Different Types of Antagonists Modify the Outcome of Complete Denture Renewal

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Purpose: The effect of renewing removable dentures on masticatory function was evaluated according to the occlusion offered by different types of mandibular arches. ***Materials and Methods:*** Twenty-eight patients with complete maxillary dentures were subdivided into three groups in terms of mandibular dentition type: dentate, partial denture, and complete denture. The participants were observed before and 8 weeks after maxillary denture renewal. The mandibular denture was also renewed in the partial and complete denture groups. The participants masticated carrots, peanuts, and three model foods of different hardnesses. The particle size distribution of the boluses obtained from natural foods was characterized by the median particle size (d_{50}) in relation to the masticatory normative indicator (MNI). Chewing time (CT), number of chewing cycles (CC), and chewing frequency (CF) were video recorded. A self-assessment questionnaire for oral health–related quality of life (Geriatric Oral Health Assessment Index [GOHAI]) was used. Statistical analyses were carried out with a mixed model. ***Results:*** Renewal of the dentures decreased d_{50} ($P < .001$). The number of participants with d_{50} values above the MNI cutoff decreased from 12 to 2 after renewal. Renewal induced an increase in mean CF while chewing model foods ($P < .001$). With all foods, renewal tended to affect CT, CC, and CF differently among the three groups (statistically significant renewal × group interactions). The GOHAI score increased significantly for all groups. ***Conclusions:*** Denture renewal improves masticatory function. The complete denture group benefited least from renewal; the dentate group benefited most. This study confirmed the usefulness of denture renewal for improving functions and oral health–related quality of life. *Int J Prosthodont 2015;28:270–278. doi: 10.11607/ijp.3916*

Prosthodontic treatment has two objectives: functional and esthetic improvement. The former is frequently the prime measurable objective, although it is often imperfectly addressed. Patients wearing removable dentures report and demonstrate compromised function when compared with dentate patients. This is reflected in reports on perceived ease of chewing and particle size measurements following mastication of test foods. This measure of masticatory efficiency shows a decrease of 50% to 85% compared with subjects with intact dentition.[1,2]

Specific and universally acceptable criteria for determining an optimal time to replace or renew complete dentures remain ill-defined and controversial. Recommendations include the suggestion that 50% of complete dentures in elderly patients should be replaced after 5 years of use.[3] Chewing performance could form a basis on which to evaluate the need for complete denture renewal because ability to chew is the primary targeted function of these prostheses. However, diverse and numerous efforts to evaluate chewing efficacy and effectiveness have yielded controversial and inconclusive results that may have been influenced by the type and status of the opposing dentition: natural teeth arch, removable partial denture, or complete denture.[4,5]

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This study evaluated *(1)* the effect of new maxillary complete dentures on food bolus so as to improve masticatory function and *(2)* what effect different opposing occlusions—intact dentitions, removable partial dentures, or complete dentures—have on masticatory function when a new complete denture is made.

Materials and Methods

Study Design

In this cohort study, pretreatment values (T1) were compared with posttreatment ones after new complete dentures were fabricated and worn for 8 weeks (T2). Patient recruitment occurred over a 14-month period in the Department of Odontology (Garancière), Hôtel-Dieu Hospital, Paris, France. The study was approved by the local ethics committee (CECIC: 2010/06; IRB no. 5044), and all participants gave their written informed consent.

Subject Samples

Patients proposed for inclusion were requesting new dentures and had removable complete dentures that did not satisfy the academic criteria for good quality. To be included, subjects had to be wearing a maxillary complete denture and using it for chewing during meals. They had healthy oral mucosa and temporomandibular joints and good or well-controlled general health. The 30 included patients fell into three groups according to type of natural versus prosthetic mandibular arch. The dentate group was made up of five patients with a complete dentate mandibular arch (mean age: 66 ± 11.2 years). The partial denture group of 11 patients had a partial removable denture restoring 5 to 10 missing teeth in the mandibular arch (mean age: 72 ± 4.7 years). The complete denture group, initially made up of 14 patients, had a complete mandibular removable denture (mean age: 73 ± 10.2 years). The exclusion criteria were having an overdenture or implant-supported removable denture, any history of oral surgery in the last 3 months, and allergy to test foods. Two patients dropped out from the initially recruited convenience sample of 30 subjects; the first patient had recently acquired acute general health problems and the second failed to attend after the complete denture insertion. The final group comprising 28 patients fell into three groups according to the type of natural versus prosthetic mandibular arch (Table 1).

