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CLINICAL RESEARCH

# Influence of facial patterns on the masticatory function and quality of life of completely edentulous patients during the transition to implant-retained mandibular overdentures

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## ABSTRACT

**Statement of problem.** Although implant-retained mandibular overdentures (IMOs) provide functional benefits, the influence of the vertical facial pattern (FP) and the anteroposterior skeletal discrepancy (ASD) on the masticatory function and patient-centered outcomes during the transition to IMOs is still uncertain.

**Purpose.** The purpose of this interventional clinical study was to evaluate the influence of the FP and ASD on the masticatory function, oral health–related quality of life (OHRQoL), and satisfaction of completely edentulous patients before and after transition to IMOs.

**Material and methods.** Cephalometric analysis was performed on 42 participants before treatment. Ricketts analysis was used to classify the FP, and the maxillomandibular relationship to the base of the skull determined the ASD. Masticatory performance (MP) and swallowing threshold (ST) test results were evaluated by the multiple sieve method by using artificial test food (Optocal cubes) to determine the median particle size (×50), homogenization index (B), and masticatory efficiency based on sieves 5.6 (ME: 5.6) and 2.8 (ME: 2.8). OHRQoL and satisfaction were evaluated by using the Dental Impact on Daily Living questionnaire. The data were analyzed using mixed-effects linear regression models to estimate the effect of time, FP, ASD, age, and sex on MP, ST, and OHRQoL.

**Results.** The MP, ST, OHRQoL, and satisfaction improved significantly after IMO loading, irrespective of FP and ASD. However, MP outcomes were most negatively affected mainly among dolichofacial (B and ME: 2.8), class II, and class III (×50, B, and ME: 2.8) participants. The ST test showed that class II participants still showed inferior ×50 values and performed a lower number of cycles than class I and class III participants. Women presented reduced masticatory function for all MP and ST outcomes and reported lower coefficients for appearance and general performance domains than men.

**Conclusions.** The MP test detected more subtle improvements than the ST test, especially in class III participants. The class II participants benefited the least from the IMO installation according to the ST test. The IMO treatment improved the OHRQoL and satisfaction of edentulous patients, irrespective of the FP or ASD. (J Prosthet Dent 2019;122:450-8)

Cephalometric analysis is widely used in orthodontics to diagnose craniofacial form and plan rehabilitation treatments.[1] Cephalometric analysis uses linear and angular measurements to classify patients according to their facial skeletal pattern.[1] The facial growth pattern can be mainly vertical (dolichofacial), vertically and horizontally balanced (mesofacial), or mainly horizontal (brachyfacial).[2,3] The mandibular anteroposterior position can be classified according to the position of the mandible in relation to the base of the skull: normal (class I), distal (class II), or medial (class III).[4] Those evaluations are useful for determining the ratio of the facial thirds, the differences in the vertical dimension of the

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## Clinical Implications

The evaluation of masticatory function and self-perception of edentulous patients with different facial pattern and anteroposterior skeletal discrepancy during the transition from complete dentures to implant-retained mandibular overdentures showed that these factors may influence the prognosis of prosthetic rehabilitation, mainly in class II patients.

oral cavity, and the maxillomandibular relationship. These data can assist during the fabrication of conventional complete dentures and can also prevent problems in the temporomandibular joint.[5]

Knowledge of facial morphology enables clinicians to tailor treatment planning, as different facial patterns (FPs) are associated with specific problems that can influence the masticatory function and patient expectations.[6,7] The FP of edentulous patients can also be determined using cephalometric analysis if the measurements are performed in the rest position.[3,8] Mesofacial and class I patients are considered the reference group because their prosthetic rehabilitation is more straightforward.[5,9] Dolichofacial patients have excessive facial convexity, narrow nasal cavities, and breathing difficulties. Those patients push the tongue forward to improve breathing, which directly affects complete denture retention and stability. Brachyfacial patients have strong muscular activity in the masseter, with a tendency to overload the mandible.[5] This frequently results in displacement of the mandibular denture due to muscular activity,[5] with the risk of temporomandibular dysfunction. This unfavorable prognosis must be considered during treatment planning.[5]

The mandibular protrusion of class III complete denture wearers frequently results in a significant decrease in the vertical facial dimension over time.[10] To achieve a maxillomandibular relationship comparable with that in class I patients, the correct vertical dimensions must be reestablished.[10] Although anteroposterior skeletal discrepancy (ASD) in completely edentulous patients can be compensated in various ways, it is not always possible to reestablish masticatory function and satisfaction.[11,12] In addition, women have less masticatory function than men under these conditions,[13,14] probably because of their lower occlusal force.[15-18]

