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**Purpose:** To compare the speaking space, perceived rotational movement during chewing, and oral health–related quality of life (OHRQoL) of elderly people rehabilitated with new conventional complete dentures (CDs) and single-implant mandibular overdentures (SIMOs) using a paired design. Patient expectations for SIMO use were also evaluated. **Materials and Methods:** The participants were 22 elderly users of unsatisfactory CDs. They received new sets of conventional CDs, and assessment was performed after 2 months of use. Speaking space was recorded with a kinesiograph while participants read a list of words. Participants were asked two questions about perceived posterior rotational denture movement during chewing. The Dental Impact on Daily Living (DIDL) questionnaire was used to examine OHRQoL, and a visual analog scale was used to quantify participants’ SIMO expectations. Subsequently, the mandibular CDs were converted to SIMOs, and the assessment was repeated after 2 months of use. Speaking space and OHRQoL data were submitted to ANOVA and Student t test, and perceived mandibular movement and expectation data were examined using likelihood-ratio chi-square test. **Results:** The speaking space and perceived rotational movement did not differ between CD and SIMO use. General performance and eating restriction DIDL scores increased after SIMO insertion. Participants’ SIMO expectations regarding speaking, cleaning, esthetics, and general aspects were met. **Conclusion:** Relative to CD use, SIMO use did not change the speaking space or perceived rotational movement when chewing among elderly patients. It improved OHRQoL via enhancement of two DIDL dimensions and met most elderly patients’ expectations. Int J Prosthodont 2022;35:711–717. doi: 10.11607/ijp.7901
and oral health–related quality of life (OHRQoL) with SIMO use compared to conventional CD use. However, the effects of SIMOs on other crucial oral functions, such as speaking, remain unknown.

The first study evaluating speech articulation in implant-supported fixed CD wearers showed that difficulties in pronouncing the /s/ phoneme were associated with decreased bite force, number of teeth in occlusion, width of the front of the implant-supported CDs, and sensitivity to masticatory muscle palpation. In addition, no correlation was found between interdental space and impaired speech, and mandibular movement pattern did not change except when the individuals started to use the artificial palate for the first time. During the first time using the artificial palate, individuals presented smaller mandibular movement and worsening quality of the /s/ phoneme. Lundqvist et al. and Molly et al. also found that maxillary implant-supported fixed CDs may contribute to short-term distortion of the /s/ phoneme in individuals who had previously used conventional CDs. However, a recent systematic review found a low quality of evidence on speech articulation disorders for maxillary and mandibular implant-supported fixed CD users.

There are several studies in the literature assessing the speech articulation of implant-supported CD users. However, there are few studies evaluating the speaking space in these patients. In contrast to speech articulation, which measures the speech quality, studies on speaking space show the range of mandibular movement during speech. The mandible and tongue act as a connected system; the mandible supports and positions the tongue while the tongue fine tunes the airstream during pronunciation, modifying sounds to produce speech. The speaking space is determined by the degree to which the mandible moves in the oblique orientation during speaking. Since mandibular implant overdentures improve conventional CD retention and stability, they can be reasonably supposed to contribute to expansion of the speaking space. Nevertheless, no published study has addressed this hypothesis.

Despite having increased retention, patients with overdentures anchored by two or three implants perceive rotational movement during chewing; this movement has been associated with anterior tooth arrangement and denture length. In addition, Emami et al. suggested that the number of mandibular overdenture implants influences patients’ perception of posterior movement. Posterior rotational movement occurs when patients chew with the anterior teeth and reduces their ability to chew, satisfaction with mandibular overdentures, and OHRQoL. In addition, less muscle activity occurs during chewing with a two-implant overdenture than with a SIMO, suggesting that SIMOs promote wider rotational movements, requiring wearers to exert greater stabilization effort. However, some patients must apply prosthetic adhesive under their SIMO bases for chewing, which can generate complaints and discomfort, decreasing OHRQoL.