Table 1 Study Population According to Type of Natural Versus Prosthetic Mandibular Arch*

Opposing dentition group	n	Age (y) mean ± SD	Sex (n)	
			Women	Men
Dentate	5	66 ± 11.2	5	0
Partial denture	11	72 ± 4.7	6	5
Complete denture	12	73 ± 10.9	8	4

*The dentate group was made up of patients with a complete dentate mandibular arch; the partial denture group included patients who had partial removable dentures restoring 5 to 10 missing teeth; the complete denture group comprised patients who had a complete mandibular removable denture.

Rehabilitation Procedure

A single experimenter performed the whole needed prosthetic rehabilitation, including partial and complete removable dentures of the mandible and maxilla. A conventional technique was used[6] for denture fabrication according to academic criteria. A preliminary impression was made with plaster (Snow-White, Kerr) or alginate impression material (Zelgan, Dentsply Detray). Custom trays for definitive impressions were fabricated on the preliminary cast obtained. Border molding was performed with impression compound (Kerr), and the definitive impression was made with Impression Paste (SS-White Group) or Permlastic materials (Kerr) related to salivary secretion and health of the mucosa. The definitive impression was poured with dental stone type IV (Vel-Mix, Kerr) to obtain the master cast. A facebow (Fag Dentaire) was used to transfer the maxillary cast on a semi-adjustable articulator (Quick-Master B2 , Fag Dentaire). The occlusion rims were adjusted to the vertical dimension and contoured to simulate the position that would be occupied by the artificial teeth. Then the centric relationship was recorded to position the mandibular cast on an articulator. The teeth were set in the occlusion rim according to bilateral balanced occlusion. After the try-in appointment, and after processing the denture, occlusal equilibration was performed on denture insertion day. The patients returned for routine control 1 week after insertion.

Food Samples

Three viscoelastic model foods and two natural foods were used. The three viscoelastic model foods, differing in hardness (soft [S], medium [M], and hard [H]), and standardized in size and shape, were prepared from gummy sweet jelly products (Haribo), gelatin, and water as previously described.[7] The gummy jelly products (105 g) were placed in a glass container with gelatin (none for S, 4.2 g for M, 10.5 g for H) and water (10 mL for S and M, 20 mL for H) and then warmed in a water bath until completely melted, giving a homogenous liquid. Three drops of colorant were then used to mark each hardness. After mixing for 3 minutes,

the blend was poured into Plexiglass cylindrical molds (1 cm in height, 2 cm in diameter). After the gelling process had stabilized (at least 3 days), there were 75 cylinders of each hardness. A fresh batch of model foods was prepared for each session.

Model food cylinders (1 cm in height, 2 cm in diameter) of each hardness were tested using an Instron Universal Testing Machine (Instron mini 55, High Wycombe) under uniaxial compression performed at 50 mm per minute at a strain of 50% of initial sample height. Stresses were 70 ± 20 kPa for S, 90 ± 70 kPa for M, and 100 ± 20 kPa for H. Four standardized samples of carrot (cylinders of 2 cm diameter adjusted in height to weigh 4.0 ± 0.5 g) and unsalted raw peanuts (4.0 ± 0.5 g in weight) were prepared.

Experimental Procedure

Video recording was used to evaluate the kinematic parameters.[8] A digital camera (DCR-PC330E, Sony) positioned in front of the subject recorded a video of the face. The subjects were first asked to chew four replicates of carrots and peanuts. The first replicate was completely masticated and swallowed for training. This allowed determination of chewing time (CT) until swallowing and formed the baseline time for subsequent measurements. For the other three replicates, boluses were spat out just before swallowing. Then, three replicates of each of the three hardnesses of model foods were presented in random order and chewed.

During this sequence, the CT (time in seconds between the moment at which the subject started to chew and swallowing, identified by the immediate swallow after the end of rhythmic rotary movements) was monitored by an investigator and formed the baseline time for subsequent measurements. For the other three replicates, participants were instructed to spit out each bolus when they thought it was ready to be swallowed. They were then asked to chew the S, M, and H viscoelastic model foods, which were presented in triplicate in random order (3 × 3 model foods). All subjects were asked to close their eyes while the experimenter placed the food sample on their tongue so as to prevent recognition of the food sample. They then had to close their mouth and teeth without contracting their muscles, keeping the food sample between their tongue and palate. When prompted by the experimenter, the subjects began chewing as naturally as possible.