Implant-retained mandibular overdentures (IMOs) are considered the minimum treatment for rehabilitating completely edentulous patients[19] because they positively impact the masticatory function,[20] satisfaction, and oral health–related quality of life (OHRQoL).[21-25] IMOs can reduce the bone resorption rate[26,27] and offer facial support when an advanced alveolar ridge resorption is observed. IMOs also require fewer supporting implants,[28,29] have a relatively low cost, and are easy to remove for hygienic maintenance.[30] Although many of the benefits provided by IMOs are well known, masticatory parameters and patient-centered outcomes of completely edentulous patients according to the FP and ASD during the transition from complete denture to IMO are lacking. The purpose of this prospective interventional clinical study was to evaluate the influence of the FP and the ASD on the masticatory performance (MP), swallowing threshold (ST), OHRQoL, and satisfaction of complete denture wearers before and after 3 months of the transition to IMOs. The null hypothesis was that the different FPs and ASD would not influence the masticatory function, OHRQoL, or satisfaction of edentulous patients after the transition to IMO.

## MATERIAL AND METHODS

This prospective interventional clinical study was conducted using the secondary data of patients treated at the Complete Denture Clinic of the Dentistry School of the Federal University of Pelotas between 2013 and 2015. This study was conducted according to the Helsinki 2008 declaration and followed the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.[31] All procedures involving humans were approved by the local ethics committee, protocol (no. 69/2013). This study included completely edentulous participants with good general and oral health who had difficulties adapting to a mandibular complete denture.

Fifty-six individuals were evaluated. Forty-two of them (29 women and 13 men) fulfilled the inclusion criteria and signed the informed consent form. Lateral cephalograms were obtained by using radiographic equipment (Rotograph Apparatus Plus; Villa Sistemi Medicali) to determine the FP and the ASP before rehabilitation with new complete dentures. Each participant was positioned in the physiological rest position, that is, the usual position of the mandible when the individual is relaxed and holds the head upright. The participants were asked to remove their prostheses, swallow, and relax before the radiograph was made.[3,8] The radiological analyses were made in duplicate by 2 trained and calibrated radiologists (A.P.P.M., A.C.M.M.) independently by using a software program (CefX v4.5.10; Computarized Cephalometry, CDT Informática LTDA).

Agreement between the radiographs was evaluated visually; concordance analysis was not performed as the visual correspondence between all radiographs was deemed sufficient for the purposes of this study. The Ricketts analysis was conducted to classify the patients as

**Table 1.** Mixed-effects regression models of masticatory performance outcomes conditional on time, facial pattern (FP), anteroposterior skeletal discrepancy (ASD), sex, and age

| | Masticatory Performance | | | |
|---|---|---|---|---|
| **Outcomes** | **×50, Coefficient (95% CI)** | **B, Coefficient (95% CI)** | **ME 5.6, Coefficient (95% CI)** | **ME 2.8, Coefficient (95% CI)** |
| Time | | | | |
| Baseline | Ref. | Ref. | Ref. | Ref. |
| 3 mo | **-0.90 (-1.30; -0.41)** | **-3.24 (-5.17; -1.32)** | **-0.80 (-1.10; 0.48)** | **0.31 (0.14; 0.48)** |
| FP | | | | |
| Mesofacial | Ref. | Ref. | Ref. | Ref. |
| Brachyfacial | 0.60 (-0.17; 1.40) | **4.31 (0.11; 8.50)** | **0.85 (0.05; 1.65)** | **-0.30 (-0.50; -0.10)** |
| Dolichofacial | 0.90 (-0.34; 2.13) | **6.77 (1.10; 12.44)** | 0.74 (-0.45; 1.94) | **-0.44 (-0.82; -0.06)** |
| ASD | | | | |
| Class I | Ref. | Ref. | Ref. | Ref. |
| Class II | **1.10 (0.23; 1.97)** | **4.44 (0.88; 8.01)** | 0.36 (-0.48; 1.21) | **-0.35 (-0.66; -0.04)** |
| Class III | **1.17 (0.00; 2.40)** | **7.59 (2.10; 13.08)** | 0.57 (-0.67; 1.80) | **-0.56 (-0.95; -0.18)** |
| Sex | | | | |
| Male | Ref. | Ref. | Ref. | Ref. |
| Female | **0.85 (0.34; 1.36)** | **2.03 (0.67; 3.39)** | **0.83 (0.36; 1.30)** | **-0.22 (-0.36; -0.07)** |
| Age (y) | 0.02 (-0.01; 0.05) | -0.06 (-0.22; 0.09) | 0.00 (-0.03; 0.03) | 0.00 (-0.01; 0.01) |

ME, masticatory efficiency. Estimates given as regression coefficients with associated 95% confidence intervals (CI). Results in bold indicate statistically significantly associations.

