Impact of Compensating Curves on Mastication of Complete Denture Wearers: A Randomised Triple-Blind Clinical Trial

Keywords

Mastication
Complete Denture
Dental Occlusion
Occlusal Curvature

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Received: 02.09.2023
Accepted: 24.10.2023

doi: 10.1922/EJPRD_2617Janz11

ABSTRACT

Introduction: The application of occlusal concepts in prosthodontics is still under debate. This study assessed the impact of compensating curves on the comminution of complete denture wearers. Methods: Seven edentulous subjects, aged 64.6 ± 2.0 years, were rehabilitated with new muco-supported complete dentures and tested in two occlusal plane settings: with and without compensating curves. A randomised triple-blind clinical trial was conducted, considering one-week and one-month as adaptation periods for dentures. After each trial, the subjects were crossed over to their respective groups. One-week was also chosen as the washout period, and after that, the subjects were re-examined. The masticatory performance and swallowing threshold were determined while chewing Optocal test food. The multiple sieve method was used for fractionation and granulometry. Results: During the masticatory performance and swallowing threshold estimates, no differences were found between the median particle sizes obtained with the both occlusal plane conditions ($P > 0.05$). However, the swallowing threshold improved after one month, resulting in smaller particle sizes. Moreover, the chewing rates for the both test foods were also increased ($P < 0.05$). Conclusions: These findings suggest that the compensating curves did not have an impact on the masticatory function of subjects wearing complete dentures.

INTRODUCTION

Muco-supported complete dentures remain the most commonly used alternative for the rehabilitation of edentulous subjects.[1] However, the irregular resorption of residual alveolar ridges and the collapse of facial soft tissues can make spatial orientation challenging during the planning of artificial dental arches.[2] The position and inclination of the stock teeth are functionally determined by the sagittal and frontal angulations of the condylar and anterior guidance, the height of the cusps, the spatial inclination of the occlusal plane, and the radius of compensating curves.[3]

The condylar and anterior guidance can be set in standard values on a semi-adjustable articulator based on the cusp shape, which can be anatomical, semi-anatomical, or monoplane.[4] The occlusal plane can be adjusted to be parallel with Camper's plane and the pupil line, or it may change according to the requirement for a normodivergent pattern and

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bilateral symmetry.[5] Moreover, the design of the compensating curves can be conceived by using an occlusal template,[6] the Broadrick flag,[7] or by the coupling of the tooth guidance.[8,9]

The curve of Spee projects from the tip of the canine cusp and the buccal cusp tips of the mandibular premolars and molars towards the anterior edge of the mandibular ramus and condyle. The curve of Wilson is formed by the buccal and lingual cusp tips of the mandibular teeth on both sides.[10] Both of these components form a theoretical figure, where the cusps and incisal edges are tangent to the surface of an 203.2 mm diameter sphere (Monson's sphere), with its centre in the glabella region.[11] All of these relationships would result in the correct alignment of teeth, with simultaneous contact on both sides of the arches from the their very first contact, and the absence of occlusal centric and eccentric interferences.[4]

Comminution can be evaluated through masticatory performance and swallowing threshold tests, which determine the median particle size (X_{50}) of a test food until a controlled number of masticatory cycles and at the moment of imminent deglutition, respectively.[12] The chewing rate (number of masticatory cycles per minute) can also be calculated. Adaptation to decreased comminution capacity might be achieved by different chewing rates, which may reflect alternative patterns of bolus control, increasing the probability of selection and breakage of food particles.[13] Although the use of complete dentures has been shown to improve the masticatory function of edentulous subjects, their capacity to comminute food is still less efficient compared to dentate subjects. On average, it requires four to eight times more masticatory cycles for edentulous subjects to achieve the same result.[14]

The magnitude of the compensating curves may balance the number of occlusal contacts during eccentric movements and thus stabilises prostheses, preventing the bases from shifting, tipping or torquing on the alveolar ridges. This is effective in ensuring patient satisfaction[15] and can help prevent inflammation of supporting tissue, which can lead to accelerated bone resorption.[16] However, these curves do not exactly align with the root projections of natural dentition.[17] Moreover, a 'flatter' occlusal plane seems to favour more efficient masticatory movements for swallowing,[18] greater maximum bite force,[19] and better mixing ability and food comminution in dentate subjects.[20]

The absence of evidence regarding the clinical impact of occlusal features on masticatory function renders the design of occlusal curves an unregulated aspect in prosthesis manufacturing.[21] Thus, this study aimed to determine the impact of an occlusal plane containing compensating curves on masticatory performance and the swallowing threshold in mucosupported complete denture wearers. We hypothesised that a curved occlusal plane provides better masticatory function compared to an arrangement without occlusal curves.