Bolus Granulometric Analysis

Each chewed bolus (masticate) was collected, rinsed, and dried. The bolus was then thinly spread over a transparent A4 sheet. The sheet was scanned to produce a 600 dpi image.[7] The images were processed by software to evaluate food particle size and distribution (Powdershape, Innovative Sintering Technologies). The results were expressed in terms of the d_{50} value, characterizing the theoretical sieve size that would allow 50% of the particles to pass through. Thus, the d_{50} value decreased as the food boluses contained smaller particles. The three d_{50} values recorded for each subject and each natural food were averaged; d_{50} values for carrots above 4 mm represented a patient with impaired mastication based on the masticatory normative indicator (MNI).[9]

Every instance of a subject refusing to test the natural food and every instance of a subject spitting the sample out before the end of the first chewing cycle was recorded as a food refusal.

Kinematic Parameters of Mastication

The evaluation of each kinematic parameter required independent reading of each video recording by a calibrated observer who watched the recordings in random order.[8] The method had previously been validated for healthy, fully dentate patients and for denture wearers. The recorded variables were CT and number of chewing cycles (CC: number of chewing actions during the CT period; this included all rotary patterns with and without lip closure). Chewing frequency (CF) was calculated as the ratio CC:CT.

Oral Quality of Life Assessment

Geriatric Oral Health Assessment Index (GOHAI) is a questionnaire on oral health–related quality of life (OHRQoL). It comprises 12 items grouped into three fields: *(1)* functional, *(2)* psychosocial, and *(3)* pain or discomfort. The method used in this study was the cumulative method (Add-GOHAI). Each of the 12 questions is scored from 1 to 5. The maximum score is 60 (functional field = 20, psychosocial field = 25, pain or discomfort field = 15). According to Atchison and Dolan,[10] a score of 57 to 60 is regarded as high and corresponds to a satisfactory OHRQoL. A score from 51 to 56 is regarded as average, and a score of 50 or less is regarded as a low score, reflecting a poor OHRQoL. A validated French version was used.[11]

Statistical Analysis

The population sample was described by the mean ± SD for quantitative variables (CC, CT, and CF). Normality was checked using the Shapiro-Wilk test. For the comparison among viscoelastic model foods (three hardness levels), groups (dentate, partial