**Table 2.** Mixed-effects regression models of swallowing threshold outcomes conditional on time, facial pattern (FP), anteroposterior skeletal discrepancy (ASD), sex, and age

| | Swallowing Threshold | | | | | |
|---|---|---|---|---|---|---|
| | **Cycles** | **Time** | **×50** | **B** | **ME 5.6** | **ME 2.8** |
| **Outcomes** | **Coefficient (95% CI)** | **Coefficient (95% CI)** | **Coefficient (95% CI)** | **Coefficient (95% CI)** | **Coefficient (95% CI)** | **Coefficient (95% CI)** |
| Time | | | | | | |
| Baseline | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| 3 mo | **-12.67 (-23.21; -2.12)** | **-26.23 (-37.24; -15.22)** | **-0.81 (-1.12; -0.51)** | **-1.78 (-3.41; -0.14)** | **-0.65 (-0.91; -0.40)** | **0.28 (0.16; 0.40)** |
| FP | | | | | | |
| Mesofacial | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| Brachyfacial | -24.92 (-53.70; 5.45) | -18.70 (-45.88; 8.47) | 0.64 (-0.17; 1.46) | 3.40 (-0.68; 7.48) | 0.67 (-0.02; 1.35) | -0.24 (-0.57; 0.08) |
| Dolichofacial | -27.70 (-65.19; 9.78) | -19.41 (-58.89; 20.06) | 0.28 (-1.24; 1.82) | 3.63 (-1.28; 8.54) | 0.21 (-0.86; 1.28) | -0.16 (-0.62; 0.30) |
| ASD | | | | | | |
| Class I | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| Class II | **-23.91 (-48.10; 0.00)** | -10.88 (-39.70; 17.93) | **0.52 (0.76; 1.81)** | 0.00 (-3.60; 3.60) | 0.01 (-0.81; 0.82) | -0.04 (-0.34; 0.27) |
| Class III | -27.57 (-60.93; 5.80) | -25.94 (-65.30; 13.41) | 0.42 (-1.15; 2.01) | 2.14 (-3.024; 7.32) | 0.24 (-0.90; 1.39) | -0.18 (-0.67; 0.31) |
| Sex | | | | | | |
| Male | Ref. | Ref. | Ref. | Ref. | Ref. | Ref. |
| Female | **-5.42 (-26.90; 16.04)** | 9.19 (-13.00; 31.37) | **0.81 (0.22; 1.40)** | **1.53 (0.04; 3.11)** | **0.50 (0.07; 0.92)** | **-0.22 (-0.36; -0.07)** |
| Age | 0.55 (-0.48; 1.58) | 0.77 (-0.21; 1.75) | 0.00 (-0.04; 0.04) | -0.11 (-0.26; 0.04) | -0.01 (-0.04; 0.03) | 0.00 (-0.01; 0.01) |

ME, masticatory efficiency. Estimates given as regression coefficients with their associated 95% confidence intervals (CI). Results in bold indicate statistically significantly associations.

dolichofacial, mesofacial, or brachyfacial based on 5 angles.[22] The ASD was based on measurements of the following 3 angles: sella-nasion-A point point angle (SNA); maxilla position in relation to the base of the skull; sella-nasion-B point angle (SNB); mandible position in relation to the base of the skull; and A point-nasion-B point angle (ANB), maxillomandibular relation in the anteroposterior direction.[4,32]

After 3 months of adaptation to the new complete dentures, the participants' masticatory function was evaluated using the MP and ST tests.[33,34] In the MP test, the participants were instructed to masticate a portion of 17 cubes (5.6 mm) of the Optocal artificial test food for 40 cycles, whereas in the ST test, participants masticated another 17 cubes until they felt the desire to swallow.[35] In both tests, the triturated mass was expelled into a paper filter after mastication, dried for 7 days, and sifted through a system of 10 sieves. These tests were evaluated in 2 distinct ways. First, using the multiple sieves method, the material retained in each sieve was weighed, and the median particle size (×50) and homogenization index (B) values for each test were calculated. Second, using the single sieve method, the masticatory efficiency (ME) was calculated as the amount of material retained in the sieves with meshes of 5.6 and 2.8 mm.[36] The OHRQoL was assessed using the dental impact on daily living (DIDL) questionnaire.[37,38]

All patients were rehabilitated with a Facility-Equator system consisting of 2 narrow dental implants

