Clinical evaluations for the masticatory efficiency of heat cure resin and flexible types of denture base materials

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ABSTRACT

Background: The aim of this study was for estimation and comparism of masticatory efficiency in patient wearing heat cured acrylic and flexible base partial denture, finding out the role of peanuts and carrots on the measurement of chewing efficiency, and to find out whether the types of P.D. (being single or two opposing each other) has any effect on the masticatory performance.

Materials and methods: Twenty partially edentulous patients were selected. Five of these patients were selected having Kennedy class I with no modification against natural dentition, other 5patients having Cl.I against Cl.I . The other 5 patients having Cl.III against natural dentition and the last 5 patients were with Cl.III against Cl.III. several ways were used for measuring masticatory efficiency including: number of chewing strokes, number of swallows, the mastication time, and measure the masticatory performance by sieving method. Differences between the means of the four groups were analyzed with t-test.

Results: The differences between the two denture base types in total number of strokes was significant at (p<0.001) in study group (2,3,4), the study group (4)have the highest mean value of the total number of strokes for acrylic denture during chewing carrots food types(47.6)strokes. The highest mean value of the total chewing time is for the fourth group with the acrylic denture during chewing carrots (35.2 sec.), and the highest masticatory performance index was for the flexible denture in all study groups during chewing the two tested food.

Conclusion: 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, there was significant differences between carrots and peanuts in both flexible and heat cure acrylic partial denture, and patient with single denture show better chewing efficiency than patient with paired denture.

Key words: Heat cure acrylic partial denture, flexiblepartial denture, masticatory performance, and masticatory efficiency. (J Bagh Coll Dentistry 2013; 25(3):57-61).

INTRODUCTION

Chewing is the primary function of teeth and dentistry is the science that is responsible for returning structural integrity not only of the teeth, but the stomatognathic system in general. However if all missing teeth have been replaced, the masticatory function is usually improved but to a lesser extent than that of previous natural dentition.

Favorable denture base material is needed for fabricating long lasting and biologically acceptable dentures**.** Acrylic "poly methyl methacrylate"(PMMA) is one of the most widely used denture base material with numerous advantages [1],but PMMA has poor mechanical properties like fracture [2], allergic reactions to PMMA are also reported [3]. The flexible denture base was introduced in order to improve both the aesthetic and functional limitations of conventional RPD [4].

MATERIALS AND METHODS

Twenty partially edentulous patients were be selected (10 male and 10 female) attending the removable prosthodontics clinic, at Babylon dental university.

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Five of these patients were selected having a maxillary or mandibular partially posterior edentulous area Kennedy class I with no modification against natural dentition with no complaint of pain or discomfort at the time of study ,other five patients having Cl.I against Cl.I. The other five patients having Cl.III including missing (3 or 4 posterior teeth) against natural dentition and the last five patients were with Cl.III against Cl.III Kennedy classification.

Two types of food were employed for the measurement of chewing efficiency which are peanuts and carrots. Peanut was characterized as a soft food[5] and raw carrot was considered to be one of the hardest foods[6]. Both are inexpensive, uniform and most people like them as test material. Raw carrots containing both inner core and outer portion was prepared by boring machine to obtain standardized square form with 1 cm² then cut by using a sharp knife and millimeter ruler to get cube piece(1cm³) .

In this study several ways were used for masticatory efficiency including:

1. Number of chewing strokes performed up to the first swallow.
2. Number of chewing strokes until the mouth is empty.
3. Number of swallows till the mouth is empty.
4. The time (seconds) elapsed until the first swallow.

5. The time (seconds)elapsed until the mouth was free of food .

Then measure the masticatory performance was evaluated by measuring the particle size by sieving method as follow:

a. The subject was instructed to chew a carrots (3g) then peanuts(3g) , to a prefixed numbers of strokes (15 strokes) of mastication on the artificial teeth.

b. Spit the chewed sample (chewed test portions) in a container.

c. The subject was asked to rinse with water and make a new expectoration of waste.

d. Intraoral inspection to verify the absence of waste.

e. The particles were washed and left to dry by air in a container.

f. Recording the weight of the particles.

g. Vibration analysis through sieves of 4 mm ,2.5 mm and 1.5 mm opening for 120 sec. .

h. The weight of particles retained on each sieve was recorded.

i. Application of masticatory performance index:

$$R = 100 [1 - (X + Y) / (2T-X)]$$

R = percentage of masticatory performance.
X = weight in grams of material in the coarse fraction.
Y = weight in grams of material in the middle fraction.
T = total weight in grams of the test portion after chewing.