METHODS

TRIAL DESIGN

This randomised crossover clinical trial was conducted in accordance with the 2010 CONSORT statement. This study was approved by the Research Ethics Committee of the University of Ponta Grossa, Paraná, Brazil (no. 3.056.867), and registered with the Brazilian Registry of Clinical Trials (no. RBR-7gcggcm). All the participants provided written informed consent.

Subjects were alternately subjected to two occlusal plane settings: condition 1, new complete dentures with the teeth arranged to have an occlusal plane containing compensating curves, and condition 2, new dentures without occlusal curves. All subjects were given one week to adjust and adapt to the dentures. Then, their masticatory function was evaluated.[13] After the completion of the initial one-month testing phase,[22] the conditions were crossed over. The subjects were provided with new dentures, each group receiving a new occlusal plane corresponding to their respective group. After one week of adaptation, the masticatory function was re-evaluated *(Figure 1)*.[23] The occlusal plane without curves served as the experimental group and the negative control.

PARTICIPANTS

Subjects were selected over a six-month period from people seeking new dentures at the Prosthodontics Clinics of University of Ponta Grossa. The inclusion criteria were as follows: good general health; older than 60 years (elderly, according to the World Health Organisation); totally edentulous in the upper and lower arch; previous satisfactory experience with complete dentures; alveolar ridges classified as horizontal or distal ascending in the mesiodistal direction and normal in the

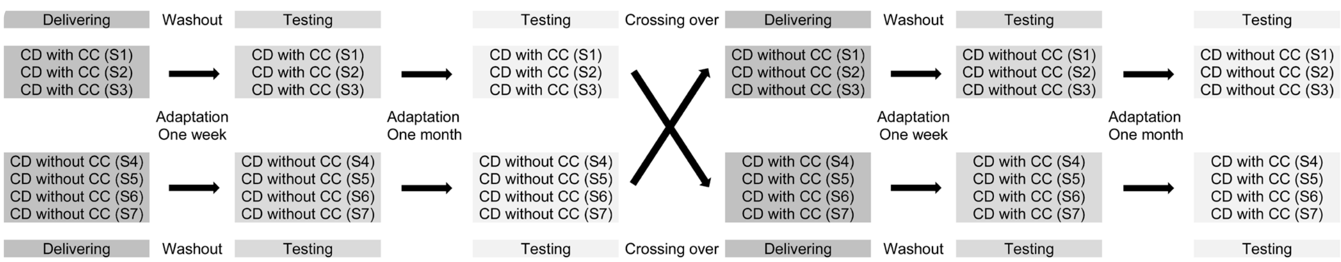

Figure 1: Flow chart of the crossover design. CD: Complete denture; CC: Compensating curve; S1-S7: Subjects 1-7.

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buccolingual direction; mandibular symphysis bone height >15 mm;[24] and favourable bone regularity, mucosal quality, and insertion of muscle fibres and bridles. The exclusion criteria were as follows: uncontrolled systemic diseases, neoplastic conditions, osteoporosis, visually assessed hyposalivation, signs and symptoms of parafunctional habits, history of temporomandibular disorders, or smoking.

The subjects were classified as class I or II according to the edentulism classification index of the American College of Prosthodontists. This classification is based on four levels: bone height, maxillomandibular relationship, bone crest morphology, and muscle attachment. A final score was obtained to classify anatomical structures supporting the prosthesis according to the following classes: class I, ideally or minimally compromised; class II, moderately compromised; class III, substantially compromised; and class IV, severely compromised anatomical supporting structures.[25]

INTERVENTIONS

Complete Denture Fabrication

Upper and lower study casts were made using anatomical impressions and a type III dental plaster. Casts were used to make individual trays in acrylic resin and customised in the mouth for peripheral sealing and functional impression using a low-fusion compound and zinc-enol paste, respectively.[26] The functional casts were duplicated using Zetalabor® laboratory silicone (Zhermack, Badia Polesine, Italy) to obtain the second pair of prostheses. After block out all undercuts and applied separating medium, record bases and occlusal rims were made in autopolymerisable acrylic resin and wax, respectively.