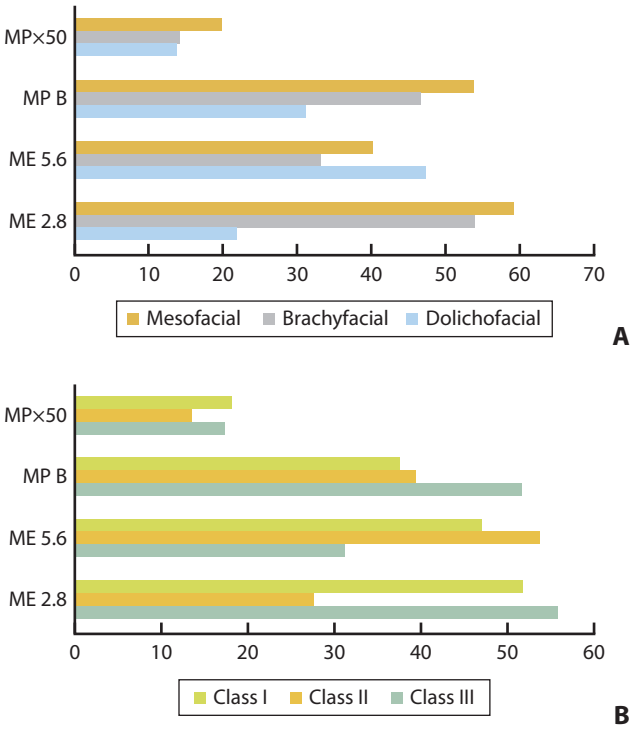


**Figure 1.** Relative improvements of masticatory performance test (%) after 3 months of IMO usage. A, FP. B, ASD. ASD, anteroposterior skeletal discrepancy; FP, facial pattern; IMO, implant-retained mandibular overdenture; ME, masticatory efficiency; MP, masticatory performance.

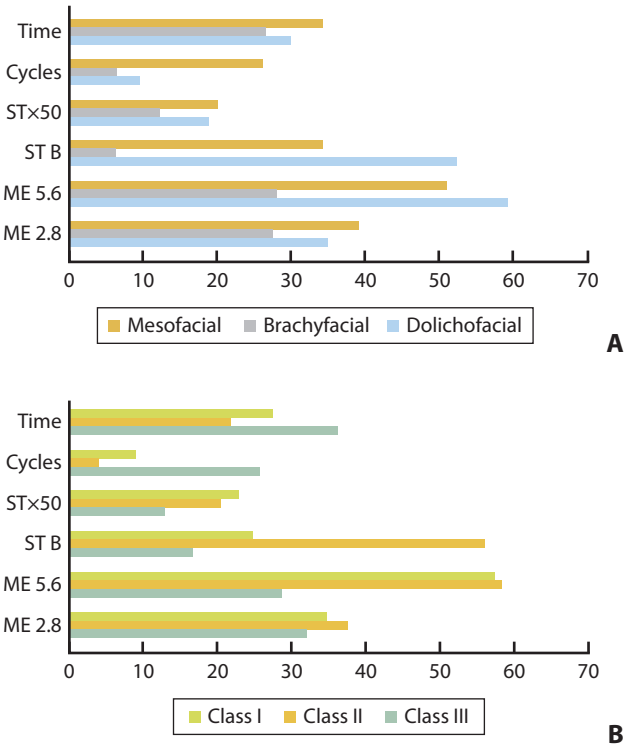


**Figure 2.** Relative improvement of swallowing threshold test outcomes (%) after 3 months of IMO usage. A, FP. B, ASD. ASD, anteroposterior skeletal discrepancy; FP, facial pattern; IMO, implant-retained mandibular overdenture; ME, masticatory efficiency; ST, swallowing threshold.

(2.9×10 mm, Facility NeoPoros; Neodent) installed in the anterior region of the mandible. After 3 months, the healing abutments were replaced by prosthetic abutments (Equator attachment; Neodent), and the IMOs were loaded. The masticatory function tests and the DIDL questionnaire were applied again after the 3-month adaptation period.

Given the data structure and the longitudinal aspect of the study, mixed-effects linear regression models were used to estimate the effect of evaluation time, FP, ASD, sex, and age on the MP, ST, and OHRQoL-related study outcomes. Multiplicative interaction terms between the FP and ASD were tested but were not included in the final models due to their lack of significance. Regression coefficients and 95% confidence intervals were estimated. For the OHRQoL, the effect size (ES) was calculated as the difference in the mean DIDL domain scores divided by the standard deviation of the previous evaluation period. The ES was classified as small ($0.2 \leq ES < 0.5$), moderate ($0.5 \leq ES < 0.8$), or large ($0.8 \leq ES$).[39] All analyses were conducted by using a statistical software program (Stata v14.1; StataCorp).

## RESULTS

The study sample consisted of 42 participants with a mean age of 66.31 years. The mean time since edentulism in the mandible was 24.14 years. The sample was composed of 33% dolichofacial (8 women and 6 men), 31% brachyfacial (9 women and 4 men), and 36% mesofacial (12 women and 3 men) participants. In terms of the ASD, the sample consisted of 26% class I (6 women and 5 men), 29% class II (7 women and 5 men), and 45% class III (16 women and 3 men) participants.

