

Evaluation of masticatory performance in subjects with shortened dental arch: A comparative study

Mayank Singh, Arvind Tripathi¹, Neerja Raj², Raghuwar D. Singh

Departments of Prosthodontics, Faculty of Dental Sciences, King George's Medical University,
¹Saraswati Dental College, Lucknow, Uttar Pradesh, India

Address for correspondence:

Dr. Mayank Singh,
Department of Prosthodontics,
Faculty of Dental Sciences,
King George's Medical University,
Lucknow - 226 003,
Uttar Pradesh, India.
E-mail: dr_mayank1983@yahoo.co.in

ABSTRACT

Objectives: The purpose of this study was to evaluate the masticatory performance of shortened dental arches (SDAs) compared with the complete dentition. **Materials and Methods:** A total of 28 subjects with the age group of 45-60 years were selected in the study, which were equally divided into two groups - subjects with shorten dental arch (missing molars; case group) and subjects with complete dentition (control group). Masticatory performance was evaluated by a multiple sieve method on the basis of median particle size of the fragmented particles. Roasted peanuts were used as test food. A method of measuring masticatory performance developed by Manly and Braley and modified by Kapur and Soman was used in this study. Assessment of chewing ability level was also done by asking structured questionnaire. Each question was answered on a four point rating scale. **Results:** Overall masticatory performance in control group ranged from 60% to 70.5% with standard deviation (SD) of 3.20. The male subjects showed higher masticatory performance with SD of 2.60% when compared to females with SD of 1.77%. The overall masticatory performance in case group ranged between 50.6% and 59%, respectively. The male subjects showed higher masticatory performance with SD of 2.29 when compared to females with SD of 1.08. On comparing both groups, it was found that masticatory performance of control group (3.20) was higher when compared to case group (2.59). **Conclusions:** Within the limitations of this study, it can be concluded that SDA subjects have masticatory performance and patient satisfaction level within acceptable range to that of complete dental arch subjects.

Key words

Complete dentition, masticatory performance, shortened dental arch

INTRODUCTION

Teeth are an essential prerequisite for the ability to commute food during mastication and to prepare the ingested food for swallowing and further processing in the digestive tract.^[1] Effective masticatory function is one of the important goals of prosthodontic rehabilitation in partially dentate patients. Number of functional tooth units and occlusal force are two major factors affecting masticatory performance.^[2] The number of teeth needed to satisfy functional and social needs varies individually and depends on a combination of local and systemic

factors, such as periodontal condition of remaining dentition, age of patient, physiologic occlusal activity, and adaptive capacity of tissues.^[2]

Shortened dental arch (SDA) concept proposed by Käyser (1981),^[3] has been recognized as a treatment alternative in subjects with missing molars that can meet the patient's masticatory aspiration, especially for middle aged and elderly patients. This concept can be applied to unilateral or bilateral partially edentulous situation and provides an alternative for the partially dentate patient who is less likely to consider removable partial denture as an ideal option for rehabilitation. The removable partial denture in absence of meticulous oral hygiene measures may accelerate the progression of caries and destruction of periodontal tissues.^[4-6] The aim of this paper is to compare the masticatory performance of partially edentulous subjects with missing molars (SDA) and subjects having complete dentition complete dental arch (CDA) and evaluation of patient satisfaction between these two groups.

Access this article online	
Quick Response Code:	Website: www.ejgd.org
	DOI: 10.4103/2278-9626.134843

MATERIALS AND METHODS

A total of 28 subjects with the age group of 45-60 years were selected in the study and equally divided into two groups:

- Group 1: Subjects with bilateral missing molars, termed SDA (case group)
- Group 2: Subjects with complete dentition, termed CDA (control group).

All the subjects were briefly informed about study protocol and individual consent was taken. Inclusion criterion were class I maxillo-mandibular skeletal relationship and intact tooth region up to second premolars in case group. Subjects with any pathological tooth wear that is attrition, periodontal diseases, temporomandibular disorders and having any malocclusion dental state were excluded in the study.

