

Original Article

Masticatory Efficiency of Shortened Dental Arch Subjects with Removable Partial Denture: A Comparative Study

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ABSTRACT

Objective: The objective of this study was to compare the masticatory efficiency in subjects with shortened dental arch (SDA) before and after restoration with removable partial denture (RPD). **Materials and Methods:** This was a prospective study carried out on 36 consecutive patients. The subjects were asked to chew 5 g of a measured portion of fresh raw carrot for 20 specified numbers of strokes. The raw carrot was recovered into a cup and strained through a standard mesh sieve of 5 mm by 1 mm, it was air dried for 30 min and weighed with FEM digital series weighing scale. The masticatory performance ratio was then determined. **Result:** The age range of the subjects was 34–64 years with the mean age being 52.2 ± 8.2 years. The difference between the total masticatory performance score at the post- and pre-treatment phases was statistically significant ($P = 0.001$). The improvement in masticatory performance was marked among the younger age groups ($P = 0.001$), unilateral free end saddle subjects ($P = 0.001$), and among the male gender ($P < 0.05$). **Conclusion:** Masticatory performance improved with the provision of RPD. However, the improvement was marked among the younger age groups, unilateral free end saddle subjects, and the male gender; thereby supporting the need for RPDs in patients with SDA.

KEYWORDS: Masticatory performance, removable partial denture, shortened dental arch

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INTRODUCTION

Effective masticatory function is one of the important goals of prosthodontic rehabilitation in partially dentate patients.^[1] The ability to chew is not only an important dimension of oral health but has been increasingly recognized as being associated with general health status.^[2] Masticatory performance is the percentage particle size distribution of food when chewed for a given number of strokes.^[3] Although, this ratio provides a measurement of performance of the dentition it however fails to define the degree of impairment.

The minimum number of teeth needed to satisfy functional demands has not been absolutely determined; however, Yurkstas^[4] in 1954 related the loss of molar teeth to a variation in the degree of masticatory performance and efficiency. Similarly, in a later study, the number of functional teeth and maximum bite force were shown as the two major factors affecting masticatory performance.^[5]

However, studies^[6,7] have reported the adaptability of the masticatory system and proposed the premolar dentition as functional and durable.

It has been reported that there is a sufficient adaptive capacity in subjects with shortened dental arch (SDA) when at least four occluding units are left^[8], and it does not result in the impairment of masticatory ability except where <10 occluding pairs of teeth were present.^[9] SDA with an intact premolar region and at least one occluding pair of molar has been found to provide sufficient chewing ability.^[10] An epidemiological study indicated a subjective decrease in chewing ability with an increasing degree of tooth loss.^[11] It was also found that SDA with three to four pairs of occluding premolars and asymmetric arches result in impairment of chewing ability especially for hard food, while in extremely SDAs

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comprising of zero to two pairs of occluding premolars, chewing ability was severely impaired.^[9]

Literature review revealed that the masticatory performance of SDA subjects in Nigeria has received less than adequate attention hence this study to draw attention to this subset of the population. The study aims to compare the masticatory efficiency of subjects with SDA before and after restoration with removable partial denture (RPD).

MATERIALS AND METHODS

This was a prospective interventional study that comprised 36 consecutive patients with SDA, who attended the Prosthetic Dental Clinic of a Teaching Hospital, and met the inclusion criteria. Included in the study were subjects with SDAs and an intact anterior region, those with unilateral free end saddle not involving the second premolar and subjects with asymmetrical SDA with intact anterior teeth. Prior to the commencement of the study, an ethical approval was obtained from the Ethical Committee of the Teaching Hospital.

The demographic data of the subjects were obtained. The masticatory performance of the subjects was evaluated before and after the provision of RPDs based on a procedure described by Gunne.^[12] The subjects were given 5 g of fresh raw carrot to chew for 20 specified numbers of strokes. The raw carrot was then recovered into a cup and strained through a standard mesh sieve of 5 mm by 1 mm, air dried for 30 min, and weighed with FEM mini digital series weighing scale. The volume of the test raw carrot that remained on the sieve and the one that passed through the sieve was determined. The masticatory performance ratio was determined as the volume of raw carrot that passed through the sieve divided by the total volume of raw carrot recovered and expressed as a percentage. The values obtained were calculated and recorded in a data collection sheet. The masticatory performance test was repeated 3 months later after the delivery of metal-based RPD with the denture in place in the subject's mouth.