The occlusal rims were adjusted as a plane parallel to the pupil line and the Camper plane according to conventional aesthetic parameters. During facebow transfer, all subjects showed a medium intercondylar distance (110 mm). The vertical dimension was determined by the association of facial measurements with Willis's gauge, rest jaw position minus 2-4 mm (freeway space), aesthetic harmony, deglutition, and phonetic tests. The casts were mounted in a semi-adjustable articulator (4000; Bioart, São Carlos, Brazil) in a centric relationship.[27] Since occlusal vertical dimension, lip support, position of teeth within the neutral zone, freeway space, midline position, and overjet are potential confounding variables, both sets of casts and occlusal rims were constantly interleaved and compared.[28]

Denture Occlusal Plane

For a curved arrangement, the occlusal rims were shaped by the static transfer of Monson's sphere and dynamic control of the condylar and anterior guidance in the articulator. Then, an accessory device was tangentially coupled to the lower wax rim and the condylar elements *(Figure 2)*. In addition, the condylar guidance was adjusted at 25° and 15° (Bennett's angle), and the anterior guidance at 25° (incisal guide) and 10° on the sagittal and frontal planes, respectively.[9] The occlusal rims were not modified for the arrangement without occlusal curves. Therefore, the occlusal plane followed a Balkwill angle of 20-26° with the Bonwill's plane *(Figure 2)*.[29]

Using the same control factors for occlusal curves did not mean placing the same dental arches for all subjects. The different dimensions, shapes, and arrangements of the bone bases and residual alveolar ridges determined dental arches with different characteristics. The full set of acrylic teeth had a cusp angle of 33° (Biolux OMC Vipi®, Pirassununga, Brazil). The teeth were arranged in the following sequence: upper anterior, lower anterior, lower posterior, and upper posterior.

The incisal edge of both upper central incisors was situated +/- 1 mm above the upper occlusal plane. The incisal edge of each lateral incisor was positioned +/- 0.5 mm above the occlusal plane. The incisal edge of each incisor was parallel to the occlusal plane. The tips of both canines were placed at approximately the level of the occlusal plane. The tips of both canines were situated at an approximate distance of 10 mm from the end of the first pair of the palatal ridges *(Figure 3)*.

The incisal edge of each lower central incisor corresponded precisely to the occlusal plane contour. The incisors and canines were parallel to the pupil line and corresponded to a positive smile line on the arch. The vertical and horizontal overlaps were approximately 2 mm. The inclination of the anterior teeth followed conventional facial and smile parameters *(Figure 3)*.

The lower posterior teeth are generally positioned at the centre of the alveolar ridge. The central fissures were in a straight line that ran between the tips of the canines and the centre of the retromolar triangle. The buccal cusps were situated on the tangent of the Bonwill circle, which extended from the buccal limit of the first premolar to the buccal limit of the retromolar triangle. The lingual cusp tips were positioned on Pound's line. Tooth inclination was perpendicular to the curved or 'flat' occlusal plane.

When possible, the upper posterior teeth were placed at the centre of the alveolar ridge. The central fissures were situated on an elliptical line connecting the tips of the canines and the tuber maxillae. On each side, the buccal ridges of the canines, premolars and first molars (mesial) align with a straight line, which diverges from another straight line that connects the buccal ridges of the first (distal) and second molars. Viewed from the front, less of the buccal surface could be seen from the first premolar to the second molar, giving rise to the 'buccal corridor'. Proper occlusion between the lower and upper posterior teeth determines the inclination of the upper teeth *(Figure 3)*.

All dentures were adjusted for centric occlusion using 0.02 mm thick Accufilm II articulating paper (Parkell, Brentwood, CA, USA) and Maxicut tungsten carbide burs (Edenta, São Paulo, Brazil). When necessary, dentures with compensating curves were lightly adjusted in the mouth, in lateral and protrusion movements at