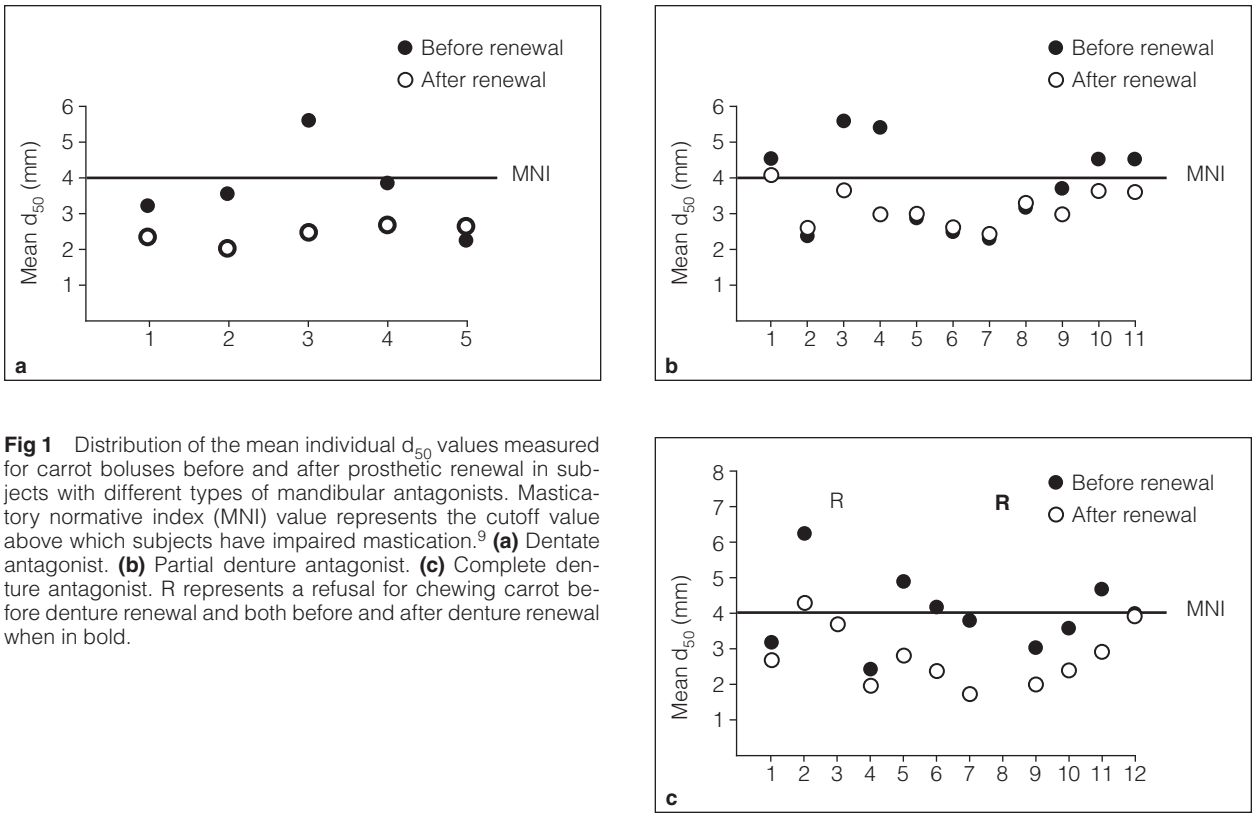

Fig 1 Distribution of the mean individual d_{50} values measured for carrot boluses before and after prosthetic renewal in subjects with different types of mandibular antagonists. Masticatory normative index (MNI) value represents the cutoff value above which subjects have impaired mastication.[9] **(a)** Dentate antagonist. **(b)** Partial denture antagonist. **(c)** Complete denture antagonist. R represents a refusal for chewing carrot before denture renewal and both before and after denture renewal when in bold.

denture, complete denture), and renewal (T1 and T2) to be considered as fixed effects, analyses were carried out with a mixed model that took into account the non-independence of repeated measures and allowed for the within- and between-subject variability to be entered in a model through the so-called random effect (subject, repetition, renewal). Interactions were studied for all models, together with the normality of residuals and random effects. The same approach was used for natural foods. The fractions of variability due to the random effects were calculated by intraclass coefficient. For further insight into intragroup differences, analyses were completed by Student paired *t* test or Wilcoxon matched-pairs rank test. In three cases, some values were missing due to chewing refusal or obvious inability to chew (resulting in a piece of carrot measuring 30 mm). These missing or outlier values were replaced by the 95th percentile of the all-group values. This avoided the bias that would have resulted from either including unrealistic values or averaging after exclusion of subjects unable to chew. All analyses were performed for a two-tailed risk of 5% with Stata version 10 (StataCorp).

Results

Food Refusals and MNI

Before renewal of dentures, two participants who belonged to the complete denture group could not chew carrots and were recorded as "refusal." Ten subjects out of 26 had a d_{50} value above the normal limit of 4 mm, and 16 subjects had a d_{50} below 4 mm. After renewal, only one refusal remained, 1 subject had a d_{50} value above 4 mm and another had a d_{50} of 4 mm. Distribution of the subjects across the three groups is shown in Fig 1.

Chewing of Carrots

The mean d_{50}, CC, CT, and CF values measured for carrot before and after renewal in the three groups of antagonists are presented in Table 2 and Fig 2. Renewal of the dentures had a significant effect on the mean d_{50} ($P < .001$), which decreased from 3.98 ± 1.30 mm (n = 28) before renewal to 3.08 ± 1.10 mm after renewal. The complete denture group made the

Table 2 Effect of Denture Renewal on Particle Size (d_{50} in mm) of Carrots and Peanuts, Number of Chewing Cycles, Chewing Time (in seconds), and Chewing Frequency (in Hz) Recorded Before (T1) and After (T2) Denture Renewal* in Three Groups† of Patients: Mean (SD)

	Particle size		Chewing cycle		Chewing time		Chewing frequency	
	d_{50} T1	d_{50} T2	T1	T2	T1	T2	T1	T2
Carrot								
Dentate (n = 5)	3.73 (1.28)	2.45 (2.38)	73.9 (26.2)	93.8 (38.0)	52.9 (18.2)	64.3 (31.9)	1.40 (0.14)	1.51 (0.16)
Partial denture (n = 11)	3.67 (1.24)	3.21 (0.65)	70.8 (28.6)	67.1 (15.5)	46.6 (18.4)	43.2 (10.4)	1.53 (0.25)	1.56 (0.18)
Complete denture (n = 12)	4.36 (1.29)	3.21 (1.50)	81.0 (31.7)	78.0 (29.4)	71.0 (32.2)	71.0 (41.8)	1.29 (0.22)	1.25 (0.26)
Total	3.98 (1.30)	3.08 (1.10)	70.0 (29.1)	73.1 (28.1)	53.2 (25.1)	55.6 (31.9)	1.36 (0.28)	1.40 (0.28)
Peanut								
Dentate (n = 5)	2.98 (1.17)	2.32 (0.58)	79.3 (26.2)	97.7 (59.3)	59.9 (19.5)	64.5 (41.0)	1.33 (0.12)	1.55 (0.18)
Partial denture (n = 11)	2.61 (0.68)	2.73 (0.63)	72.8 (21.3)	72.0 (19.2)	47.0 (13.6)	46.5 (13.6)	1.56 (0.21)	1.57 (0.18)
Complete denture (n = 12)	3.62 (1.76)	2.72 (1.30)	78.5 (35.6)	82.8 (41.6)	66.2 (31.2)	69.0 (37.8)	1.22 (0.28)	1.22 (0.24)
Total	3.11 (1.39)	2.65 (0.97)	76.4 (28.9)	81.2 (39.4)	57.5 (25.0)	59.3 (32.7)	1.37 (0.28)	1.42 (0.27)