The OHRQoL of SIMO users has been investigated thoroughly, most commonly with use of the Oral Health Impact Profile. The questionnaire design can influence research results, and studies performed with other OHRQoL assessment instruments are needed to expand knowledge of the impact of SIMO use on the OHRQoL of elderly edentulous users. In addition, as patient expectations regarding prosthetic treatment can motivate the choice of therapy, the assessment of these expectations before and after implant-supported or retained denture placement is important for clinical practice to maximize patient satisfaction with implant treatment. Currently, data on patient expectations related to SIMO treatment are scarce.

Thus, the aims of this study were to compare the speaking space, chewing rotational denture movement, and OHRQoL of elderly people rehabilitated first with new conventional CDs and then with SIMOs using the Dental Impact on Daily Living (DIDL) questionnaire. Patient expectations regarding SIMO use were also explored. The null hypothesis was that SIMO use would not improve outcomes compared to conventional CD use.

**MATERIALS AND METHODS**

**Study Design and Participants**

This clinical paired study was performed in elderly edentulous people who sought prosthetic treatment at Piracicaba Dental School, University of Campinas, São Paulo, Brazil. Participants first received conventional CDs and later received SIMOs. The study protocol was approved by the local ethics committee (no. 70804111.3.0000.5418) and registered at ClinicalTrials.gov (identifier: RBR-47gbn4). The principles of the Helsinki Declaration were fully adopted for this study.

Eligible elderly (age > 60 years) people were completely edentulous (class II or III according to the American College of Prosthodontics) and had sufficient midline mandibular bone height and volume for implant placement. All participants had already participated in a previous study in which speech articulation parameters, such as articulation disorders, mandibular movements during speech, and swallowing threshold, were evaluated by a paired-design study in which the subjects were evaluated with their old dentures, new conventional CDs, and SIMOs. People who smoked, had cognitive impairments, alcoholism, had undergone radiotherapy, had parafunctional habits, had signs or symptoms of temporomandibular disorders, and/or had uncontrolled diseases that contraindicated dental implant surgery were excluded. Sample
size calculation indicated that 15 subjects would be sufficient to detect significant differences with 80% power and a 5% probability of error.\textsuperscript{45} To compensate for possible losses, 22 patients were included in this study.

All subjects received new maxillary and mandibular conventional CDs. After 2 months of new CD use, the speaking space and chewing denture rotational movement were measured, and patients’ OHRQoL and expectations were assessed. Subsequently, one implant was placed in the mandibular middle region of each subject, and the mandibular CDs were converted into SIMOs. Assessments were performed again after 2 months of SIMO use.

**Clinical Procedures**

New conventional CDs were manufactured with heat-cured acrylic resin using the conventional technique.\textsuperscript{46} After placement in the participants’ mouths, the CDs were adjusted to provide balanced bilateral occlusion and address any participant complaint. Participants then wore the new prostheses for 2 months. Thereafter, a hexagonal implant (Titamax Ti Cortical, Neodent; 11-mm length, 3.75-mm diameter) was placed in each participant’s symphysis region. A submerged healing protocol was adopted, and second-stage surgery was performed 3 months after implant placement. After 2 weeks of healing, an attachment system (Equator, Neodent) was connected to the implant, and the corresponding matrix was used for SIMO retention. Two dentists (I.A.M. and M.A.P.) and one dental technician performed all prosthetic treatments.

**Speaking Space**

Speaking space was recorded by a kinesiograph (JT-3D, BioResearch Associates) using the “freeway space” function of the BioPAK program while the subject was seated in a dental chair with the Frankfurt plane parallel to the ground. A magnet was fixed provisionally to the mandibular artificial incisors such that it did not interfere with dental occlusion. A magnetic sensor device was adjusted on the subject’s head according to the manufacturer’s instructions. The participant was asked to occlude and then to read a list of words containing all Brazilian Portuguese phonemes while the mandibular movement was registered.\textsuperscript{47} The “maximum slant” data, representing oblique mandibular movement during speech,\textsuperscript{48} were recorded as the speaking space.