Masticatory performance

Masticatory performance was evaluated by a multiple sieve method on the basis of median particle size of the fragmented particles. Roasted peanuts were used as test food. A method of measuring masticatory performance developed by Manly and Braley,^[7] and modified by Kapur et al.,^[8] was used in this study.

The test food for each subject consisted of 15 g of roasted peanuts. Test was divided into five sub-runs for each patient to obtain enough material for sieving and to reduce experimental scatter. In each sub-run the subject was given 3 g of peanut and instructed to masticate it by 20 masticatory strokes. This procedure was repeated for each of the four remaining portions of peanuts and chewed food and all rinses were collected every time in the same beaker. The collected pieces in the beaker were stirred gently with a glass rod to break up the clumps and then poured over a sieve with opening of 1700 µm (US. Standard no. 10 Mesh sieve) and the filtrate was collected in a 500CC beaker. The residue thus left over the mesh sieve was then collected in a beaker together with 20CC of water used for washing the sieve to detach the residue particles. The collected filtrate was poured into 15CC graduated test tubes and centrifuged at 1500 rpm for 3 min. The volume of the sediment thus formed in each tube was recorded. The volume of filtrate collected from each subject was then obtained by totaling the recorded volume of filtrate in all the test tubes. The residue was also centrifuged and its volume obtained by same procedure as for the filtrate. Percentage masticatory performance was then calculated by following formula,

$$\text{Percentage masticatory performance} = \frac{F \times 100}{F + R}$$

Where *F* stands for volume of sedimented filtrate, *R* stands for volume sedimented residue.

Assessment of chewing ability

Satisfaction of subjects was assessed by using questionnaire for chewing ability. The subjects were asked structured questionnaire each question was answered on a four point rating scale. Complaints about chewing function were scored as:

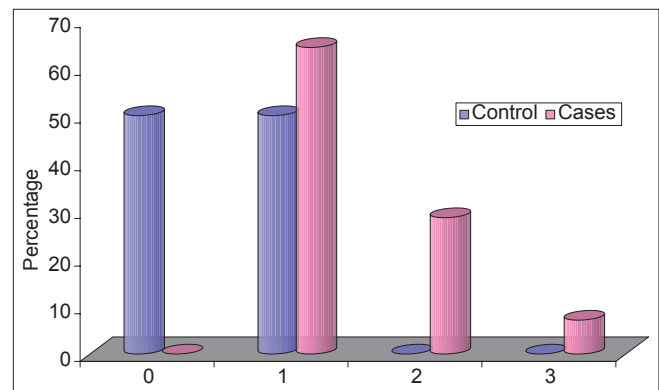
- 0 = No complaints in chewing
- 1 = Minor difficulty but adapted
- 2 = Difficulty in chewing
- 3 = Very difficult to chew and not adapted.

Statistical analysis

The study was carried out with an objective to compare masticatory performance of subjects with missing molars and with complete dentition and to evaluate the patient satisfaction between subjects with missing molars (SDA) and with complete dentition CDA. The statistical analysis was done using Statistical Package for Social Sciences (SPSS 20.0, Inc., and Chicago, IL). The values were represented in number (%) and mean ± standard deviation (SD). Mann-Whitney U-test was used to calculate the significance of difference. A probability level of *P* < 0.05 was considered as significant and *P* < 0.001 was considered as highly significant.