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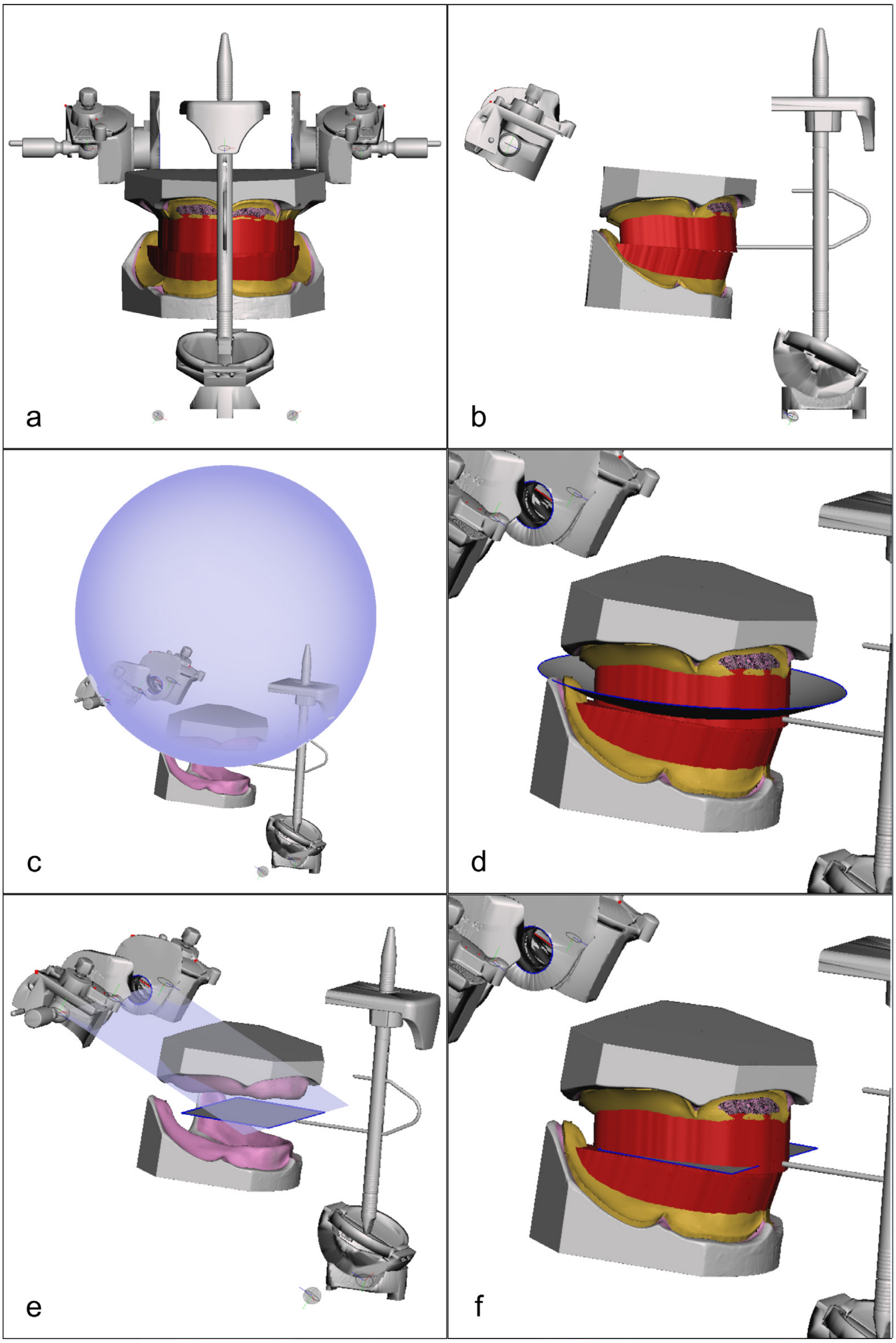

Figure 2: 3D diagram representing the record bases and wax rims mounted on a semi-adjustable articulator in the front (a) and right (b) views; For a curved arrangement, a Monson's sphere was followed (c); The occlusal rims with compensating curves were tangential to the anterior buccal limit of the lower rim and projected to the articulator condyles (d); For the arrangement without occlusal curves, a Balkwill's angle of 20-26° between the Bonwill's plane (bounded by lines connecting the contact points of the mandibular central incisor's incisal edge or the midline of the mandibular residual ridge to each centre of the mandibular condyles) and the occlusal plane (described by the interincisal point and the distobuccal cusps of the mandibular second molars) was used (e); The occlusal rims following an occlusal plane without curves (f).