The sum of the weight in grams of the chewed material accumulated on the sieve with aperture of 4 mm was referred to as the coarsest fraction (X).

The sum of the weight in grams of the chewed material accumulated on the sieve with aperture of 2.5 and 1.5 mm was combined and was referred to as the medium fraction (Y). (T) was the total weight in grams of the test portion after mastication[7,8].

RESULTS

The flexible partial denture performed the chewing of the carrots raw to the first swallowing threshold with the least number of strokes than the acrylic denture and the carrots required more strokes than peanuts, also the patients in group (4) registered the largest number of strokes to the first swallow(25) than the other groups, and the effect of paired denture compared to single denture among class-III is significantly increasing the number of strokes to first swallowing by 5 strokes in flexible and 4.6 strokes for acrylic dentures. Among the fourth study group (Class-I against Class-I) having flexible partial denture significantly reduce the total number of chewing

strokes to mouth empty by 14.4 strokes compared to acrylic denture, the percentage of change for flexible denture in reduction the number of strokes by 30.2% of acrylic denture strokes during chewing carrots .There is no differences in number of swallows till mouth empty between the two denture base materials during chewing carrots, with little but not significant differences in group (2) during chewing peanuts. The differences in chewing time between the two different denture base materials was highly significant at (p<0.001) in groups (1,2,4) during chewing carrots and in group (4) only during chewing peanuts.

The total chewing timewas higher for the heat cured acrylic partial denture for both types of food compared to flexible partial denture.The highest masticatory performance index was for the flexible denture in all study groups during chewing the two tested food. Using carrots as the test food significantly decrease the masticatory performance index by 10.5% compared to using peanuts as a test food.

DISCUSSION

The flexible denture wearer had the lowest number of chewing strokes and the shortest mastication times, figures (1 and 2) during chewing the two food types and the least number of swallows compared with acrylic denture wearer. The highest masticatory performance index was for the flexible denture wearers, tables (1 and 2) that means it provided the largest weight of fine particles of the chewed food with both carrots and peanuts ,and consequently the most efficient mastication, the probable explanation is that because the flexible denture has the flexibility to disengage forces on individual teeth and prevent transfer of forces to remaining natural teeth and the other side of the arch because it acts as stress-breaker to disengage forces on individual saddles, thus shifting the burden of force control from the design features of the appliance to the material properties of the base material, where flexible lever does not work well as a lever. So let's make the partial flexible to reduce the leverage effects of its extensions [9].

When comparing single dentures with paired dentures ,we can notice that single denture (partial denture against natural dentition) was more efficient in all scales of measurements than paired denture and the probable explanation is that with single denture the food will be crushed between natural dentition and artificial teeth, in the presence physiological human factors influence such as the bite force and the oral sensorimotor of the natural dentition[10],the bite force was greater

in natural dentition than artificial teeth that will facilitate better food breakage and so better

masticatory performance [11].