The results of the mixed-effect models for the MP and ST outcomes conditional on time, FP, ASD, sex, and age are displayed in Tables 1 and 2. The relative improvements in MP and ST outcomes according to FP and ASD are shown in Figures 1, 2. Table 3 lists the results for the DIDL domains, and Figure 3 presents the mean scores according to each domain according to FP and ASD. The scores for all DIDL domains increased significantly over time. Dolichofacial participants reported higher DIDL scores in the appearance and general performance domains than mesofacial participants, and class II participants reported significantly higher coefficients than class I participants in the oral comfort domain. Women reported lower scores in the appearance and general performance domains compared with men. Figure 4 shows the patient satisfaction level in each DIDL domain according to FP (Fig. 4A) and ASD (Fig. 4B), expressed by the difference in satisfaction before and after IMO treatment.

**Table 3.** Mixed-effects regression models of DIDL domains conditional on time, facial pattern (FP), anteroposterior skeletal discrepancy (ASD), sex, and age

| | DIDL | | | | |
|---|---|---|---|---|---|
| **Outcomes** | **Appearance, Coefficient (95% CI)** | **Pain, Coefficient (95% CI)** | **Oral Comfort, Coefficient (95% CI)** | **General Performance, Coefficient (95% CI)** | **Eating and Chewing, Coefficient (95% CI)** |
| Time | | | | | |
| Baseline | Ref. | Ref. | Ref. | Ref. | Ref. |
| 3 mo | **0.29 (0.11; 0.47)** | **0.39 (0.21; 0.56)** | **0.73 (0.57; 0.88)** | **0.28 (0.16; 0.40)** | **0.84 (0.62; 1.06)** |
| FP | | | | | |
| Mesofacial | Ref. | Ref. | Ref. | Ref. | Ref. |
| Brachyfacial | 0.28 (-0.01; 0.57) | 0.0 (-0.25; 0.25) | 0.14 (-0.08; 0.36) | 0.05 (-0.12; 0.24) | 0.06 (-0.36; 0.49) |
| Dolichofacial | **0.40 (0.15; 0.65)** | 0.05 (-0.15; 0.26) | -0.02 (-0.20; 0.18) | **0.26 (0.12; 0.40)** | 0.12 (-0.26; 0.50) |
| ASD | | | | | |
| Class I | Ref. | Ref. | Ref. | Ref. | Ref. |
| Class II | 0.15 (-0.06; 0.37) | 0.18 (-0.04; 0.40) | **0.24 (0.11; 0.38)** | 0.04 (-0.11; 0.20) | -0.06 (-0.50; 0.37) |
| Class III | 0.07 (-0.11; 0.25) | 0.0 (-0.24; 0.25) | -0.02 (-0.21; 0.17) | -0.01 (-0.15; 0.12) | -0.13 (-0.48; 0.21) |
| Sex | | | | | |
| Male | Ref. | Ref. | Ref. | Ref. | Ref. |
| Female | **-0.17 (-0.32; -0.03)** | -0.09 (-0.30; 0.12) | -0.01 (-0.16; 0.13) | **-0.15 (-0.28; -0.02)** | -0.02 (-0.35; 0.39) |
| Age | 0.00 (-0.01; 0.01) | 0.00 (-0.01; 0.01) | 0.02 (-0.04; 0.02) | 0.01 (-0.01; 0.02) | 0.01 (-0.01; 0.02) |

DIDL, dental impact on daily living. Estimates given as regression coefficients with their associated 95% confidence intervals (CI). Results in bold indicate statistically significantly associations.

## DISCUSSION

The null hypothesis was rejected as the masticatory function outcomes were influenced by FP and ASD; however, OHRQoL and satisfaction were less influenced by facial morphology. Brachyfacial participants showed minimal improvements in masticatory function after IMO loading; only the ME 5.6 and ME 2.8 outcomes of the MP test improved. The results also highlighted that class II participants had greater difficulty adapting to the IMO because they showed no improvement in MP and that the ST cycles decreased by only 4%. Dolichofacial participants reported higher scores than mesofacial participants in the appearance and general performance domains, and class II participants reported significantly higher coefficients than class I participants in the oral comfort domain. Finally, the masticatory function, quality of life, and satisfaction levels of all IMO wearers improved, irrespective of the FP and ASD. The highest clinical ESs were observed in the oral comfort domain, although this domain had the lowest satisfaction level after IMO loading.

According to the MP test, brachyfacial and dolichofacial patients were less able to homogenize the food bolus (B) and effectively crush the food particles (ME 2.8) than mesofacial IMO wearers. However, dolichofacial and brachyfacial patients were able to equalize their masticatory outcomes, but they spent more time and more masticatory cycles to complete the ST test than mesofacial participants. The highest relative improvement was observed in dolichofacial participants. Both masticatory tests indicated that class II participants had a compromised mastication process, as evidenced by their higher ×50 coefficients. Conversely, treatment had the greatest impact on class III participants because they compensated for the inferior results obtained during the MP test by taking additional time and mastication cycles in the ST test.