*Antagonist of a complete denture in the maxilla.
†The dentate group was made up of patients with a complete dentate mandibular arch; the partial denture group included patients who had partial removable dentures restoring 5 to 10 missing teeth; the complete denture group comprised patients who had a complete mandibular removable denture.

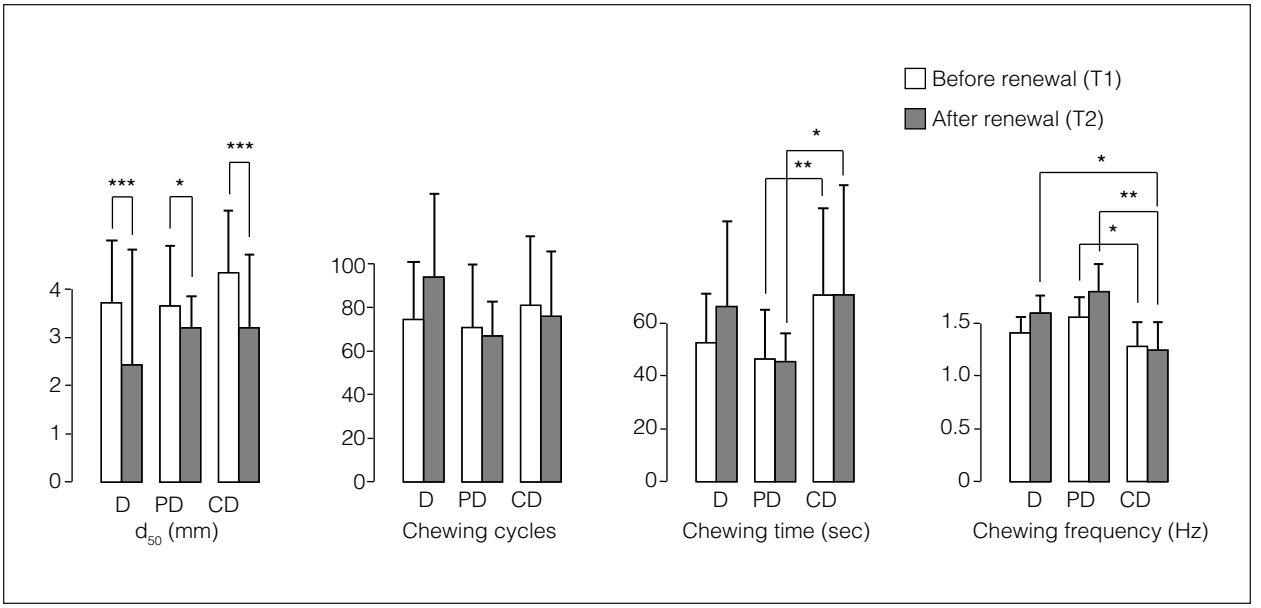

Fig 2 Mean (SD) values of median particle size of boluses of carrots at swallow time (d_{50}), numbers of chewing cycles, chewing time, and chewing frequency required to chew a standard sample of carrot before and after renewal of the prosthetic maxillary dentures in three groups of mandibular antagonists. A mixed model was used for comparisons. D = dentate; PD = partial denture; CD = complete denture. *P < .05, **P .01, ***P < .001.

coarsest boluses, but the difference from the two other groups was not significant. The renewal effect was not significantly different across the three groups (no renewal × group interaction), but the renewal had a significant effect within each group (Fig 2). Renewal of the dentures had no significant effect on the mean CC and CT, but the dentate group was differently affected by renewal, as shown by renewal × group interaction (P = .022). The complete denture group had the greatest CT, with a significant difference from the partial denture group both before (P = .006) and after renewal (P = .022).

