Original Article

Bite Force Evaluation in Complete Denture Wearer with Different Denture Base Materials: A Randomized Controlled Clinical Trial

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Abstract

Aim: The aim of this study is to evaluate the maximum bite force (MBF) with different denture base materials in completely edentulous patients.

Materials and Methods: MBF was evaluated in randomly selected 100 completely edentulous patients. Patients were selected from the Outpatient Clinic, College of Dentistry, Aljouf University, Saudi Arabia. The patients were randomly divided into two equal groups: Group I (control group): Patient received a conventional heat-cured acrylic complete denture (Vertex™ Regular, Vertex-Dental B.V., The Netherlands) and Group II (experimental group): Patient received a thermoplastic complete denture (Vertex™ ThermoSens, Vertex-Dental B.V., The Netherlands). MBF measurements were taken at the time of new denture placement and after 6 months of denture use. Statistics were analyzed using independent *t*-test to compare the MBF measurements between both groups.

Results: At the time of denture placement, there was no significant difference in bite force measurements between both groups. Bite force is increasing considerably after 6 months of denture use, and it was higher than MBF recorded at the time of new prosthesis placement in the same group. The MBF values were considerably higher in patients with a thermoplastic denture than patients with conventional acrylic denture with statistically significant difference after 6 months of denture use.

Conclusion: After 6 months of denture use, patients with a thermoplastic denture have a higher biting force than patients with a conventional acrylic denture. Therefore, it could be considered a treatment plan option according to the ridge nature and quality to solve the problem of diminished bite force in old age patients.

Keywords: *Acrylic dentures, bite force, denture base materials, thermoplastic denture base*

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Introduction

Many people have been affected by teeth loss which causes physiological and functional disorders, so rehabilitation treatments with an adequate prosthesis are indicated.[1]

Nearly 30% of patients with complete dentures have complaints. They suffer from various problems with their dentures, particularly regarding the mandibular denture, such as decreased stability, retention, and pain during mastication.[2]

Studies have shown that when compared with natural dentition subjects, denture wearers suffer from a decline in masticatory performance.[3-5] When people age, their muscles undergo functional changes mainly through atrophy and tooth loss.[6]

Considering the constant increase in elderly people all over the world, it has become essential to evaluate bite force and muscle changes associated with age.[7,8]

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Bite force is an important variable to investigate oral function.[1] Maximum bite force (MBF) also directly influences diet choice, which has an important role in the maintenance of masticatory function.[9] The old people with fewer or no teeth avoid fibrous foods resulting in reduced food intake and leaving out various sources of proteins, fibers, minerals, and vitamins.[10,11]

Selecting less nutritious food leads to high risk of malnutrition and consequently the potential for cardiovascular disease and cancer.[12,13]

In dental field, bite force acts as an important parameter to evaluate of masticatory system efficacy. Different devices with different designs have been used to record bite force.[14]

Jeong *et al*.[15] studied the relationship between mandibular tori and bite force and they found that the size of torus mandibularis increased significantly in proportion to the bite force and thus it can be used to clinically assess occlusal stress.

In fact, the masticatory force of completely edentulous patients is 20%–40% of that of healthy dentate persons. Therefore, complete denture wearers need up to seven times more chewing strokes to reduce food particle than do dentulous subjects.[16,17]

The chewing forces used by denture wearers may be limited by the discomfort and the pain that happens when one or both of the dentures lose their retention or even by the fear of such pain. MBF that can be exerted by denture wearers on objects placed between their dentures has also been shown to be considerably lower than that observed in dentate persons.[6]

The provision of two mandibular implants significantly improves bit force and quality of life for completely edentulous patients.[18,19] Telescopic distal extension removable partial dentures with cantilevered extensions were found to be associated with improved MBF.[20]

Three principal factors, i.e., retention, stability, and support should be considered for successful complete dentures. Treatment alternatives that aid in increasing retention and stability for improving denture function should be considered when conventional denture therapy is inadequate. One of these alternatives is using thermoplastic denture base materials.[5]

Even though retention and alveolar ridge height which could influence the results were not evaluated, the present study is one of the few studies comparing MBF in complete denture wearers with a thermoplastic denture base versus conventional acrylic one, at the time of new denture placement and after 6 months.

Materials and Methods

Patient selection

This cross-sectional, prospective study was conducted from June 2016 to June 2017 at College of Dentistry, Aljouf University, Saudi Arabia. The study group comprised randomly selected 100 completely edentulous patients with an average age of 52 years. Based on standard deviation from pilot study and previous studies, it was found that 50 cases are enough for conducting the research at power 0.80, confidence interval 0.95, and alpha level 0.05.[1,4,9,16]

All the patients studied have no psychiatric disease or movement disorders. The study protocol was approved by the Ethics Committee at Aljouf University (ethical approval letter no. 2016\18). Informed consent was obtained from all patients after an explanation of the methodology before enrolment in the study.

The patients were randomly allocated into two groups (each group consisted of 50 individuals) according to line of treatment:

a. Group I (control group): Patient received a conventional heat-cured acrylic complete denture (Vertex™ Regular, Vertex-Dental B.V., The Netherlands)
b. Group II (experimental group): Patient received a thermoplastic complete denture (Vertex™ ThermoSens, Vertex-Dental B.V., The Netherlands).

All patients received new complete dentures, with even occlusion and free from discomfort.