**Chewing Rotational Denture Movement**

Participant perceptions about rotational prosthesis movement during chewing were assessed using two questions: (1) Does your denture raise at the back when you chew? (yes/no); and (2) How much does this raising of your denture bother you? (100-mm visual analog scale [VAS] ranging from “not at all” to “extremely”).\textsuperscript{32}

**Oral Health–Related Quality of Life**

The DIDL questionnaire, which is used to determine the impacts of buccal interventions on daily quality of life,\textsuperscript{49,50} was administered to participants. The DIDL consists of 36 negatively and positively oriented objective questions in 5 dimensions (appearance, pain, comfort, general performance, and eating restriction).\textsuperscript{49} The response options are “agree,” “neutral,” and “disagree.” One point was awarded for each positive response and deducted for each negative response; neutral responses were worth 0 points.\textsuperscript{49} Mean dimension scores were obtained by summing scores from the items in that dimension and then dividing by the number of dimension items. Higher dimension scores were considered to reflect more positive dimension-specific impacts of denture use on the subject’s daily quality of life.\textsuperscript{49}

**Participant Expectations for SIMO Use**

Participants using their new conventional CDs were asked about their expectations for SIMO use with regard to esthetics, retention, comfort, chewing, cleaning, speaking, and overall hopefulness.\textsuperscript{43,51} They rated their expectations on a 100-mm VAS, with higher scores reflecting higher expectations. For each aspect evaluated, scores ≥ 90 were classified as high, those < 90 and > 10 were classified as medium, and scores ≤ 10 were classified as low.\textsuperscript{43}

After SIMO insertion, participants’ satisfaction with the overdentures was evaluated as described by Awad and Feine,\textsuperscript{52} with higher scores indicating greater satisfaction. It is important to emphasize that measuring participants’ satisfaction is part of the expectation methodology.\textsuperscript{43} Thus, to determine whether participants’ expectations were met with SIMO use, the expectation scores (0 to 100 mm) were subtracted from the satisfaction scores (0 to 100 mm) for each aspect evaluated. Expectations were considered to have been met when the resulting values were ≥ 0, and unmet when the values were < 0.\textsuperscript{43}

**Statistical Analysis**

The data were analyzed using SAS software (version 9.3, SAS Institute). As the assumption of normal data distribution was fulfilled, repeated-measures ANOVA and Student \textit{t} test were used to analyze the speaking space and OHRQoL data. Likelihood-ratio chi-square test was used to analyze the frequencies of participants with and without perceived mandibular denture rotational movement and those whose expectations were met and unmet. A significance level of 5% was used for all analyses.

**RESULTS**

A total of 22 denture users (10 men and 12 women) with a mean age of 66.7 ± 4.6 years (range: 60 to 76 years)
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participated in this study. The participants’ sociodemographic characteristics have been reported previously.45 Three participants dropped out before the assessment of new conventional CD use, and 4 participants were lost to follow-up before implant placement; thus, the assessment of SIMO use was performed in 15 participants.

The mean ± SD value for speaking space did not differ between new conventional CD (15.6 ± 3.0 mm) and SIMO (16.3 ± 3.7 mm) use (P = .5560). Similarly, the number of participants who perceived chewing posterior rotational movement of conventional CDs (n = 6) and SIMOs (n = 3) did not differ (P = .4473) (Table 1).

Mean DIDL scores for general performance and eating restrictions were higher after SIMO use than after new conventional CD use (P = .0036 and P = .0133, respectively) (Table 2), reflecting improved OHRQoL in terms of the ability to chew/bite, perform daily activities, and engage in social interaction (P < .05). Approximately 80% of participants had high expectations for SIMO use (Fig 1). Larger proportions of subjects had their expectations met generally and in terms of esthetics, ability to speak, and ability to clean the prosthesis than those whose expectations were not met (P < .05) (Table 3).