Renewal had no significant effect on the mean CF but affected the three groups differently, as shown by the renewal × group interaction (P < .029). The complete denture group had the smallest CF values, with

Table 3 Effect of Denture Renewal on Number of Chewing Cycles, Chewing Time (in seconds), and Chewing Frequency (in Hz) of Patients* Chewing Three Different Hardnesses of Viscoelastic Model Foods Recorded Before (T1) and After (T2) Denture Renewal: Mean ± (SD)

	Gel1		Gel2		Gel3	
	T1	T2	T1	T2	T1	T2
Chewing cycle						
Dentate (n = 5)	59.5 (26.7)	40.6 (15.6)	69.8 (38.8)	56.4 (15.1)	125.9 (57.8)	92.9 (53.4)
Partial denture (n = 11)	53.0 (18.3)	48.5 (18.4)	75.8 (28.9)	64.4 (28.3)	102.2 (39.8)	88.5 (43.6)
Complete denture (n = 12)	45.9 (20.4)	48.7 (17.3)	61.9 (23.3)	67.3 (21.3)	90.5 (42.6)	95.4 (29.9)
Total	60.0 (21.1)	47.2 (17.5)	67.7 (28.9)	64.3 (23.5)	100.4 (44.9)	92.3 (39.8)
Chewing time						
Dentate (n = 5)	46.9 (22.2)	31.4 (15.7)	59.2 (37.0)	41.7 (16.3)	96.6 (49.3)	70.9 (44.6)
Partial denture (n = 11)	38.1 (13.0)	35.0 (15.4)	54.9 (20.2)	46.8 (22.6)	77.5 (31.4)	63.5 (31.7)
Complete denture (n = 12)	37.4 (12.9)	39.5 (14.3)	50.5 (13.2)	54.9 (17.1)	77.0 (23.1)	80.9 (23.4)
Total	39.2 (15.0)	36.3 (15.1)	53.7 (21.5)	49.4 (19.7)	80.0 (31.6)	72.4 (31.8)
Chewing frequency						
Dentate (n = 5)	1.27 (0.16)	1.39 (0.25)	1.20 (0.19)	1.40 (0.19)	1.35 (0.28)	1.37 (0.19)
Partial denture (n = 11)	1.40 (0.20)	1.42 (0.25)	1.38 (0.21)	1.40 (0.20)	1.33 (0.16)	1.41 (0.20)
Complete denture (n = 12)	1.21 (0.27)	1.26 (0.24)	1.22 (0.27)	1.24 (0.20)	1.15 (0.26)	1.19 (0.23)
Total	1.30 (0.24)	1.35 (0.25)	1.28 (0.25)	1.33 (0.21)	1.25 (0.24)	1.30 (0.24)

Gel1 = soft viscoelastic model food group; Gel2 = medium viscoelastic model food group; Gel3 = hard viscoelastic model food group.
*The dentate group was made up of patients with a complete dentate mandibular arch; the partial denture group included patients who had partial removable dentures restoring 5 to 10 missing teeth; the complete denture group comprised patients who had a complete mandibular removable denture.

significant differences from the partial denture group both before (P = .033) and after renewal (P = .002). The dentate group appeared to benefit more from renewal (renewal × group interaction, P = .029), as also shown by the appearance of a significant difference from the complete denture group (P = .046), which did not occur before renewal.

Chewing of Peanuts

The mean d_{50}, CC, CT, and CF values are shown in Table 2. Renewal was effective in reducing the mean d_{50} from 3.11 ± 1.39 to 2.65 ± 0.97 mm (P < .001). Considering the d_{50} across the three groups (group effect), the complete denture group made the coarsest boluses, with a significant difference from the partial denture group before renewal (P = .048). This difference disappeared with the new denture. There was no renewal × group interaction.

Renewal had no effect on the CC and CT, and the only significant difference between groups was for CT, with subjects with complete dentures chewing longer than subjects with partial dentures (P = .046).

Renewal had no significant effect on the mean CF, but affected the three groups differently, as shown by the renewal × group interaction (P < .001). Again, the dentate group appeared to benefit more from renewal. The complete denture group had the smallest CF values, with significant differences from the partial denture group before renewal (P = .001) and from both the partial denture group (P < .001) and the dentate group (P = .008) after renewal.

Contribution of Within-Subject Factors to the Variability of the Models

The repeated within-subject factors contributed diversely to the total variability of the eight models (four variables × two foods). Subject contributed from 54% to 73% and repetition from 2% to 4%.

Chewing Adaptation to Hardness of Viscoelastic Foods

The mean CC, CT, and CF values measured for the three viscoelastic foods before and after renewal in the three groups of antagonists are presented in Table 3 and Fig 3.