RESULTS

The result of this study is summarized in Table 1 and Graph 1. The overall masticatory performance in control



Graph 1: Graphical representation of comparison of satisfaction level in CDA and SDA groups (CDA: Complete dental arch, SDA: Shortened dental arch)

Table 1: Comparison of mean masticatory performance between case and control group

Variable	Control			Case			Significance of difference (Mann-Whitney U-test)	
	n	Mean	SD	n	Mean	SD	z	P
Overall	14	64.52	3.20	14	54.06	2.59	4.503	<0.001
Males	7	66.81	2.60	7	55.93	2.29	3.130	0.001
Females	7	62.22	1.77	7	52.20	1.08	3.134	0.001

SD – Standard deviation

group ranged from 60% to 70.5% with SD of 3.20. The male subjects showed higher masticatory performance with SD of 2.60% when compared to females with SD of 1.77%.

DISCUSSION

Impaired masticatory function has been suggested to be one of the main concerns of a reduced dental arch. Thus, the correlation between dental arc length and masticatory ability can be evaluated by subjective method and objective method.^[2] In the study both objective as well as subjective evaluation was done for the reliability of the results. Furthermore, it was shown that results obtained by questionnaire method could be correlated with objective evaluation using sieving method.^[9] During subjective evaluation, the subjects assessed their own chewing functionality through structured interviews. The subjects were given questionnaire regarding satisfaction level for mastication. Each question was answered on four point rating scale and scored. The degree of impairment of mastication was measured by objective tests like masticatory performance.^[10] The fractional sieving method is most common and easy method of evaluating masticatory efficiency and performance. It is simple, accurate and cheap method.^[11]

In this study, masticatory efficiency of the subjects was assessed by the fractional sieving method developed by Manly and Braley,^[7] and modified by Kapur *et al.*,^[8] which consisted of a subject chewing a measured portion of test food (peanut) for a specified 20 number of strokes, the test food is recovered and strained through a US standard mesh sieve no. 10 (opening 1700 μm). The volume of food remaining on the sieve and that passing through the sieve was determined as masticatory performance percentage.

In the study roasted peanuts were chosen as test food material.^[8] Some of the reasons cited in favor of peanuts were adequate consistency and resistance to crushing, friability, low moisture content, requires sufficient chewing for comminution, normally forms a part of the diet and easy for subject to handle the food bolus.

A gender wise comparison of masticatory function was done between the two groups. Studies done in the past included a diverse subject population with varying dental status, age and gender. The subjects included in the present study were very similar regarding these criteria. An early study compared the patient perceptions related to masticatory efficiency in SDA subjects and complete dentition subjects.^[4] The result indicated that while masticatory function and food selection were affected for SDA subjects but the perceived reduction was within acceptable limit.

A more recent study was carried out to assess the masticatory abilities in Tanzanian population in rural areas with SDA subjects and complete dentition subjects

for 20 food items.^[12] It was concluded that a SDA with intact premolar regions provided acceptable chewing ability with soft foods. The method of food preparation of selected subjects was cooking on firewood or charcoal.

In this study, a total of 28 subjects were selected of which 14 cases each were selected as control and case subjects and were distributed gender wise. Masticatory performance of subjects was summarized after objective evaluation that is sieving test. The overall masticatory performance in control group ranged from 60% to 70.5% with SD of 3.20. The male subjects showed higher masticatory performance with SD of 2.60% when compared to females with SD of 1.77%. The overall masticatory performance in case group was ranged between 50.6% and 59%. The male subjects showed higher masticatory performance with SD of 2.29 as compared to females with SD of 1.08. Similar results were found in previous studies.^[4,6]

On comparing both groups, it was found that masticatory performance of control group (CDA subjects) was higher when compared to cases (SDA subjects) with SD 3.20 when compared to 2.59 [Table 1 and Graph 1]. SDA subjects established masticatory performance close to that of CDA subjects despite remarkable reductions in their occlusal contact area and occlusal force.