The IMO treatment had the largest positive impact on the MP outcomes of mesofacial participants, as the ×50 decreased significantly by about 20%. This was corroborated by a significant 40% decrease in the 5.6-mm sieve and a concomitant 59% increase in the 2.8-mm sieve. In addition, the B value decreased significantly by 54%, indicating improved particle homogenization. For brachyfacial participants, a significant difference was found only for the ME 5.6 and ME 2.8 outcomes, with a 33% decrease in the particles retained in the 5.6-mm sieve and a concomitant 54% increase in the material retained in ME 2.8. Dolichofacial participants only improved significantly in terms of the initial food comminution, with a 47% decrease in ME 5.6 after IMO treatment. Furthermore, dolichofacial participants showed better food homogenization than brachyfacial participants before and after the IMO installation. They also showed a greater quantity of material retained in the 2.8-mm sieve than in the other groups before IMO treatment.

Dolichofacial individuals have a longer inferior third of the face, enabling them to move the food bolus more during mastication, which could explain the more homogenous food comminution. Ochiai et al[6] observed that dolichofacial participants showed a slightly inferior MP. Previous studies have shown that brachyfacial individuals show a higher occlusal force and muscular activity, factors which are closely related to improved mastication.[5,11,20] However, in this study, even after IMO

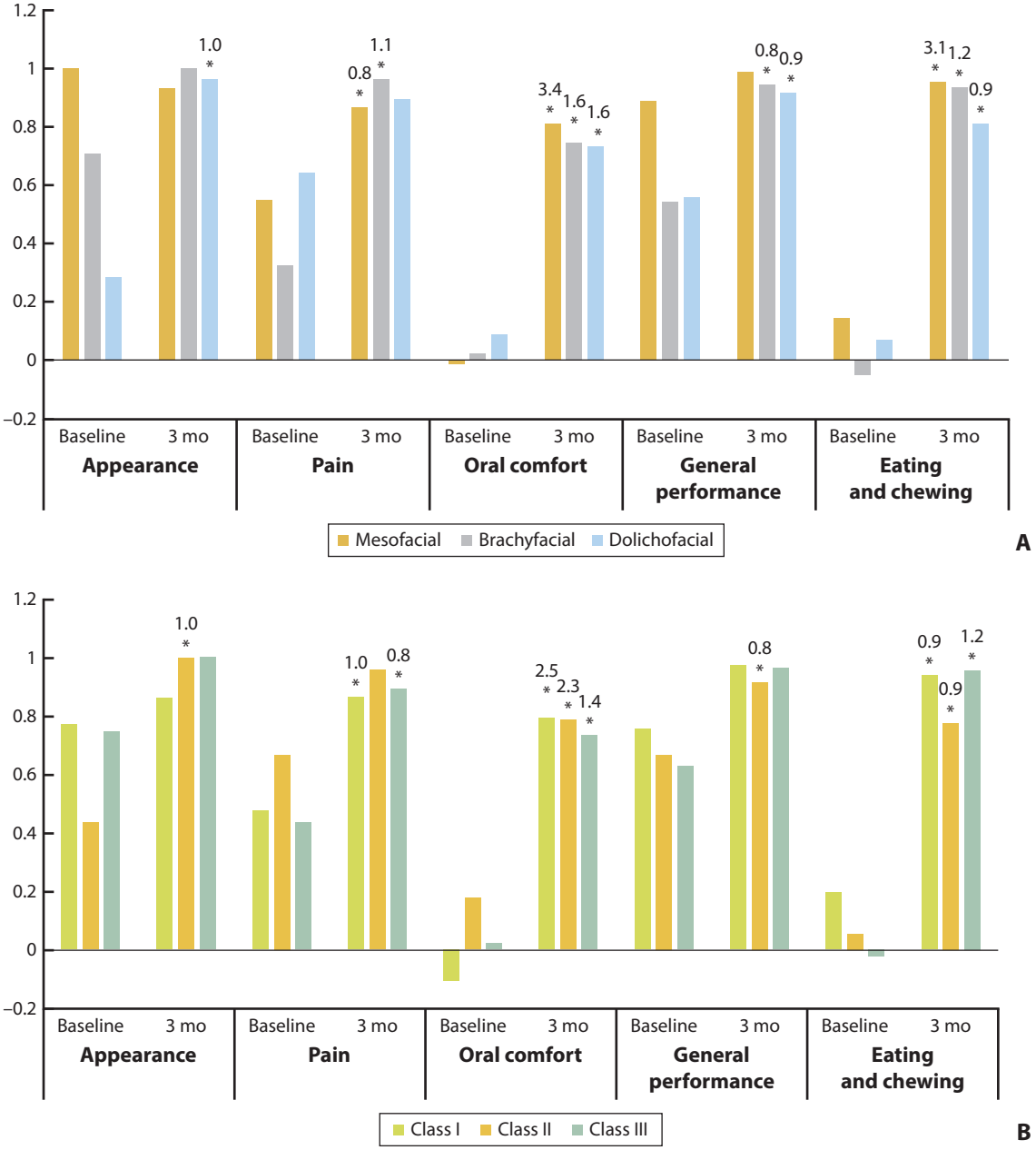


**Figure 3.** Mean scores of DIDL questionnaire domains. Asterisks indicate values with large effect sizes in each group. A, FP. B, ASD. ASD, anteroposterior skeletal discrepancy; DIDL, dental impact on daily living; FP, facial pattern.

loading, brachyfacial participants still had the poorest food homogenization, corroborating the hypothesis that a greater oral space for organization is beneficial for homogenous comminution.