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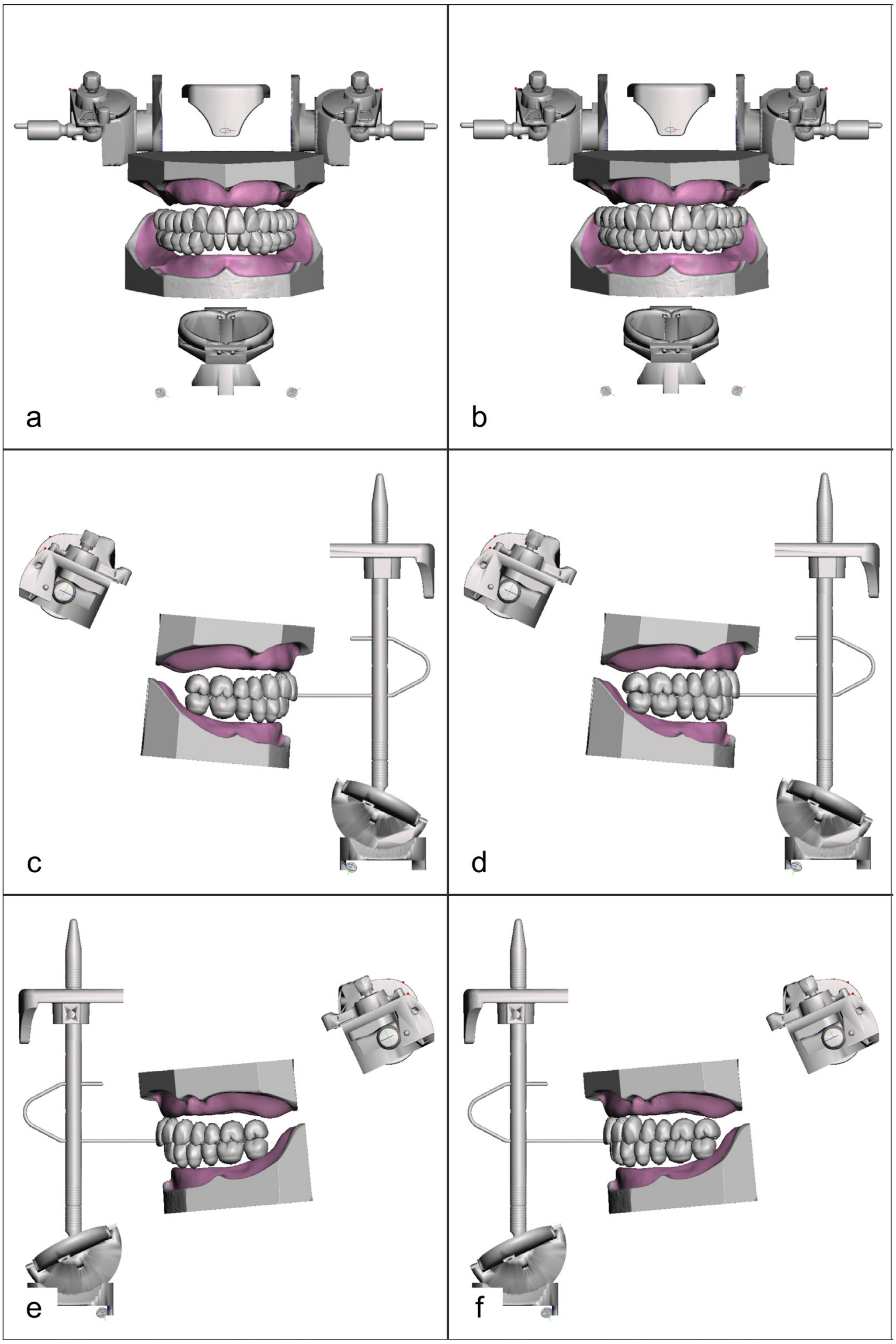

Figure 3: 3D diagram representing the arrangement of teeth on the occlusal plane with compensating curves in the front (a), right (c) and left side (e) views; The diagram also shows the arrangement of teeth on the occlusal plane without occlusal curves in the front (b), right (d) and left side (f) views.

0.5, 1, and 2 mm to corroborate bilateral balanced occlusion. The occlusal contacts in these positions were checked using Arti-Fol® Metallic Shimstock Film (Dr Jean Bausch GmbH & Co. KG, Köln, Germany) with uncoated strip thicknesses of 12 mm and 8 × 50 mm. Eccentric adjustments for dentures without occlusal curves were not performed because the disocclusion pattern was not controlled. The polished surfaces of the denture, extent of the denture bearing area covered, gingival position and contour, height and width of the denture flanges, and overbite were constantly verified.[28]

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OUTCOMES

Masticatory Function

The masticatory performance and swallowing threshold tests were conducted in the morning in a calm and peaceful environment, with suitable lighting that provided the examiner and participant privacy. On the day of the test, the participants had breakfast as usual. During the procedure, each subject sat in a chair with back support in a comfortable position, with the Frankfort plane parallel to the floor (initial position) and arms supported on their thighs and feet on the floor. Before starting the test, the subjects positioned their heads in a free and normal position, but they were instructed to avoid abrupt movements. The evaluation was blinded by not informing the participants about the number of masticatory cycles and timing. Although the participants were unfamiliar with the test foods, no pre-training was performed. Control or feedback was also not used so as not to provoke an imbalance in the conscious/unconscious nature of mastication and probable oscillations in the bite force or chewing rate.[30]

Optocal artificial test food was prepared by the same examiner by mixing the components listed in Table 1 in a ceramic mortar and shaped in metallic matrices to form cubes with a 5.6 mm edge (≈ 0.2 g). After pressing, the silicone cubes were removed from the moulds and stored in an oven (Odontobrás EL-1.1, Ribeirão Preto, Brazil) for 16 h at 60 °C to optimise polymerisation. After the material cooled, it was disinfected and dried at room temperature. A portion of the 17 cubes was collected and weighed (≈3.5 g) on an analytical balance (Bel Engineering, Monza & Brianza, Italy) to be standardised.[31]

Table 1. Optocal artificial test food components.