The data collected were analyzed using Statistical package for social science version 17.0 (SPSS Inc; Chicago, Illinois, 2010). Discrete variables were tested using Chi-square while continuous variables were tested using Student's *t*-test and one-way ANOVA. The results were presented in the form of frequencies, percentages, mean, and standard error of mean and tables. *P* < 0.05 was considered statistically significant.

RESULT

A total of 36 patients with SDA who met the inclusion

criteria were recruited for the study with a male-female ratio of 1:2. The age range of the subjects was 34–64 years with the mean age being 52.2 ± 8.2 years. The majority 10 (27.8%) of the subjects were in the age range of 46–50 years [Table 1]. Twenty (55.6%) of the subjects had bilateral free end saddles while 16 (44.4%) of the subjects had unilateral free end saddles. More than half 20 (55.6%) of the subjects received metal-based denture treatment on mandibular arch only, only 2 (5.6%) subjects received treatment on the maxillary arch only, while 14 (38.9%) subjects received treatment for both maxillary and mandibular arches.

The total masticatory performance score at the posttreatment phase was observed to be higher than that at the pretreatment phase, and the difference in percentage scores at pre- and post-treatment phases was observed to be statistically significant (*P* = 0.001) [Table 2].

The masticatory performance scores at the pre- and post-treatment phases (50 ± 5.77 ; 60.00 ± 5.77) were higher in subjects <45 years while the least masticatory performance scores (16.00 ± 5.16 ; 40.00 ± 0.00) were observed among subjects aged 61–65 years [Table 3].

Table 4 showed the effect of gender on masticatory performance at the pre- and post-treatment phases with males recording higher masticatory performance score at pre- and post-treatment phase compared with females; the difference was not statistically significant (*P* > 0.05).

The subjects with unilateral free end saddles at the pre- and post-treatment phases were observed to have

Table 1: Sociodemographic characteristics among the subjects

Sociodemographic characteristics	n (%)
Age (year)	
<40	2 (5.6)
41-45	4 (11.1)
46-50	10 (27.8)
51-55	6 (16.7)
56-60	8 (22.2)
61-65	6 (16.7)
Gender	
Male	12 (33.3)
Female	24 (66.7)
Total	36 (100.0)

Table 2: Comparison of masticatory performance at the pre- and post-treatment phase among the subjects

Variable	Mean score±SEM		<i>t</i>	<i>P</i>
	Pretreatment	Posttreatment		
Masticatory performance	35.56±2.83	53.61±1.59	10.81	0.001

SEM=Standard error of mean

Table 3: The effect of age on the masticatory performance at the pre- and post-treatment phase among the subjects

Variable	Mean score±SEM						F	P
	Age (years)							
	<41	41-45	46-50	51-55	56-60	61-65		
Premasticatory performance	20.00±0.00	50.00±5.77	44.00±4.52	20.00±0.00	40.00±5.98	16.67±5.16	7.81	0.001
Postmasticatory performance	60.00±0.00	60.00±5.77	57.00±2.49	50.00±0.00	57.50±3.13	40.00±0.00	6.64	0.001
<i>t, P</i>	*	0.00, 1.000	3.62, 0.006	*	5.58 0.001	11.070.001		

*Cannot be computed because the standard error of the difference is zero. SEM=Standard error of mean

Table 4: The effect of gender on masticatory performance at pre- and post-treatment phase among the subjects

Variable	Mean score±SEM		t	P
	Female	Male		
Premasticatory performance	35.00±3.35	36.67±5.41	0.27	0.786
Postmasticatory performance	52.92±1.73	55.00±3.37	0.61	0.796
<i>t, P</i>	8.34, 0.001	6.78, 0.001		

SEM=Standard error of mean

Table 5: The effect of saddle type on masticatory performance at pre- and post-treatment phase among the subjects

Variable	Mean score±SEM		t	P
	Unilateral	Bilateral		
Premasticatory performance	51.25±2.02	23.00±2.31	8.79	0.001
Postmasticatory performance	59.38±1.88	49.00±1.91	9.23	0.001
<i>t, P</i>	9.04, 0.001	23.13, 0.001		

SEM=Standard error of mean

a statistically significant ($P = 0.001$) higher masticatory performance score than those with bilateral free end saddles [Table 5].