The IMO treatment improved mastication for class I and class III participants as both classes retained 50% of the particles in the ME 2.8 sieve after treatment. Meanwhile, the benefit of IMO treatment among class II participants was significantly reduced in comparison with that among class I individuals (Table 1). A study that evaluated the MP for patients with malocclusion showed that class III participants had the greatest difficulties in comminuting food, followed by class II participants, whereas class I participants reduced the particle size to a medium size more easily.[7] As complete denture wearers, class III participants showed poorer food homogenization than class I participants, as indicated by their 39% higher B values obtained in the MP test. Furthermore, the class III participants showed a comminution that was inferior to that of class II participants, as also found by English et al,[7] with 45% less material retained in the ME 2.8 sieve.

IMO treatment also reduced the number of cycles in the ST by 5 for mesofacial and by 4 for dolichofacial participants, whereas the number of cycles did not

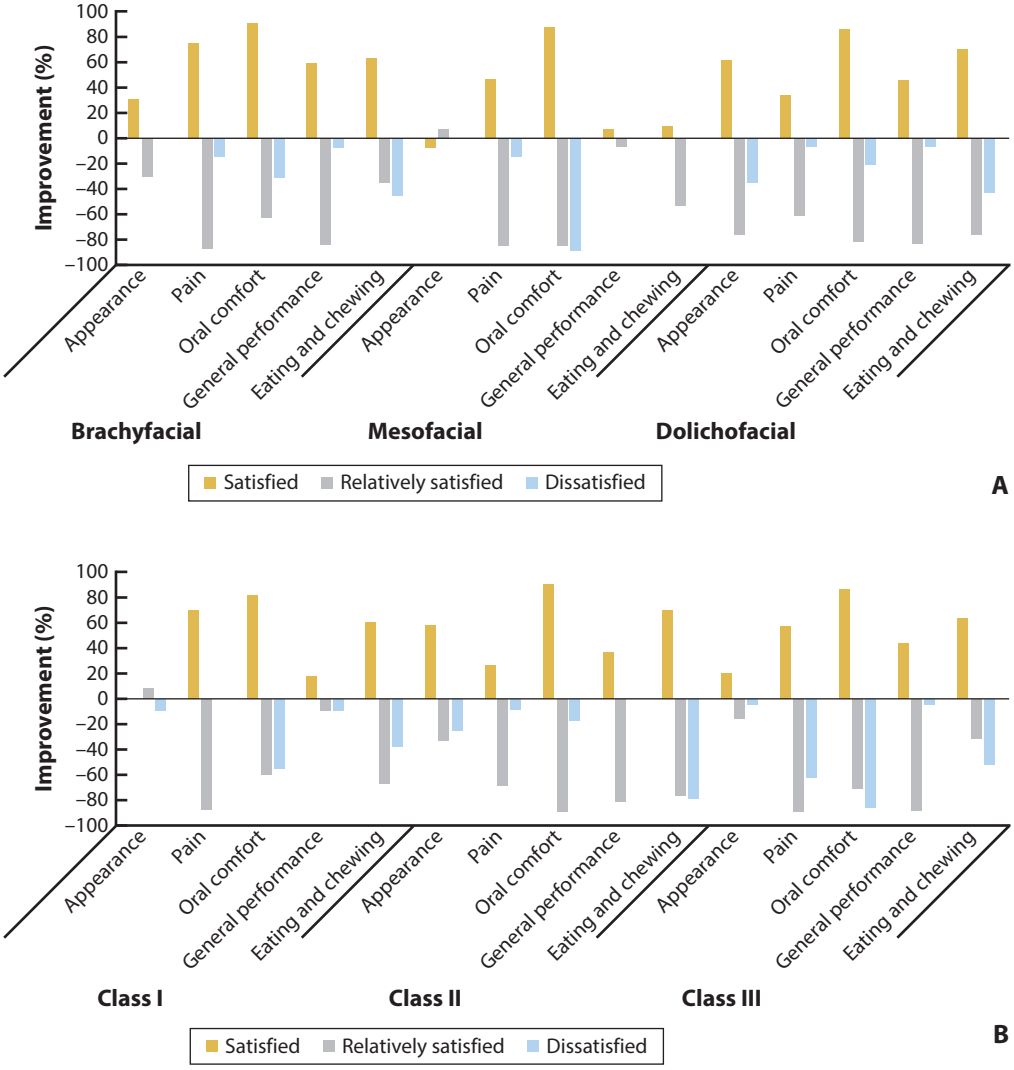


**Figure 4.** Patient satisfaction level expressed as difference before and after IMO treatment (%) in each domain of DIDL questionnaire according to facial pattern and anteroposterior skeletal discrepancy. A, Facial patterns. B, Anteroposterior skeletal discrepancy. IMO, implant-retained mandibular overdenture.