Proportion	Material	Manufacturer
58.3%	Polydimethylsiloxane putty	Optosil Comfort, Heraeus Kulzer GmbH & Co., KG, Germany
7.5%	Toothpaste	Colgate-Palmolive, Co., Osasco, Brazil
11.5%	Vaseline®	Rioquímica, São José do Rio Preto, Brazil
10.2%	Dental plaster powder	Asfer, Indústria Química Ltda., São Caetano do Sul, Brazil
12.5%	Alginate powder	Jeltrate, Dentsply Indústria e Comércio Ltda., Petrópolis, Brazil
20.8mg/g	Activator universal	Optosil Xantopren, Heraeus Kulzer GmbH & Co., KG, Hanau, Germany

Masticatory Performance

The test food was placed on the subject's tongue, and mastication was initiated with maximum intercuspation. Each subject was instructed to chew a portion of 17 silicone cubes in a natural manner (freely) during 60 masticatory cycles,[32] which were counted and timed by a calibrated examiner. The particles were expelled from the filter paper in a beaker. The subjects' mouths were rinsed with 200 mL of water, and then the particles were expelled again on the same filter several times until the oral cavity was completely clean. The interior was inspected to ensure the recovery of the remaining particles. The residual water was drained, and the filter containing the particles was stored in an oven at 80 °C for 25 min. The particles were sieved through a tower of ten sieves and a bottom pan on a shaker (Bertel Metallurgical Industry Co., Caieiras, Brazil) for 10 min. The sieves were set vertically to decrease the mesh opening order. Each mesh was decreased geometrically following a constant of √2 (8.0 – 0.5 mm). The particles retained in each sieve were weighed on a 0.001 g analytical balance.[33] Masticatory performance was described by the equation

$$Q_{\bar{W}}(X) = 1 - 2^{-(X - X_{50})^{b}} \quad (1)$$

where $Q_{\bar{W}}(X)$ is the percentage of accumulated weight of particles smaller than X or that can cross a sieve with a certain opening; X_{50} is the opening of a theoretical sieve through which 50% of the material weight could pass; and b is the broadness variable for distribution dispersion. A lower X_{50} value indicates thorough comminution of the test food and, therefore, a high level of masticatory performance.[34]

Swallowing Threshold

A 3.7 g portion of non-salted peanuts was given to each participant, who was instructed to habitually chew the food until they felt the urge to swallow. During this period, a calibrated examiner recorded the number of completed masticatory cycles. Next, particle size reduction was evaluated using the Optocal portion. The subject was asked to chew this portion naturally, and the examiner controlled the number of masticatory cycles. In this way, the same number of cycles used during peanut mastication was maintained during Optocal mastication.[35] The comminuted particles were processed and analysed in the same manner as for masticatory performance.

X_{50} (mm) data from the masticatory performance and swallowing threshold tests were considered the primary outcomes. The secondary outcomes were the chewing rate values for masticatory performance, the number of masticatory cycles, and the chewing rate results for the swallowing threshold.

SAMPLE SIZE

Sample calculation was performed using the GPower® software program (v. 14.8.1; Microsoft Partner, Ostend, Belgium). For this study, the parameters for within-factor repeated measures analysis of variance (ANOVA) were considered, which were: effect size *f* = 0.5 (medium effect),[36] α = 5%,

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power = 80%, number of groups = 2 (order of installation of the complete denture according to each condition: with or without then with compensating curves), number of measurements = 8 (two occlusal plane designs: with and without compensating curves ×2 masticatory tests: until 60 masticatory cycles and swallowing threshold ×2 time points: one week and one month after installation), correlation between repeated measures = 0.5, and non-sphericity correction = 1.[37] A sample size of six was calculated. Considering the withdrawal of participants during the study, the study recruited 11 complete denture wearers. Altogether, four volunteers dropped out of the study for personal reasons. Consequently, the final sample comprised seven volunteers, including two males and five females (average age 64.6 ± 2.0 years, range 62-67 years).

RANDOMISATION

Simple randomisation was performed using Excel® software random number generator (v. 2016, Microsoft Corporation, Redmond, WA, USA) to create alternated sequences between the groups. Subjects were identified by a number with concealed allocation that was given in the randomisation process and kept until the last intervention. The numbers were then used as codes for the type of denture, masticatory tests, and their analysis. Four of the subjects initially received complete dentures with compensating curves, and three received them without occlusal curves. All subjects were notified about a change in tooth alignment during the study but were not informed about specific occlusal concepts.

BLINDING

The participants did not know which group they were in. The masticatory performance and swallowing threshold examiners were blinded to the subjects' conditions. The samples collected by the test examiner were made available to another examiner for analysis of the comminuted particles.

