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COMPARISON OF BITING FORCE AND MASTICATORY EFFICIENCY IN PATIENT WITH DIFFERENT DENTURE BASE MATERIAL

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ABSTRACT

Background: The potential alternative materials to PMMA are the polycarbonates and the nylon denture base resins. Of this nylon is the generic name for certain types of thermoplastic polymers belonging to the class polyamides. This study had compared between conventional and thermoplastic complete denture base materials regarding maximal voluntary biting force and masticatory efficiency of the patient. **Method:** Ten completely edentulous patients received both types of dentures respectively. Each patient was allowed to wear each set of dentures for six months during which bite force of each side and masticatory efficiency (with three test foods; carrots, peanuts and banana) were measured at one week, three months and six months intervals. **Results:** Independent t test was used for the statistical analysis. There were no remarkable variances between the two types of denture bases as P-value >0.05. **Conclusion:** The results of this study showed there were no significant differences in biting force and masticatory efficiency between conventional and thermoplastic polyamide complete dentures during this period.

KEY WORDS: acrylic denture, flexible denture, bite force

INTRODUCTION

Several difficulties exist in producing a satisfactory denture material or designing a technique that is useful for its application. Conditions in oral cavity seem almost suited to destruction. Biting stresses on dentures can be extremely high, temperatures may fluctuate between 25°C to 45°C and pH may change rapidly from acidic to alkaline[1].

Conventional acrylic resin has been widely adopted as a popular denture base material since the 1930s [2]. One of the main drawbacks of this material is considered to be its poor mechanical performance. Generally, there are three ways which have been investigated to improve the mechanical properties of denture bases; search for or development of an alternative material to PMMA, chemical modification of PMMA and the reinforcement of PMMA [3] .

Thermoplastic resins have been used in dentistry for over 50 years. Since that time their applications have continued to grow, and the interest in nylon based materials have increased.[4]

Thermoplastic resins and co-polymers have many advantages over conventional powder or liquid resin systems. They have almost no porosity, which reduces biologic material build up, odors, and stains and exhibit higher dimension and color stability [5] .

Maintenance of masticatory function is especially important for patients wearing complete dentures due to their limitations [6]. Dentition and bite force were confirmed as the key determinants of masticatory performance: number of occluding (pre) molar teeth and bite force could explain 70% of the variance in masticatory performance.

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Maximum bite force is a useful indicator of the functional state of the masticatory system and the loading of the teeth to evaluate the physiological characteristics of jaw muscles [7] .

The aim of this study was to compare the effect of conventional and flexible complete denture bases on masticatory efficiency and biting force of the patient.

METHODS

Ten completely edentulous male patients were selected for complete denture construction, from those attending the outpatient's clinic of removable prosthodontic department, faculty of Dental Medicine, Al –Azhar University, Cairo, boys.

The selected patients were ranging from 45-55 years old, free from any systemic disease or neuromuscular disorder that might affect chewing efficiency of masticatory muscles, free from any temporo-mandibular joint disorder and class I Angle's ridge relationship.

After evaluation of patient`s oral state acrylic complete dentures were constructed as usual manner and duplication of the master cast was made using reversible hydrocolloid duplicating material in a special flask.

Then, the finished dentures were checked for proper extension, retention and stability intra-orally and then duplicated. The dentures had their intaglio, polished and occlusal surfaces were replicated as accurately as possible using special flask and putty consistency rubber base impression material. The duplicated dentures were processed by injection molding technique using flexible resin type.

The flexible resin material was heated, softened, injected and finished according to the manufacturer instructions. Figure (1).

The patient was given a proper program for denture insertion and oral hygiene measures.

Evaluation methods:

All patients were permitted to be adapted with the measurement method and the device.

Objective evaluations:

A) Chewing efficiency

Chewing efficiency of the conventional acrylic resin denture was evaluated firstly for 6 months (one week, three and six months) follow-up periods. Then, there was 2 weeks a period of rest. Chewing efficiency of the flexible denture was done for another 6 months by the same program of follow-up that was formerly mentioned.

During each follow-up period, standard 1 cm cubes of three different foods (Carrot, peanuts "same number and size" and banana) were given to each patient. He was asked to chew each food cubes, measurements of efficiency were recorded as:

- Number of chewing strokes until the patient's first swallow.
- Time (in seconds) elapsed from the first chewing stroke until patient's first swallow.
- Number of chewing strokes until the mouth was free of food.
- Time (in seconds) elapsed until the mouth was free of food.
- Number of swallows until the mouth was free of food.

Three cubes of each test food were chewed and the means of these records were used to evaluate the masticatory efficiency.

B) Bite force measurements:

For each patient at each follow-up session, maximum bite force was recorded using occlusal force meter device.

Bite force was measured for both denture types (conventional and flexible) at one week, three, and

six months follow-up periods. The recorded force during maximal clenching was gained with one bite force meter placed between pairs of opposing teeth at one side and four wood tongue depressors at the other side. Figure (2)

The meter and depressor were located at the area of premolar/molar where there is more number of occlusal contacts with strong element of muscle action and subsequent great bite force. The tip of the disposable cap that covered the arm of the meter device was inserted into the patient mouth and he asked to bite on it slowly.

When the force has reached its maximum value, the buzzer would be sound continuously and the biting should be stopped immediately.

For each patient, the mean of at least 10 records of the right and left sides were collected and used in the statistical analysis.