Bite force recordings

Measurements were made with the patient in an upright position at the time of new prosthesis placement and after 6 months of denture use.

MBF was measured bilaterally at the first molar region by an occlusal force meter which involves a hydraulic pressure device and a disposable polyvinyl cap (17 mm in width and 5.4 mm in height). The measuring range was 0–1000 N with an accuracy of ± 1 N [Figure 1] (GM10, Nagano Keiki, Tokyo, Japan). The instrument was placed such that all bite forces were directed to the center.

Figure 1: Occlusal force meter

The patients were instructed to bite as powerfully as possible three times per side at maximum intercuspation, with a rest time of 2 min in between. The maximum occlusal force recorded in Newtons (N) was recorded. The highest of the three records was considered to be the patient's MBF.

The difference in bite force after 6 months was calculated, and the mean of two groups was compared. Statistical analysis was completed using SPSS 20 (IBM, Armonk, NY, USA).

Results

MBF with different denture base materials in completely edentulous patients was evaluated.

At the time of new denture insertion, the mean value of MBF with conventional complete denture was 33.7 ± 12.07. The mean value of MBF with thermoplastic complete denture was 34.3 ± 12.25. The independent *t*-test revealed that there was no statistical difference found in MBF values between both groups ($P > 0.01$) [Table 1 and Figure 2].

After 6 months, for each group, MBF increased considerably after 6 months of denture use and it was higher than MBF recorded at the time of new prosthesis placement in the same group [Table 1 and Figure 2].

When comparing both groups, the patients who received a conventional heat-cured acrylic complete denture recorded lower MBF values than patients received a thermoplastic complete denture. The independent *t*-test revealed that there was statistically significant difference in MBF ($P < 0.01$).

Table 1: Bite force after six months of denture use

Grouping	*n*	Mean	Std. deviation	Std. error mean	Sig. (2-tailed)
MBF_0					
G1	50	33.75	12.07	1.90	0.819
G2	50	34.37	12.25	1.93	
MBF_6					
G1	50	39.37	14.85	2.34	0.007*
G2	50	47.50	11.30	1.74	

G1=Conventional complete denture, G2=Thermoplastic complete denture

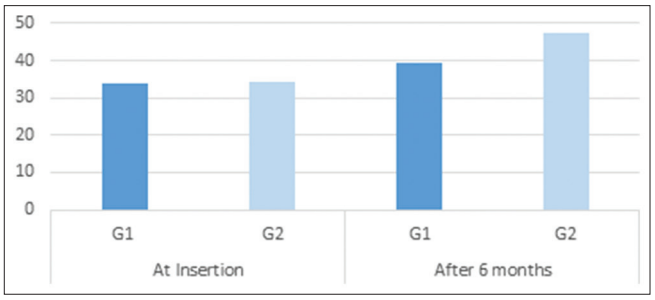

Figure 2: Mean bite force comparison at the time of denture placement and after 6 months of denture placement

Discussion

MBF is an important variable for masticatory function evaluation.[21,22] Bite force varies in different locations in the oral cavity and is highest in the first molar area because nearly 80% of the total bite force is distributed in that area,[23,24] and it is easier and faster to measure. Multiple recordings are more reliable than a single recording.[25]

Old patients are more vulnerable to the trauma of oral mucosa and stomatitis due to atrophy with a slow turnover of tissues, an overall increase in the number of elastic fibers. Moreover, an old age people show a decrease in the muscles activity. Consequently, older people tend to have weak neuromuscular control.[26]

Second measurement was done after 6 months of denture insertion as Goiato *et al*.[27] suggested that >5 months was needed to evaluate patient adaptation and functional capacity with new complete dentures.

The question raised in this study is what denture base material (conventional acrylic resin or a thermoplastic acrylic resin) provides greater bite force in completely edentulous patients.

The thermoplastic material is methyl methacrylate, and therefore, it bonds chemically to the denture base. It is relatively rigid material at mouth temperature but softens in hot water.[28]

At the time of denture insertion, there was no significant difference between patients with a thermoplastic denture and patients with a conventional acrylic denture. It measures 33.7 ± 12.07 N for patients with conventional acrylic denture while it measures 34.3 ± 12.2 N for patients with a thermoplastic denture.

Bite force is increasing considerably after 6 months of denture use in both groups. It measures 39.3 ± 14.8 N and 47.5 ± 11.3 N for the Group I and Group II, respectively. These results match the findings of Roldan.[29] It is important to mention that although there was only 6 months between measurements, significant differences were observed and may be explained by the adaptation period to the new prosthesis.[30,31] This result is in agreement with the finding of Borie *et al*.[9] who found that MBF was found to increase significantly after 1 month of use.

The MBF values were considerably higher in patients with a thermoplastic denture than patients with conventional acrylic denture after 3 months of

denture use. It measures 61.29 ± 17 N for patients who received conventional acrylic complete denture, while in patients who received thermoplastic denture, it measures 71.35 ± 18.8 N. The higher values observed in patients with a thermoplastic denture may be directly related to better stability and retention obtained with a thermoplastic denture base.

Conclusion

The rehabilitation of orofacial structures requires the restoration of esthetic and function irrespective of the structure left. The complete thermoplastic denture was found to significantly better MBF values after 6 months of denture use as compared to the conventional methyl methacrylate dentures on the parameters taken in the present study. However, further long-term studies are recommended to evaluate the overall usefulness of the material.

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Conflicts of interest

There are no conflicts of interest.

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