STATISTICAL METHODS

Data were analysed using Prism for Windows (version 8; GraphPad Software, Inc., CA, USA), and all inferences were carried out using two-tailed tests, with a test power of 80% (type II error, β = 1-0.20) and a significance level of 95% (type I error, α = 0.05). The normality assumption was verified using the Shapiro-Wilk test. A two-way repeated measures ANOVA was used to determine the differences between the occlusal plane conditions and time. Tests were applied after X^3, X^2 and 1/X transformations regarding masticatory performance, masticatory cycles, swallowing threshold, and chewing rates, respectively.

RESULTS

Masticatory performance assessment up to 60 masticatory cycles presented overall mean values of 5.62 ± 1.26 mm and 69.75 ± 9.50 cycles/min for X_{50} and the chewing rate, respectively. As shown in Table 2, there were no differences ($p > 0.05$) between the occlusal plane conditions and time for either variable.

A global X_{50} of 5.14 ± 1.40 mm was obtained with 71.46 ± 11.26 masticatory cycles during the swallowing threshold analysis. Moreover, the chewing rates showed for peanuts and silicone cubes were, on average, 64.62 ± 9.69 cycles/min and 62.38 ± 9.27 cycles/min, respectively. Following a similar trend *(Table 2)*, the mean values of those variables in relation to the occlusal plane conditions were also equivalent ($p > 0.05$). However, after one month, X_{50} decreased and the chewing rate increased ($p < 0.05$).

Table 2. Mean and standard deviation of masticatory variables according to occlusal plane (OP) design and time (n = 7).

Masticatory function	With compensating curves		Without compensating curves		OP	Time
	1 week	1 month	1 week	1 month	P	P
Masticatory performance						
Median particle size (mm)	5.72 ± 1.40	5.60 ± 1.28	5.66 ± 1.39	5.50 ± 1.24	0.760	0.460
Chewing rate $_{cubes}$ (cycles/min)	69,53 ± 9,97	70,32 ± 9,31	68,73 ± 10,28	70,41 ± 10,61	0.536	0.055
Swallowing threshold						
Median particle size (mm)	5.25 ± 1.79	5.13 ± 0.99	5.51 ± 1.41	4.68 ± 1.50	0.873	0.026
Masticatory cycles	71.57 ± 12.67	71.57 ± 11.52	71.00 ± 11.72	71.71 ± 11.80	0.573	0.441
Chewing rate $_{peanuts}$ (cycles/min)	62.54 ± 10.48	64.10 ± 9.90	64.67 ± 9.12	67.17 ± 10.88	0.368	0.048
Chewing rate $_{cubes}$ (cycles/min)	60.89 ± 9.55	61.82 ± 9.78	62.27 ± 9.52	64.54 ± 10.04	0.403	0.014

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DISCUSSION

It is believed that occlusion in muco-supported complete dentures is fundamental for aesthetics, stability, the transmission of masticatory forces to the supporting tissues, mastication, comfort, and the patient's acceptance of treatment.[37] A recent consensus paper stated that there is strong support that the average denture patient, who has good residual ridges and no neuromuscular problems, will experience sufficient functionality with a properly fabricated prosthesis, regardless of the occlusal scheme.[38] According to our results, it seems that compensating curves designed in dentures for class I/II edentulous subjects also do not influence masticatory performance and the swallowing threshold. In dentate subjects, differences in masticatory systems are primarily due to functional parameters.[39] However, the practical significance of occlusal curves is not fully understood.

The curve of Spee is highly variable among subjects and is influenced only to a minor extent by craniofacial morphology. Its design is primarily explained by the horizontal position of the mandibular condyle in relation to the occlusal plane. The degree of curvature is weakly influenced by the vertical craniofacial dimensions and by the position of the mandible in relation to the anterior cranial base. With the curve of Wilson, the buccolingual inclination of the posterior teeth is parallel to the orientation of the internal pterygoid muscle.[40] It has been suggested that occlusal curves play a biomechanical role in food processing. They increase the crush shear ratio between the posterior teeth, the number of occlusal contacts, and the efficiency of force distribution. This would enable the natural dentition, mandible, and condyle to better resist stress during mastication.[41]

Along with improving food contact during the selection and breakage process, the alignment of teeth on compensation curves is closely related to a functional gear system of anterior and posterior guidance.[39] Compensating curves may optimise the work of cusp contacts, preventing non-functional contacts or occlusal interferences. However, it was found that the contact areas in lateral excursions do not improve the prediction of masticatory performance.[42] Then, the biomechanical advantages of acrylic resin teeth may not outweigh the dysfunction caused by total edentulism. It is possible that occlusal characteristics, which provide stability and retention to denture bases, are the primary factors influencing comminution.