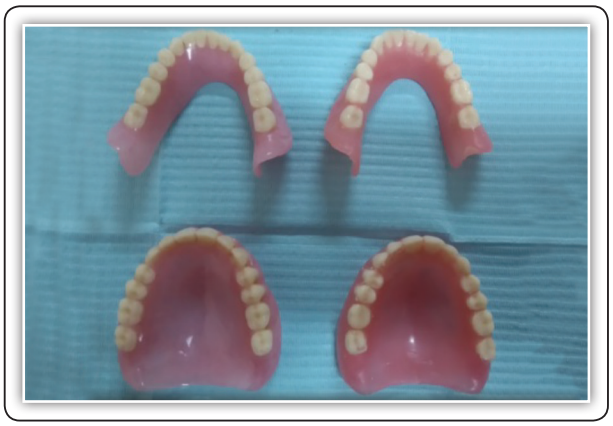

FIG (1) Left acrylic denture, right flexile type.

FIG (2) Bite force device and tongue Depressor in place

RESULTS

Bite force:

The recorded mean values of biting force for conventional and flexible dentures of average of both sides were 131.34 ± 44.75 and 112.20±47.03 at one week, 178.18 ± 49.09 and 157.12±49.74 after three months and 206.31 ± 59.72 and 191.91±57.32 at six months follow-up periods respectively.

Analysis of the result revealed non-significant difference between the two types of denture (P>0.05).

TABLE (1): Comparison between conventional complete denture and the flexible denture bases regarding bite force in average of both sides.

Bite force (average of Rt & Lt)	Acrylic denture		Flexible denture		P-value
	Mean	SD	Mean	SD	
At 1 week	131.34	44.75	112.20	47.03	0.390
At 3 months	178.18	49.09	157.12	49.74	0.379
At 6 months	206.31	59.72	191.91	57.32	0.609

Masticatory efficiency:

When patients were eating peanuts the recorded mean values of the number of chewing strokes until the patient first swallow were 19.84±8.39 and 22.56±9.71, number of chewing strokes until the mouth free of food were 3.00±1.66 and 2.67± 0.71, number of swallows until the mouth was free of food 2.11± 0.33 and 2.44±0.53, time in seconds elapsed from the first chewing stroke until patient's first swallow 13.66 ± 6.31 and 14.99±7.22, time in seconds elapsed until mouth was free of food 3.24 ± 0.73 and 3.42±0.82for conventional acrylic denture and flexible denture respectively at six months. There was no significant difference of chewing efficiency between both types of denture base (P>0.05).

TABLE (2): Comparison between conventional and flexible complete dentures regarding masticatory efficiency when patients were eating peanuts at six months.

After 6 months	Acrylic denture		Flexible denture		P-value
	Mean	SD	Mean	SD	
Number of chewing strokes until the patient first swallow	19.84	8.39	22.56	9.71	0.5
Number of chewing strokes until the mouth free of food	3.00	1.66	2.67	0.71	0.5
Number of swallows until the mouth was free of food	2.11	0.33	2.44	0.53	0.1
Time in seconds elapsed from the first chewing stroke until patient's first swallow	13.66	6.31	14.99	7.22	0.6
Time in second elapsed until mouth was free of food	3.24	0.73	3.42	0.82	0.6

DISCUSSION

The selected patients were ranging from 45-55 years old, to avoid weakness caused by muscle atrophy due to aging process [8] . Patients are of the same age group to display approximately the same muscle efficiency.

The selected patients were male because female patients may show psychological, hormonal alterations and they have less chewing efficiency[9]. Also to avoid difference in muscle efficiency between different sexes [10] .

The same patients received both types of dentures alternatively to avoid bias resulting from individual variation.

Masticatory efficiency was measured as done by khamis et al [11] .

The maximum voluntary bite force was evaluated using a digital force gauge [12] .Accuracy and repeatability of this device were assessed by Nakatsuka and associates [13] .

All reading values of biting force of the two-denture base for both sides are higher in case of acrylic denture base than that of flexible type but didn't reach the value of significance.

There were no statistically significant difference for masticatory performance values of peanuts between the conventional and flexible dentures and this result was in accordance with study by Hazari, et al [14] .

While in case of carrots, the results of the present study were found between Hazari, et al. and contradictory to them Al-Jammali, et al in their study found that the flexible partial denture provide better chewing efficiency than heat cure acrylic partial denture, the masticatory performance was higher for flexible partial denture than heat cure acrylic partial denture [15].

Hazari, et al.[14] found conventional complete dentures were more efficient for mastication with carrots than flexible type which disagree with the results of the present study, this difference may be attributed to the difference in mean age and age range of the patients in these studies. The mean age of the subjects in their study was 55 years, while my patients' age range was 45-55 years with a mean of 50 years, which was lesser than that in their study.

Also, their study was carried out on both male and female patients, while the present study was carried out on male patients only. The MBF of males was found to be statistically significantly higher than for females which had been previously reported in several other studies.

Al-Jammali, et al. [15] study was carried out on partially edentulous patients while the present study was carried out on completely edentulous patients, and so there was a difference in the basic nature of the two denture categories. Also, they used different methods for measuring masticatory efficiency other than the method used in the present study.

CONCLUSION

Within the limitation of this study it is concluded that there were no statistically significant differences between conventional and thermoplastic complete denture base materials regarding maximal voluntary biting force and masticatory efficiency of the patient.

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