DISCUSSION

The rehabilitation of missing teeth with RPD is often utilized to improve patients' masticatory function among others. The majority of the subjects presented with bilateral free end saddle. This is similar to reports in earlier studies.^[13,14] This finding can be ascribed to the greater degree of masticatory difficulty experienced by individuals with bilateral free end saddles unlike those with unilateral free saddles who appears to have a full complement of teeth on one side of the arch. Hence, the stronger motivating factor in seeking denture treatment among subjects with bilateral free end saddle.

The total masticatory performance score at the posttreatment phase was observed to be significantly

higher than that at the pretreatment phase. This corroborates with previous studies,^[15-17] where treatment with RPD significantly improved masticatory performance. It, however, differs from those of previous studies^[10,18,19] where no significant difference was observed in the masticatory performance of subjects with SDA before and after treatment with RPD. In the study by McKenna *et al.*,^[19] it was observed that there was no change in mini nutritional assessment after 1 month. It was argued that follow-up after 1 month was too short a period to observe any difference between the interventions.^[20] However, a recent systematic review by Khan *et al.*^[21] supported the use of SDA as a treatment option with a conclusion that it was encouraging in terms of function, patient satisfaction, and cost-effectiveness.

Kayser^[6] suggested that in addition to the anterior teeth, most people require at least four occluding pairs of teeth (one pair of occluding premolar represent one occlusal unit, and a pair of occluding molar represent two occlusal units). The statistically significant increase in the posttreatment masticatory performance of the studied subjects could be attributed to the more chewing surfaces as well as more occlusal units available for mastication after the replacement of missing posterior teeth. Although, the measurement of masticatory efficiency in denture users showed a decrease of 50–80% when compared with intact dentition,^[22] the masticatory scores of the subjects posttreatment appear to satisfy their functional needs. This is particularly important, when viewed against the types of food consumed by Nigerians; which consists of hard, coarse, and fibrous food type which may require large masticatory surfaces and force to chew.

Better masticatory performance was observed in the younger age groups compared to the older age groups at the pre- and post-treatment phases. This is in agreement with a previous study.^[23] The greater masticatory performance in the younger subjects could be explained by their having better adaptability, maximum bite force, and neuromuscular coordination compared to the older subjects.^[24] It, however, differs from those of earlier studies where there was no association between age and masticatory performance.^[25,26]

Although, there was an improvement in both genders, the males had a higher masticatory performance score at pre- and post-treatment phases compared with the females. This was observed in earlier studies,^[25,26] where it was adduced to the masticatory muscle mass and maximum bite force of men which tends to be greater than those of women; hence, the increase in masticatory function.^[8] However, this was not the situation in some other studies where there was no association between gender and masticatory performance.^[5,27]

Subjects with unilateral free end saddles were observed to have a significantly higher masticatory performance score than those with bilateral free end saddle at both pre- and post-treatment phases. It is possible that the presence of contralateral posterior teeth in subjects with unilateral free end saddle may have increased their biting force; hence, the improved chewing ability. Moreover, mastication tends to be better in subjects with unilateral free end saddle because of the occlusal surfaces provided by teeth on the antagonist arch^[28] and perhaps as a result of better support and stability of the RPD.

Even though there was an improvement in masticatory performance after treatment with RPD, the only single predictor of masticatory performance was unilateral free end saddle when a correlation analysis was done. All other variables had no significant effect on masticatory performance.

A major limitation of this study is the small sample size which was due to the strict inclusion criteria for the study, which demanded an intact anterior teeth and the absence of molar teeth whether in unilateral or bilateral free end saddle. This small sample size further limited the ability of the authors to do a comparison between the contributions of the varied saddle and arch types to the masticatory efficiency in these subjects. Therefore, a larger sample size is recommended to validate the conclusions of this study.

CONCLUSION

Masticatory performance improved with the provision of RPD. However, the improvement was marked among the younger age groups, unilateral free end saddle subjects, and the male gender; thereby supporting the need for RPDs in patients with SDA.

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Nil.

Conflicts of Interest

There are no conflicts of interest.

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