Figure 1. Bar chart of the mean time interval to mouth emptying (seconds) for flexible denture, acrylic denture and for the differences between flexible and acrylic in 4 study group(carrots).
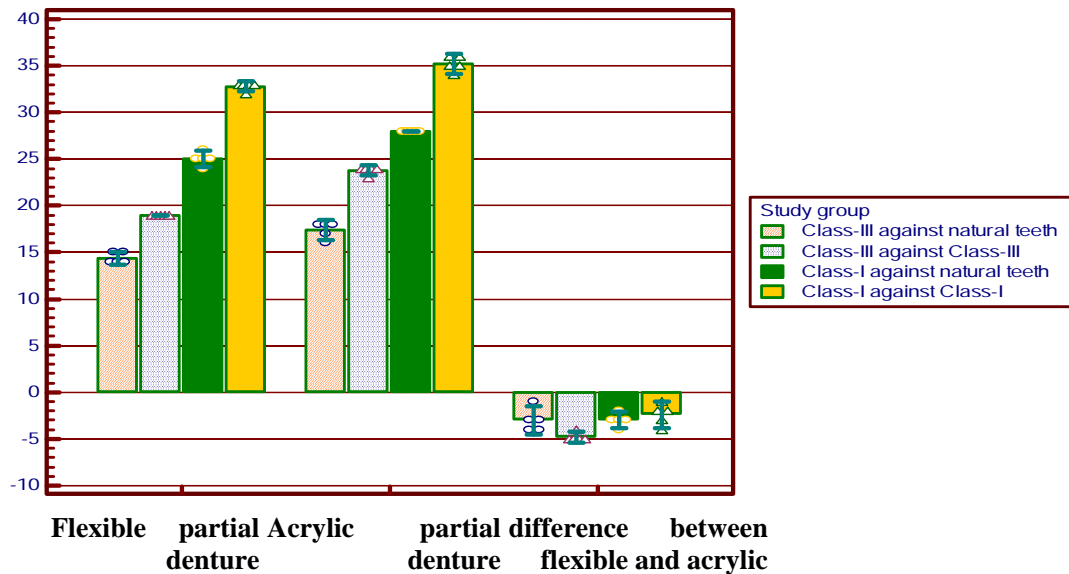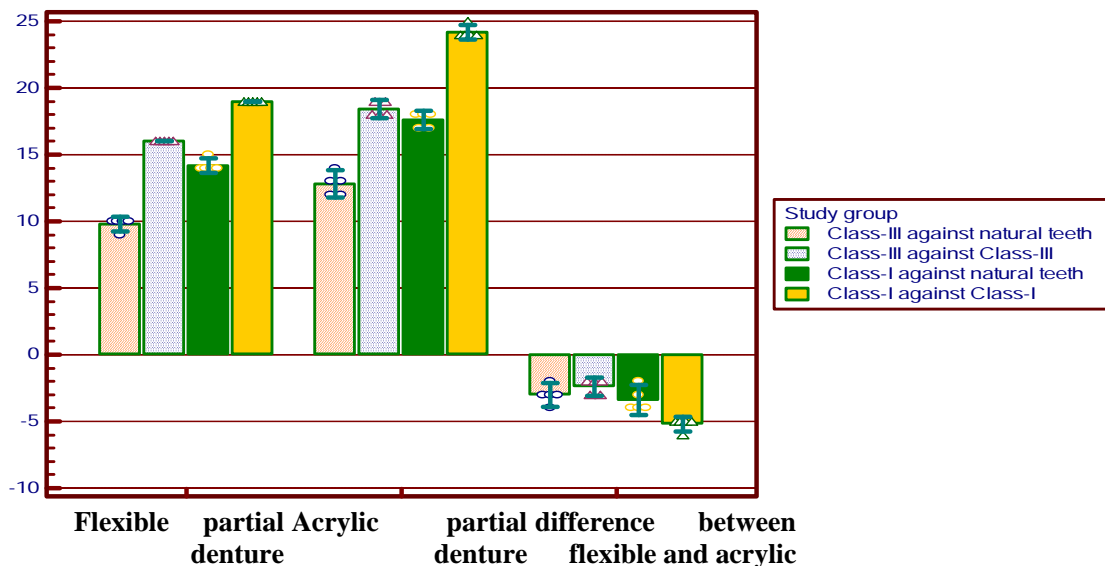

Figure 2. Bar chart ofthe mean time interval to mouth emptying (seconds) for flexible denture, acrylic denture and for the differences between flexible and acrylic in 4 study group (peanuts).

