Masticatory Performance and Mandibular Movement Patterns of Patients with Natural Dentitions, Complete Dentures, and Implant-Supported Overdentures

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The aim of this study was to compare quantitatively the masticatory performance of patients with overdentures supported by two implants, conventional complete dentures, and natural dentitions. Each patient was asked to chew a gelatin cube. The collected remains of the test food (gelatine cube) were fractioned by a sieving procedure and weighed. Maximum mouth opening and masticatory area were measured using kinesiography. There were statistically significant differences among groups with respect to masticatory performance using a 3.15-mm-diameter sieve ($P < .001$) and 0.5-mm-diameter sieve ($P < .001$), masticatory area ($P = .019$), and maximum mouth opening ($P < .001$). Increasing retention of a mandibular complete denture with two implants improved masticatory performance. *Int J Prosthodont 2012;25:135–137.*

Masticatory performance of complete denture wearers is markedly reduced to between one-fourth and one-seventh of that of adults with natural dentitions.[1] Mandibular complete dentures exhibit complications with oral function caused by retention and stability problems.[2] Edentulous patients with implant-supported overdentures have expressed their satisfaction with various aspects of improved social life and general health.[3] The purpose of this study was to compare the masticatory performance of three groups of subjects with overdentures supported by two implants, conventional complete dentures, and natural dentitions. The amount of mandibular movements (area of each chewing cycle and maximum mouth opening) during mastication were measured. The null hypothesis was that increasing retention of a mandibular complete denture would not affect the masticatory performance.

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Materials and Methods

This study was conducted on three patient groups (conventional complete denture, implant-supported mandibular overdenture, natural dentition [control]). The number of specimens for each group was determined as 9.6 to detect a difference with a power of 80% and an error probability of 0.05. Study groups consisted of 30 patients (13 women, 17 men) whose ages varied from 45 to 60 years, with a mean of 53.2 years. The ethics committee of the University of Ege Medical Center, Izmir, Turkey, approved the protocol (no. 07-6.1/8). Written informed consent was obtained from each patient after a full explanation of the clinical trial.

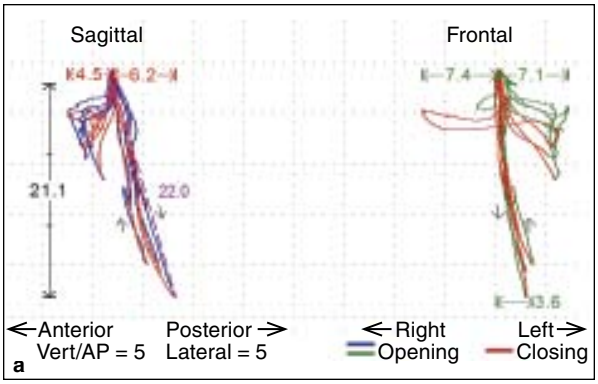
In the overdenture group, two implants (Frialit-2, Friadent) had been positioned in the region of the mandibular canines. New maxillary and mandibular complete dentures were fabricated after positioning ball attachments on the implants (Frialit-2). The dentures were made in centric occlusion with balanced articulation, and anatomically shaped acrylic resin teeth (Bonartic, Ivoclar Vivadent) were used. All patients wore their complete dentures for 4 weeks before masticatory performance was tested.

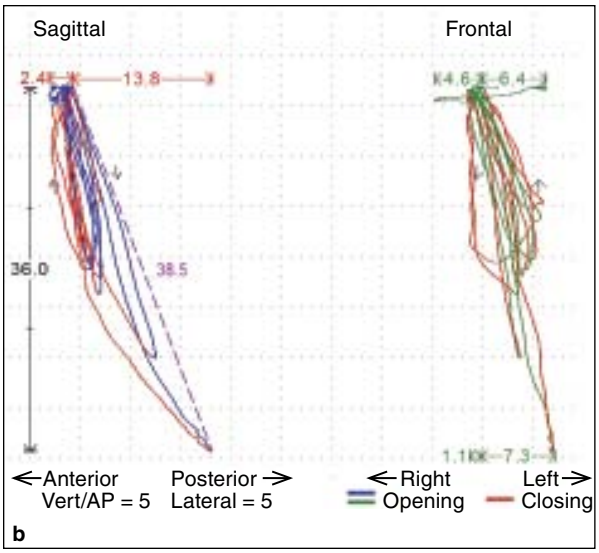
For masticatory performance testing, soft bolus gelatin cubes were prepared. The gelatin cubes were used to determine the masticatory performance and chewing movement. The gelatin cubes were chewed for 15 cycles. Collected particles were air dried for 1 week at room temperature before being sieved. They were filtered, fractioned by a sieving procedure, and weighed. Sieves of 3.15- and 0.5-mm diameter