Other method used was subjective method in which subjects were asked questionnaire based on their masticatory satisfaction level. Although chewing was more difficult for the SDA subjects compared with complete dentition subjects, the mean score corresponded mainly to "minor problems but adapted." The female subjects showed better masticatory satisfaction compared with male subjects, the difference between their masticatory level satisfactions was found to be nonsignificant. The SDA subjects demonstrated low masticatory performance to CDA subjects but within acceptable limit. This may be attributed to functionally occluding premolars in SDA subjects. It was found that SDA comprising of minimum 20 teeth with intact anterior tooth region and premolars can provide satisfactory chewing ability for soft foods, which supports the WHO policy aiming at functional dentition during life time.^[13]

CONCLUSION

Within the limitations of this study, it was concluded that SDA subjects can provide masticatory performance and patient satisfaction level within acceptable range to that of CDA subjects despite remarkable reduction in number of teeth and occlusal force.

REFERENCES

1. Käyser AF. Teeth, tooth loss and prosthetic appliances. in: Prosthodontics: principles and management strategies. Mosby-Wolfe,

- London; 1996:97-110.
2. Aras K, Hasanreisoglu U, Shinogaya T. Masticatory performance, maximum occlusal force, and occlusal contact area in patients with bilaterally missing molars and distal extension removable partial dentures. *Int J Prosthodont* 2009;22:204-9.
 3. Käyser AF. Shortened dental arches and oral function. *J Oral Rehabil* 1981;8:457-62.
 4. Aukes JN, Käyser AF, Felling AJ. The subjective experience of mastication in subjects with shortened dental arches. *J Oral Rehabil* 1988;15:321-4.
 5. Witter DJ, van Elteren P, Käyser AF, van Rossum MJ. The effect of removable partial dentures on the oral function in shortened dental arches. *J Oral Rehabil* 1989;16:27-33.
 6. Witter DJ, Cramwinckel AB, van Rossum GM, Käyser AF. Shortened dental arches and masticatory ability. *J Dent* 1990;18:185-9.
 7. Manly RS, Braley LC. Masticatory performance and efficiency. *J Dent Res* 1950;29:448-62.
 8. Kapur KK, Soman S, Yurkstas A. Test foods for measuring masticatory performance of denture wearers. *J Prosthet Dent* 1964;14:483-91.
 9. Hirai T, Ishijima T, Koshino H, Anzai T. Age-related change of masticatory function in complete denture wearers: Evaluation by a sieving method with peanuts and a food intake questionnaire method. *Int J Prosthodont* 1994;7:454-60.
 10. Fontijn-Tekamp FA, Slagter AP, Van Der Bilt A, Van 't Hof MA, Witter DJ, Kalk W, *et al.* Biting and chewing in overdentures, full dentures, and natural dentitions. *J Dent Res* 2000;79:1519-24.
 11. Boretti G, Bickel M, Geering AH. A review of masticatory ability and efficiency. *J Prosthet Dent* 1995;74:400-3.
 12. Sarita PT, Witter DJ, Kreulen CM, Van't Hof MA, Creugers NH. Chewing ability of subjects with shortened dental arches. *Community Dent Oral Epidemiol* 2003;31:328-34.
 13. World Health Organization. Recent Advances in Oral Health. WHO Technical Report, Series No 826. Geneva: WHO Series; 1992.

How to cite this article: Singh M, Tripathi A, Raj N, Singh RD. Evaluation of masticatory performance in subjects with shortened dental arch: A comparative study. *Eur J Gen Dent* 2014;3:146-9.

Source of Support: Nil, **Conflict of Interest:** None declared.

"Quick Response Code" link for full text articles

The journal issue has a unique new feature for reaching to the journal's website without typing a single letter. Each article on its first page has a "Quick Response Code". Using any mobile or other hand-held device with camera and GPRS/other internet source, one can reach to the full text of that particular article on the journal's website. Start a QR-code reading software (see list of free applications from <http://tinyurl.com/yzlh2tc>) and point the camera to the QR-code printed in the journal. It will automatically take you to the HTML full text of that article. One can also use a desktop or laptop with web camera for similar functionality. See <http://tinyurl.com/2bw7fn3> or <http://tinyurl.com/3ysr3me> for the free applications.