Mean CC and CT values increased with increasing hardness of viscoelastic foods both before and after renewal, and a significant difference was seen between the softest and the medium hardness foods and also between the medium and the hardest

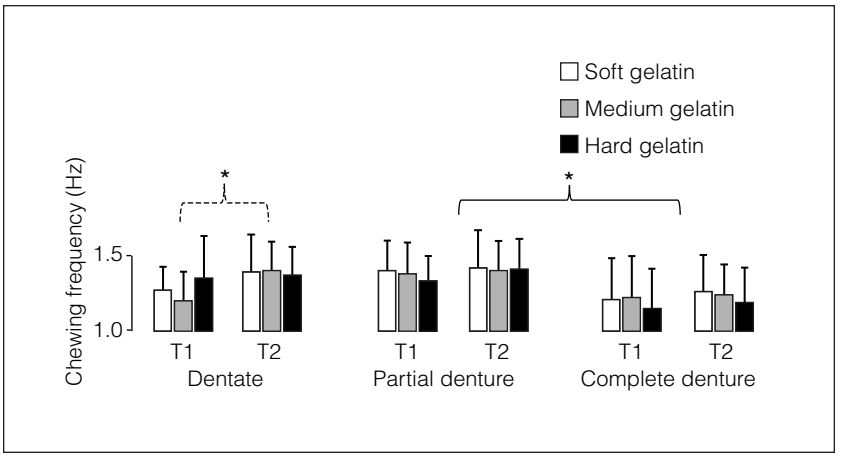

Fig 3 Chewing frequency required to chew three hardnesses of viscoelastic food (gelatin) before (T1) and after (T2) renewal of the removable dentures in three groups of mandibular antagonists. A mixed model was used for comparisons (*$P < .05$). Bracket with a broken line indicates a statistical difference between times (before and after renewal). Bracket with a continuous line indicates a statistical difference among whole, partial, and complete denture groups.

viscoelastic foods ($P < .001$). Renewal decreased CC ($P = .058$) and CT ($P = .013$), and these effects were mostly due to the dentate group, as underlined by a strong renewal × group interaction ($P < .001$ for CC and CT). CC and CT values were not significantly different between the three groups of antagonists.

Mean CF values decreased with increasing hardness of viscoelastic foods (Table 3). The difference was significant only between the softest and the hardest model foods and was found before ($P = .014$) and after ($P = .034$) denture renewal. Before renewal, the dentate group was the only group in which an increased hardness of viscoelastic foods was associated with an increased CF, as shown by a significant group × viscoelastic foods interaction ($P = .024$). This difference disappeared with denture renewal (see Fig 3). The complete denture group displayed the smallest mean CF, with values significantly different from those of the partial denture group both before ($P = .038$) and after ($P = .026$) denture renewal (see Fig 3). Renewal increased the mean CF ($P < .001$). The dentate group benefited most, as underlined by a significant renewal × group interaction ($P = .034$).

Quality of Life Related to Oral Health

Compared with the preoperative values, the mean GOHAI scores were significantly increased after renewal in all functional, comfort, and psychosocial fields that make up the Add-GOHAI score (Table 4). All three groups were found to benefit from renewal.

Discussion

Before renewal, many of the observed complete denture wearers showed a poor final end-result of masticatory function. The 10 subjects displaying MNI values above the cutoff and the 2 refusing to chew carrot samples must be considered as oral invalids.[4,9] The low CF mean value also suggested marked chewing difficulties for complete denture wearers, since CF varies little for a single individual and a given food and remains constant even with an increased hardness, as long as the individual has healthy mastication.[12,13] The study also showed that incapacities in chewing function were perceived by the patients. Chewing difficulty in complete denture wearers has already been demonstrated. The different techniques used in this study confirmed previous results based on food particles size measurements made at deglutition, at a fixed number of strokes (masticatory efficiency), by occlusal force measurement, and by questionnaire.[13–16]

Renewal of removable complete dentures improves masticatory function whatever the antagonist. This was shown by *(1)* the decrease in both the number of carrot refusals and the number of subjects with d_{50} values below the MNI cutoff, *(2)* the decreased mean d_{50} values,[17] *(3)* the renewal-induced increase in CF when chewing viscoelastic foods, and *(4)* the increased GOHAI score with denture renewal. Previous data had already suggested similar improvement based on the mixing ability test,[18] masseter burst

Table 4 Effect of Denture Renewal on Mean GOHAI Scores in Three Groups of Antagonists Recorded Before (T1) and After (T2) Denture Renewal