decline for brachyfacial participants. In general, IMO wearers need 1.5 to 3.6 times fewer masticatory cycles than complete denture wearers to obtain a similar reduction in food particle size.[11] ST outcomes of brachyfacial participants improved, mainly the ME 5.6, which declined by 28%; however, they still showed the poorest masticatory capacity before and after IMO and achieved the poorest food comminution, with ST ×50 values that were 16% larger and with 42% more material retained in the coarsest sieve (ME 5.6) compared with mesofacial participants. Even comparing with dolichofacial participants, the brachyfacial group had 19.5% larger ST ×50 values and retained 37% more material in the coarser sieve (ME 5.6). Thus, although edentulous brachyfacial individuals seemed to present higher occlusal force,[8] their food comminution was inferior to that of both mesofacial and dolichofacial participants.

The ST outcomes indicated that class III participants benefited most from the IMO installation. Only 2 outcomes (×50 and ME 5.6) improved significantly for class I participants, whereas 4 outcomes improved significantly for class II participants (×50, B, ME 5.6, and ME 2.8). Previous studies also did not report significant differences in the number of masticatory cycles in the ST test.[6,7] These results reinforce the idea that even though class III patients are considered difficult to rehabilitate,[7] their masticatory function can improve significantly when their implant-retained complete dentures are provided in a class I position. The quantity of material retained in the ME 5.6 sieve decreased by 42% for class III participants after transition to IMO, with a concomitant 11% increase in the material retained by the ME 2.8 sieve, compared with class II participants. Those results differ from those of the study by Ochiai et al[6] that reported a significant

difference in the ST outcomes between class I and class II participants. These differences can be attributed to the differences in the study design.

Studies have shown that sex impacts the rehabilitation of totally edentulous patients, both with complete dentures and with IMOs.[12,24,25] In this study, female participants had poorer food comminution in both masticatory function tests. In addition, women performed fewer cycles for the pulverization of particles in the ST test. The maximum occlusal force of women is about 40% lower than that of men.[15-18] This lower occlusal force translates to less particle reduction per cycle.[13,14] Even in terms of subjective perception, a significant difference was found between the sexes as women reported the lowest IMO treatment effects in the appearance and general performance domains of the DIDL questionnaire. These findings confirm the results of previous studies showing that women report more painful sensations and more oral health problems than male complete denture wearers and are less satisfied with their esthetics.[12,24]

The IMO treatment provided a significant improvement in terms of OHRQoL and satisfaction, irrespective of facial morphology, and each domain was impacted in a different way. A common element for all the groups in the DIDL questionnaire results was that the comfort domain obtained the greatest clinical ES, with a maximum ES of 3.4 for mesofacial patients and 2.5 for class I participants. The positive impact of IMO treatment on the OHRQoL is well established.[21,22,33] However, the authors are unaware of a study on the influence of ASD classification on the OHRQoL. The results of the present study indicate that the IMO treatment equalizes the subjective perception of all groups. However, even after the stabilization provided by the IMO, not all participants were satisfied with oral comfort, eating and chewing, and pain domains explained by the limited IMO adaptation time of 3 months. Differently, irrespective to ASD or FP classification, Schuster et al[37] reported that the positive impact of the IMO treatment on the OHRQoL and satisfaction of edentulous patients can be observed after 3 months.

Limitations of the study are related to the complex nature of the masticatory function. In this respect, the occlusal force and salivary flow were not determined, and these factors may interfere with the MP of the participants. The degree of atrophy in the alveolar ridge, the denture-bearing tissue, and the retention and stability of the complete dentures were also not evaluated.

## CONCLUSIONS

Within the limitations of this clinical study, the following conclusions were drawn:

1. The MP parameters indicated that brachyfacial participants benefited least from IMO treatment, whereas the ST outcomes showed that class III participants benefited the most.
2. The IMO treatment improved the OHRQoL and the satisfaction of the completely edentulous patients, irrespective of the cephalometric classification. However, dolichofacial participants reported more improvement in the appearance and general performance domains, whereas class II participants reported more improvement in the oral comfort domain.
3. Edentulous patients were most concerned with the oral comfort domain, irrespective of the treatment stage and facial morphology.

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