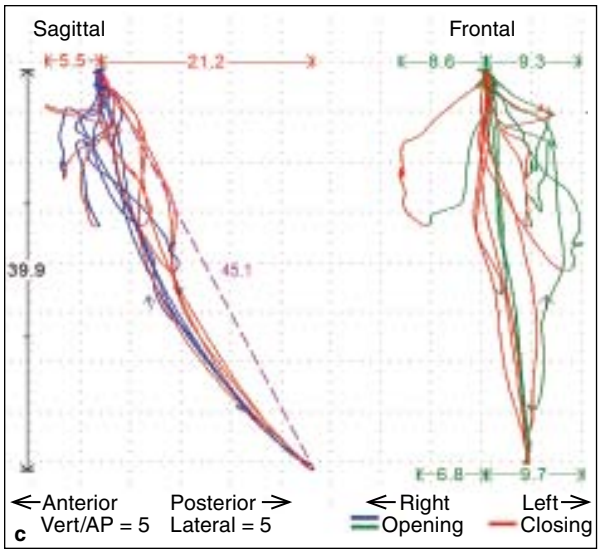
Table 1 Mean Results (SD) for Sieving, Maximum Mouth Opening, and Masticatory Area for the Three Patient Groups

	N	3.15-mm sieve (g)	0.5-mm sieve (g)	Maximum mouth opening (mm)	Masticatory area (mm^2)
Conventional complete denture	10	0.834 (0.054)	0.192 (0.043)	16.31 (2.38)	104.10 (12.96)
Implant-supported mandibular overdenture	10	0.751 (0.055)	0.133 (0.005)	23.02 (3.14)	123.40 (46.92)
Natural dentition (control)	10	0.641 (0.102)	0.048 (0.007)	25.84 (3.73)	149.20 (31.37)

SD = standard deviation.







Figs 1a to 1c Sagittal and frontal mandibular movement patterns of patients with **(a)** complete dentures, **(b)** implant-supported complete dentures, and **(c)** natural dentitions during mastication.

were used to determine masticatory performance. Masticatory performance was defined as the weight of the remaining test food after a given number of chewing strokes and the sieving procedure.

Mandibular movements were recorded using a kinesiography computer system (K6, Myotronics) during masticatory performance testing.

After assessing the normality of data distribution and homogeneity of group variances, the data were analyzed by one-way analysis of variance (ANOVA) using SPSS 15.0 (IBM) for Windows. Pairwise comparisons were performed with the Tukey test. Statistical significance was set at .05 for all analyses.

Results

Mean masticatory performance after sieving, maximum mouth opening, and masticatory area for all groups are presented in Table 1. There were statistically significant differences among the study groups according to the one-way ANOVA with respect to masticatory performance using the 3.15-mm-diameter sieve ($P < .001$) and 0.5-mm-diameter sieve ($P < .001$), masticatory area ($P = .019$), and maximum mouth opening ($P < .001$).

The movement paths of the mandibular incisal point along the frontal plane for the three patient groups are shown in Figs 1a to 1c.

Masticatory performance in patients with natural dentitions was significantly higher than that with conventional complete dentures and implant-supported complete dentures ($P < .05$). Increasing the retention of the mandibular complete denture with two implants improved masticatory performance ($P = .01$). While masticatory area in patients with complete dentures was lower than that in patients with natural dentitions ($P = .004$), maximum mouth opening during mastication in the same patient group was lower when compared to patients with natural dentitions ($P < .001$) and implant-supported overdentures ($P < .001$). There was no significant difference between the complete denture and implant-supported overdenture groups with respect to masticatory area ($P = .533$).

Discussion

The present study was conducted to make a quantitative evaluation regarding masticatory efficiency for implant-supported mandibular overdentures, conventional complete dentures, and natural dentitions.

Numerous reports on the various benefits of implant insertion, such as bone preservation and retention of complete dentures, are available. The present study demonstrated that treatment with two interforaminal implants also increased masticatory performance. Haraldson et al[4] reported that mandibular overdentures retained by two implants did not improve masticatory performance. In a 5-year prospective clinical study, implant-supported mandibular overdenture treatment permitted better occlusal and masticatory function than conventional complete dentures.[5] van Kampen et al[6] reported that improved mandibular complete denture retention after insertion of implants resulted in better masticatory function when compared with conventional complete dentures. On the other hand, increasing the retention of mandibular complete dentures after application of two interforaminal implants may cause a probable lack of retention with the maxillary complete denture.

Conclusion

Within the limitations of this study, the null hypothesis was rejected. Masticatory performance of patients with implant-supported complete dentures was higher than that of patients with conventional complete dentures.

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Literature Abstract

Regulation of tooth number by fine-tuning levels of receptor-tyrosine kinase signaling

Tooth numbers are highly variable among mammals, with evolution leading to a reduction in tooth numbers in many species. Humans have two incisors in each quadrant while mice only have one incisor per quadrant. The rodent incisor is difficult to trace from fossil records, and the influence of specific genes on the number of incisors is not clearly defined. Loss of sprouty gene function has been previously linked to dental anomalies. The aim of this study was to examine a series of mice with sprouty gene mutations to determine whether these mutations affect the number of incisors. The investigation found that modifying the sprouty gene dosage affected the number of incisors produced. Decreases in sprouty gene dosage led to an increased number of teeth. A large decrease in the sprouty gene also led to the development of two independent incisors. This study concluded that altering sprouty gene dosages in rodents has an influence on tooth numbers, and that tooth numbers can be progressively regulated by changing levels of activity of a single signal transduction pathway.

Charles C, Hovorakova M, Ahn Y, et al. *Development* 2011;138:4063–4073. **References:** 58. **Reprints:** Ophir D. Klein, Department of Pediatrics and Institute for Human Genetics, University of California San Francisco, San Francisco, CA 94143, USA. Email: ophir.klein@ucsf.edu—*Clarisse Ng, Singapore*