### DISCUSSION

The present study showed that the speaking space (reflecting vertical and horizontal mandibular movements) and perceived rotational movement of dentures during chewing did not differ between conventional CD and SIMO use, whereas OHRQoL was better with SIMO than with conventional CD use, and participants’ (high) expectations for SIMO use in terms of esthetics, speaking, and cleaning were met. Thus, the null hypothesis was rejected.

As the literature contains no data on speaking space in implant-supported prosthesis wearers, the ability to compare the present findings for this variable to those of others is limited. Souza et al31,48 found that the smallest speaking space (during /s/ pronunciation) was similar to the freeway space in conventional CD users, but this finding cannot be compared directly to the present results for overall speaking space. These findings show the importance of performing adequate conventional CD-to-SIMO conversion to maintain the vertical occlusal dimension and suggest that, in the short term, SIMOs do not enable greater laterolateral mandibular movement during speech than conventional CDs.

Considering that Kimoto et al32 found that half of a group of two-implant overdenture wearers complained about rotational movement when chewing, it was expected that many participants in the present study would report rotational SIMO movement. However, only three participants reported such movement. Kimoto et al32 did not apply alveolar ridge criteria for patient selection and used ball attachments, which may explain this discrepancy in results, given that these factors can influence patient perceptions of rotational movement. Severe atrophy of the alveolar ridge can jeopardize the stability and retention of implant overdentures due to the lack of resistance to lateral and rotational forces.5 To avoid bias, elderly people with classes II and III alveolar ridges

### Table 1

<table>
<thead>
<tr>
<th>Perceived posterior rotational movement of mandibular prostheses</th>
<th>Yes</th>
<th>No</th>
<th>χ² value; P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>New CDs</td>
<td>6 (31.6)</td>
<td>13 (68.4)</td>
<td>0.5774; .4473</td>
</tr>
<tr>
<td>SIMOs</td>
<td>3 (20.0)</td>
<td>12 (80.0)</td>
<td></td>
</tr>
</tbody>
</table>

Data are reported as n (%) unless otherwise specified.

### Table 2

<table>
<thead>
<tr>
<th>OHRQoL as Measured by DIDL Dimension Scores (Mean ± SD) for Participants Using New CDs and SIMOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIDL dimension</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Appearance</td>
</tr>
<tr>
<td>Pain</td>
</tr>
<tr>
<td>Comfort</td>
</tr>
<tr>
<td>General performance</td>
</tr>
<tr>
<td>Eating restrictions</td>
</tr>
</tbody>
</table>

Rank-based ANOVA for comparing mean scores was used for statistical analysis.
were included. In addition, the cylindrical Equator attachment used is designed to prevent a large degree of posterior SIMO rotation, whereas ball attachments may increase such movement.

In this study, SIMO insertion improved OHRQoL as evaluated by the DIDL instrument. This finding is in agreement with Schuster et al, who reported that two-implant overdenture use improved general performance and eating restriction scores among elderly patients. The conversion of a mandibular conventional CD to an implant overdenture improves retention and stability, which are relevant for the performance of daily activities such as work, social, and chewing abilities. In contrast to the present findings, Schuster et al found that two-implant overdenture use led to an improvement in the appearance dimension score. However, the mean appearance score in the present participants when using new conventional CDs was already very high, which may explain this discrepancy in findings.

The present finding that most of participants’ expectations regarding SIMO use were met is consistent with a previous study employing the same methodology. Other authors have documented greater satisfaction of SIMO users with mastication and device retention and comfort, but participant expectations for these aspects were not met in the present study. As the present participants were using very inadequate and unsatisfactory old conventional CDs at baseline, their replacement with new, well-fitting conventional CDs may have been sufficient to improve these aspects before SIMO placement, thereby generating even higher expectations regarding SIMO use that ultimately were not met. Menassa et al stated that such high expectations probably reflect a new generation of elderly edentulous patients who are influenced by marketing regarding implants and associated procedures, and despite being satisfied with new devices, these patients will not have their expectations met fully.

![Figure 1](image_url) Participants’ levels of expectation of SIMO treatment.