	T1 (mean ± SD)	T2 (mean ± SD)	Paired test (*P*)
Functional (maximum score: 20)			
Dentate (n = 5)	11.0 ± 4.1	17.2 ± 2.8	$P < .05$
Partial denture (n = 11)	13.8 ± 4.3	16.8 ± 3.5	$P < .05$
Complete denture (n = 12)	10.8 ± 3.3	17.3 ± 2.0	$P < .001$
Comfort (maximum score: 15)			
Dentate (n = 5)	10.0 ± 2.9	11.8 ± 2.2	NS
Partial denture (n = 11)	10.7 ± 1.8	12.3 ± 2.6	$P < .05$
Complete denture (n = 12)	4.6 ± 1.2	8.9 ± 1.8	$P < .001$
Psychosocial (maximum score: 25)			
Dentate (n = 5)	14.8 ± 5.3	24.0 ± 1.0	$P < .01$
Partial denture (n = 11)	19.9 ± 4.3	22.8 ± 2.8	$P < .05$
Complete denture (n = 12)	16.1 ± 4.4	23.8 ± 1.8	$P < .001$
Add-GOHAI (total)			
Dentate (n = 5)	35.8 ± 12.7	53.0 ± 4.4	$P < .01$
Partial denture (n = 11)	44.5 ± 6.9	52.1 ± 7.6	$P < .01$
Complete denture (n = 12)	31.7 ± 7.1	49.8 ± 5.0	$P < .001$

Add-GOHAI = Additive (cumulative) Geriatric Oral Health Assessment Index; NS = not significant.
*The dentate group was made up of patients with a completely dentate mandibular arch; the partial denture group included patients who had partial removable dentures restoring 5 to 10 missing teeth; the complete denture group comprised patients who had a complete mandibular removable denture.

duration,[19] and questionnaires.[20] Nevertheless, the present data showed the persistence of decreased frequency with increasing viscoelastic foods hardness, which indicates a residual level of masticatory deficiency.[12] Finally, after renewal, the subjects appeared to be in a halfway state between normal masticatory function and clear masticatory impairment. The incomplete improvement of masticatory function after renewal may also be explained by an incomplete adaptation to the new denture, which may take more than 12 weeks.[19] Many other factors may affect the patient's adaptation to the new denture, such as the patient's previous experience or the individual oral motor ability for adapting the chewing conditions offered by the new denture.[21]

The type of mandibular antagonist facing a maxillary complete denture influenced masticatory efficiency. This could be observed both before and after renewal. The data in this study indicated that the complete denture group presented the least favorable condition and the dentate group was the antagonist type that benefited most from the renewal. The CF increase induced by renewal while chewing carrots, peanuts, and viscoelastic foods was mostly due to the dentate group and confirmed their masticatory improvement. In the dentate group, but not in the other two groups, renewal tended to induce an increase in the CC and CT for carrots, peanuts, and viscoelastic foods. The CC and CT increases can be interpreted as improvements of masticatory ability in this group of subjects; they chew longer so as successfully to reach a better d_{50}. It has long been known that the number of teeth is a determining factor for chewing ability.[22,23] The parallel seen in this study between the decreased chewing ability and the tooth loss difference among the groups may be explained by the periodontal receptors, which are responsible for controlling the intensities and the direction of applied forces during chewing.[24]

Conclusions

Prosthetic complete denture renewal improves functional efficiency and self-perceived comfort, and this improvement depends on the number of residual teeth on the antagonist arch.

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Literature Abstract

Sex differences of tooth loss and obesity on systemic markers of inflammation

This study evaluated the associations of obesity and the effect of low-grade inflammation on tooth loss in men and women. Data were collected from 2,714 participants as part of the Study of Health in Pomerania (SHIP) cohort, which recorded anthropometric measures, periodontitis, tooth loss, and markers of inflammation such as C-reactive protein (CRP), and interleukin 6. Regression analyses were then performed on the dataset. Based on obesity status, it was found that men lost more teeth than did women. In contrast, there was a steeper increase in CRP levels when obesity levels increase in women as compared to men. With elevated CRP (CRP > 2 mg/L compared to CRP ≤ 2 mg/L), incidence rate ratio (IRR) of tooth loss was higher in men (IRR = 1.50; 95% confidence interval [CI]: 1.27, 1.77) than women (IRR = 1.18; 95% CI: 1.02, 1.37). Further regression analyses (negative binomial regression) revealed that more teeth were lost with a dose-response effect when analyzing body mass index and waist-to-hip ratio. After adjusting for covariates, the IRR of tooth loss associated with the third tertile of waist-to-hip ratio was lower in men (1.37; 95% CI: 1.04, 1.80) than in women (1.53; 95% CI: 1.14, 2.05). When a threshold of CRP of 2 mg/L was used, tooth loss was significant in men (IRR = 1.33; 95% CI: 1.07, 1.66; P = .006) but not in women (IRR = 0.92; 95% CI: 0.73, 1.17; P = .689). This study suggests that both obesity and low-grade inflammation may affect tooth loss, with distinct sex-specific differences. In particular, obesity as a risk factor of tooth loss is likely to be related to CRP in men but not in women.

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