This can be observed in studies on denture adhesives, where different formulations of these materials seem to enhance masticatory performance and the swallowing threshold in a similar manner. Interestingly, in subjects with resorbed ridges, a cream adhesive is better than strips for improving mastication.[41] This emphasizes the importance of the residual edge height and contact area with the supporting tissues.[43] In this study, subjects with supporting structures that were minimally or moderately compromised were included with the intention of isolating the compensating curves under ideal conditions. This explanation may be supported by implant-retained complete dentures, where the occlusal schemes also do not influence masticatory performance.[44] There is no evidence for other types of oral rehabilitation, but fixed treatments should follow the same occlusal plane design as natural dentition.

The data on the swallowing threshold showed functional improvement after one month. Despite increased muscle activity, the complete denture wearers show an abnormal formation of a food bolus, which contains numerous large particles. This impaired can be similar to the masticatory disabilities observed in subjects with neuromotor deficiencies.[45] The improvement can be confirmed by evaluating oral stereognosis, which refers to the recognition and discrimination of shapes and sizes of objects through sensory-motor integration.[46] This ability also increases after one month of adapting to new dentures, regardless of one's previous experience with wearing prostheses.[46,47] Moreover, subjects with normal residual ridges exhibit enhanced masticatory performance and higher satisfaction with their treatment, irrespectively of the duration of follow-up. On the other hand, it takes approximately three months are necessary to improve functionality with mandibular dentures,[48] regardless of the height of the ridges.[49]

The study results should serve not only to confront some occlusal concept but also to determine its probable limits. Geometric and functional parameters were developed to conceptualize an ideal, stable and efficient occlusion in an articulator. Consequently, since the beginning of oral rehabilitation, efforts have been made to replicate these parameters in both natural and artificial occlusion. In this sense, certain occlusal characteristics may have varying levels of influence in different samples and conditions. In addition to being functionally necessary for dentate subjects and the arrangement of stock teeth in a balanced scheme,[2,4,50] a slightly curved occlusal plane can also contribute to achieving an aesthetically aligned set of teeth.[51,52] The relative perpendicularity of the long axes of the teeth to the occlusal plane not only helps distribute bite forces more effectively but also provides guidance for the ideal positioning of teeth in relation to facial and smile parameters.[53,54]

It would also be interesting to determine whether the retention, stability, and support achieved in subjects with class III/IV edentulism are sufficient to subsidize for occlusal plane design during function. Because an occlusal plane with compensating curves was employed to achieve balanced occlusion, another question should also be addressed: Could a curved occlusal plane with different occlusal schemes or varying cusp heights affect mastication over time? To the best of our knowledge, lingualized, balanced, and canine guidance are preferred over monoplane occlusion. The lingualized scheme tends to demonstrate better clinical performance and higher patient satisfaction compared to the other schemes for both normal and resorbed ridges; and the group function shows inconclusive results.[15]

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It is important to highlight that the outcomes of this study were based on only seven subjects, which could be considered a limitation. Getting more volunteers would be challenging due to the nature of the older population and the specific characteristics of edentulism used in the present study. With an adequate supporting tissue, a complete maxillary denture does not imply serious adaptation problems and can even be occluded on root- or implant-retained overdentures.[55] However, since several factors such as unfavourable psychological condition, advanced age, female sex, lack of experience wearing dentures, poor technical quality, traumatic injuries, resorbed ridges, and irregular wear were found to be associated with longer adaptation time to new mandibular complete dentures,[48,56] further studies with larger cohorts and long-term evaluations are needed.

Although occlusion is one of the most determining factors for the success of prosthodontics, dentures exhibit different biomechanical behaviour compared to natural teeth. It functions as a single piece, enabling the force exerted on a single tooth to be distributed throughout the entire denture.[57] Depending on its intensity, occlusal or orthopaedic instability in the natural dentition can be individually tolerated due to the resilience of the periodontal ligament and neuromuscular regulation. Instability in artificial teeth affects all of them and the denture base. Thus, occlusal curvature may be justified based on gnathological assessment, anatomical perspective, and aesthetic intention, but not from a biological or physiological standpoint.[58]

CONCLUSIONS

Within the limitations of this study, the results lead us to reject our hypothesis. It appears that compensating curves do not impact masticatory function in edentulous subjects who have been rehabilitated with muco-supported complete dentures.

ACKNOWLEDGEMENTS

The authors thank all the involved patients, and the clinical staff of the Department of Dentistry of the University of Ponta Grossa.

FUNDING

This study was financed in part by the The Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001

AUTHORS' CONTRIBUTIONS

All co-authors took part in the conceptualisation and preparation of this manuscript. JMZ, YNR and VJO recruited the participants and completed the assessments. DEC and ASA performed the analysis, ASA wrote the first draft of the manuscript. AFC revised the manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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