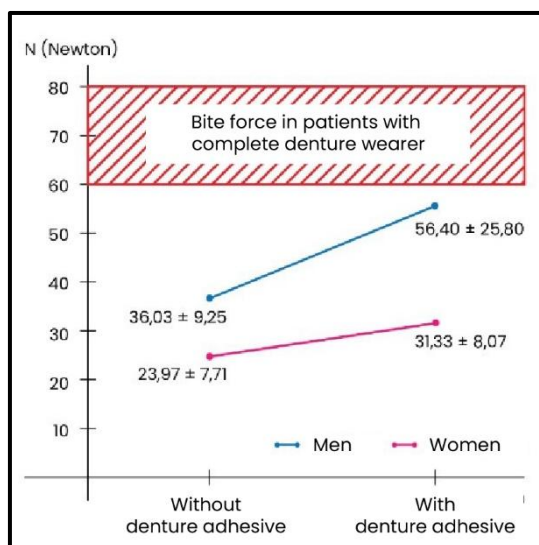


Figure no 1: The average value of bite force in men (blue line) and women (red line) complete denture wearer with and without denture adhesive.

Difference Between Bite Force In Men And Women With And Without Denture Adhesive In Complete Denture Wearer Patients

Table no 1 showed no significant difference between bite force in men and women in the group without denture adhesive with a value of $p=0.055$ ($p>0.05$) and in the group with denture adhesive with a value of $p=0.096$ ($p>0.05$).

Table no 1: The difference between bite force in men and women with and without denture adhesive in complete denture wearer patients.

Complete Denture Wearer Patients	Bite Force (N)		P value
	Men	Women	
Without denture adhesive	36,03	23,97	0,055
With denture adhesive	56,40	31,33	0,096

Effect Of Denture Adhesive On Bite Force In Patients With Complete Denture Wearer Based On Gender

Table no 2 showed no significant effect of denture adhesive on bite force in men patients with a value of $p=0.083$ ($p>0.05$) however, there was a significant effect of denture adhesive on bite force in women patients with a value of $p=0.008$ ($p<0.05$).

Table no 2: Effect of Denture Adhesive Use on Bite Force in Patients with Complete Denture Wearer Based On Gender

Gender	Bite Force (N)		Difference	P value
	Without denture adhesive	With denture adhesive		
Men	36,03	56,40	20,37	0,083
Women	23,97	31,33	7,36	0,008*

Note: significant*

IV. Discussion

Denture adhesive is a material used to attach dentures to the mucosa of the oral cavity.⁹ Denture adhesive has functions to increase dexterity, comfort, chewing ability, patient confidence, and bite force.¹⁰ Bite force is influenced by factors such as craniofacial morphology, body mass index, temporomandibular disorders, dental status, periodontal support, age and gender.⁵ In this study showed the average value of bite force in the group of men without denture adhesive was 36.03 N, while with denture adhesive was 56.40 N, and in the group of women without denture adhesive was 23.97 N, while with denture adhesive was 31.33 N. The value of bite force in the study after using denture adhesive was close to the standard value of 60-80 N.¹

Research conducted by Kalra P et al. (2012) found the value of bite force in groups with denture conditions either without the use of adhesive materials of 2.48 ± 0.16 kg and with paste adhesive materials of 6.01 ± 0.11 kg.¹¹ Fayad et al. (2018) obtained a bite force value in the group of patients using thermoplastic dentures of 34.3 ± 12.2 N and with conventional acrylic material of 33.7 ± 12.07 N.¹²