**Table 3** Participants (n, %) with Expectations Met and Unmet in Relation to SIMO Treatment According to the Aspects Evaluated

<table>
<thead>
<tr>
<th>Aspects evaluated</th>
<th>Expectations met</th>
<th>Expectations unmet</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall satisfaction</td>
<td>13 (86.7)</td>
<td>2 (13.3)</td>
<td>.0045</td>
</tr>
<tr>
<td>Retention</td>
<td>10 (66.7)</td>
<td>5 (33.3)</td>
<td>.1967</td>
</tr>
<tr>
<td>Comfort</td>
<td>11 (73.3)</td>
<td>4 (26.7)</td>
<td>.0707</td>
</tr>
<tr>
<td>Chewing ability</td>
<td>11 (73.3)</td>
<td>4 (26.7)</td>
<td>.0707</td>
</tr>
<tr>
<td>Speaking ability</td>
<td>13 (86.7)</td>
<td>2 (13.3)</td>
<td>.0045</td>
</tr>
<tr>
<td>Cleaning ability</td>
<td>12 (80.0)</td>
<td>3 (20.0)</td>
<td>.0201</td>
</tr>
<tr>
<td>Esthetics</td>
<td>12 (80.0)</td>
<td>3 (20.0)</td>
<td>.0201</td>
</tr>
</tbody>
</table>

Chi-square test was used for statistical analysis. Significant (P < .05) values are shown in bold.
This study has some limitations. The short-term evaluation period may have limited the ability to fully evaluate patient-reported outcomes; for example, the short-term follow-up may partially explain the small number of SIMO users who reported rotational movement, as such movement is more noticeable when nylon matrix retention is lacking, which is usually the case after about 6 months of SIMO use. Long-term prospective studies of patient perceptions are needed to confirm the advantages of SIMO use compared to new conventional CD use. In addition, the subjectivity of most variables should also be cautiously interpreted, as these psychosocial aspects may influence results. Additionally, considering that all volunteers received the conventional CD and SIMO prosthetic treatments free of charge, a feeling of gratitude may have been generated, and this may have influenced the questionnaire answers.

CONCLUSIONS

The increased retention provided by implant placement and SIMO insertion did not influence the speaking space or perceived rotational overdenture movement during chewing in the present study. SIMO use did improve OHRQoL, and users’ expectations regarding speaking and cleaning abilities, esthetics, and overall satisfaction were met. Thus, dentists should first consider the manufacture of new, suitable conventional CDs and recommend SIMO insertion or prosthetic treatment involving more implants depending on the patient’s satisfaction and expectations.

ACKNOWLEDGMENTS

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REFERENCES


Literature Abstract

Impact of Machined Versus Structured Implant Shoulder Designs on Crestal Bone Level Changes: A Randomized, Controlled, Multicenter Study

The collar region of an implant is its connection to the oral cavity. A balance between osseointegration and the absence of plaque accumulation is necessary for successful implantation. However, it is yet to be determined which implant collar design, polished or rough, is best for stabilizing the crestal bone level to avoid peri-implantitis and the subsequent risk of implant loss. The aim of this study was to investigate the influence of the architecture of the collar region on marginal bone and soft tissue response. This prospective, randomized, clinically controlled multicenter study included 58 patients undergoing dental implant treatment using a pair of dental implants with either machined or rough-surfaced shoulder regions. Patients were clinically and radiologically examined for bone level height and signs of inflammation after 6, 12, and 24 months. No implant was lost over the 2 years of follow-up (100% survival rate). No significant differences in crestal bone loss (machined neck: 0.61 mm ± 0.28 mm, rough neck 0.58 mm ± 0.24 mm) or soft tissue response (probing depth 3 to 6 mm with bleeding on probing in 7.6% of machined implants and 8.3% of rough implants) were observed between the implant groups over the 2-year follow-up. Machined- and roughened-collar implants achieved equally good results concerning peri-implant bone loss, rate of peri-implantitis, and implant survival rate/hard and soft tissue integration. Neither of the two collar designs showed a clear advantage regarding peri-implant reaction.