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Table 1. The difference in mean Masticatory Performance Index between 4 study group in flexible denture, acrylic denture and differences between flexible and acrylic (carrots)

	Masticatory Performance Index				
	Flexible partial denture	**Acrylic partial denture**	**difference between flexible and acrylic**	**percent change for flexible compared to acrylic**	**P (Paired t-test)**
Class-III against natural teeth					
Range	(74 to 77)	(48 to 55)	(20 to 27)	(36.4 to 56.3)	
Mean	75.6	51.6	24	46.9	<0.001
SD	1.3	2.7	3.3	8.7	
SE	0.6	1.21	1.48	3.89	
N	5	5	5	5	
Class-III against Class-III					
Range	(34 to 38)	(29 to 32)	(4 to 9)	(12.5 to 31)	
Mean	35.4	30.2	5.2	17.4	0.006
SD	1.7	1.1	2.2	7.8	
SE	0.75	0.49	0.97	3.49	
N	5	5	5	5	
Class-I against natural teeth					
Range	(42 to 46)	(34 to 39)	(3 to 11)	(7.7 to 32.4)	
Mean	43.4	36.6	6.8	18.9	0.009
SD	1.9	1.8	3.2	9.6	
SE	0.87	0.81	1.43	4.3	
N	5	5	5	5	
Class-I against Class-I					
Range	(29 to 33)	(21 to 23)	(6 to 12)	(26.1 to 57.1)	
Mean	31.8	22.2	9.6	43.6	<0.001
SD	1.8	1.1	2.2	11.3	
SE	0.8	0.49	0.98	5.03	
N	5	5	5	5	
Class-III-Effect of paired denture compared to single denture (against natural teeth)					
Difference in mean	-40.2	-21.4			
P	<0.001	<0.001			
Class-I-Effect of paired denture compared to single denture (against natural teeth)					
Difference in mean	-11.6	-14.4			
P	<0.001	<0.001			
Single denture-Effect of Class-III compared to class-I					
Difference in mean	32.2	15			
P	<0.001	<0.001			
Paired denture-Effect of Class-III compared to class-I					
Difference in mean	3.6	8			
P	0.011	<0.001			

Table 2. The difference in mean Masticatory Performance Index between 4 study group in flexible denture, acrylic denture and differences between flexible and acrylic (peanuts)

	Masticatory Performance Index				
	Flexible partial denture	Acrylic partial denture	difference between flexible and acrylic	percent change for flexible compared to acrylic	P (Paired t-test)
Class-III against natural teeth					
Range	(84 to 87)	(70 to 74)	(12 to 16)	(16.2 to 22.9)	
Mean	85.8	72.4	13.4	18.6	<0.001
SD	1.1	1.7	1.9	3.1	
SE	0.49	0.75	0.87	1.38	
N	5	5	5	5	
Class-III against Class-III					
Range	(38 to 42)	(34 to 35)	(4 to 7)	(11.4 to 20)	
Mean	39.6	34.4	5.2	15.1	<0.001
SD	1.5	0.5	1.3	3.7	
SE	0.68	0.24	0.58	1.66	
N	5	5	5	5	
Class-I against natural teeth					
Range	(60 to 65)	(50 to 55)	(7 to 15)	(12.7 to 30)	
Mean	62.4	52.2	10.2	19.7	0.003
SD	1.8	1.9	3.4	7.3	
SE	0.81	0.86	1.53	3.25	
N	5	5	5	5	
Class-I against Class-I					
Range	(34 to 37)	(27 to 31)	(4 to 9)	(13.3 to 33.3)	
Mean	35.4	28.8	6.6	23.3	0.002
SD	1.1	1.8	1.9	8.1	
SE	0.51	0.8	0.87	3.62	
N	5	5	5	5	
Class-III-Effect of paired denture compared to single denture (against natural teeth)					
Difference in mean	-46.2	-38			
P	<0.001	<0.001			
Class-I-Effect of paired denture compared to single denture (against natural teeth)					
Difference in mean	-27	-23.4			
P	<0.001	<0.001			
Single denture-Effect of Class-III compared to class-I					
Difference in mean	23.4	20.2			
P	<0.001	<0.001			
Paired denture-Effect of Class-III compared to class-I					
Difference in mean	4.2	5.6			
P	0.001	<0.001			