The results showed no significant difference between men and women in the group without denture adhesive with a value of $p=0.055$ ($p>0.05$), and no significant difference between men and women in the group with denture adhesive with a value of $p=0.096$ ($p>0.05$). This indicates that gender does not affect the difference in bite force in the group with and without denture adhesive. The maximum bite force value in men were higher than women both in the group with and without denture adhesive. This is associated with differences in the anatomical structure of the teeth and large muscle mastication. Masseter muscles in men have type-2 fibers with a diameter greater than women muscles, and hormonal differences can also contribute to the composition of muscle fibers. In addition, the correlation of maximum bite force and gender was not proven until the age of 18 years. It is clear that maximum bite force increases throughout growth and development without gender specificity. In the post-pubertal period, maximum bite force or bite force increases in men compared to women and thus can be attributed to differences by gender.⁵ Larger teeth also affect the bite force, in teeth that have a larger size there are broader periodontal ligaments that can produce greater bite force.^{1,13} The results of this study are contrary to most other research results, this is likely due to a less numerous number of research subjects.

The results of this study are in accordance with research conducted by Abu Alhaija et al (2010) which found no significant difference in maximum bite force between men and women.¹⁴ However this is contrary to research conducted by Koc D et al (2010) which found significant difference, statistically the bite force in men is greater than that of women.¹³ Shal et al (2018) and Tripathi et al (2014) in their study found significant differences, where the bite force in men is higher compared to women.^{1,4}

This study showed no significant effect on the value of men bite force with a value of $p=0.083$ ($p>0.05$). This indicates the absence of the effect of the use of denture adhesive material on the value of bite force in the group of men patients. However, in the group of women patients showed a significant effect on the use of denture adhesive material on the bite force with a value of $p= 0.008$ ($p<0.05$). In this study showed a significant effect on the use of denture adhesive on the value of bite force in women.

The application of adhesive materials on dentures can significantly increase bite force. The effect of denture adhesive on bite force is due to the adhesion and cohesion of the adhesive material thus improving the retention and stability of dentures. In addition, the adhesive material also eliminates air trapped between the denture base and mucosa of the oral cavity.⁹ The adhesive material has a strong bio-adhesive and bio-cohesive material, which can increase denture retention. This material belongs to the group of carbonyl compounds, for example polymethyl vinyl ether maleic-anhydride or PVM/MA. PVM/MA and zinc and calcium salts with CMC have high retention due to the development of strong covalent bonds produced by their covalent interactions.¹⁵ Adhesive materials also have water-resorbed properties, so the volume of adhesive materials can expand by 50-150%. The result of water absorption in the formation of anions attracted to cationic proteins in mucous membranes produces sticky properties in dentures, thus improving the retention and stability of dentures.^{15,16}

Munoz et al (2012) conducted research on 36 subjects showing the use of denture adhesive resulted in an increase in bite force from 2 lbs to 4 lbs an hour after application.⁷ Kalra et al (2012) researched the effect of denture adhesive on incisal bite force in complete dentures and found significant differences in bite force with the use of dentures with and without denture adhesive.¹¹ In this study there was no significant effect on the men group. This is likely due to the absence of retention and stability checks on dentures prior to the administration of adhesive materials, so that when using denture adhesive materials, the strength of the bite increases and deviation standards become greater.

Fujimori et al (2002) examined the effect of denture adhesive paste on dentures with good dexterity using a maximum bite force recording device in the first molar area and found a positive effect on denture adhesive.¹⁰ Pradies et al (2009) tested two denture adhesive materials with different physical properties and found an increase in bite force in dentures with both materials.¹⁷ In this study, the preparation of denture adhesive material used is paste. The increasing effectiveness of the use of paste adhesives due to their sticky consistency and polyvinylacetate.¹⁰ This material will form an electro-covalent bond that produces sticky properties in dentures or bio-adhesives. Increased viscosity is the result of the spread of adhesive materials in a lateral direction that causes air and saliva to be unable to enter between the base surface of dentures and mucosa thus increasing retention.¹⁶ To sum up, denture adhesive can improve the retention and stability of dentures so as to increase the value of bite strength in dentures.

V. Conclusion

Denture adhesive increases bite force in patients with complete denture wearer in men and women. Besides, a significant effect on bite force was only found in women with and without denture adhesive in patients with complete denture wearer with a value of $p=0.008$ ($p<0.05$).

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