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Discriminating Masticatory Performance and OHRQoL According to Facial Morphology in Complete Denture Wearers: A Single-Center Controlled Study

Ana Paula Pinto Martins, DDS, MSc
Alessandra Julie Schuster, DDS, PhD
Anna Paula da Rosa Possebon, DDS, MSc
Graduate Program in Dentistry, School of Dentistry, Federal University of Pelotas, Pelotas, Rio Grande do Sol, Brazil.

Raissa Micaella Marcello-Machado, DDS, PhD
Department of Prosthodontics and Periodontology, Piracicaba Dental School, State University of Campinas, Piracicaba, Sao Paolo, Brazil.

Diego Abreu Pastorino, DDS
Eduardo Pereira, DDS
Private Practice, Pelotas, Rio Grande do Sol, Brazil.

Luciana de Rezende Pinto, DDS, PhD
Fernanda Faot, DDS, PhD
Department of Restorative Dentistry, School of Dentistry, Federal University of Pelotas, Rio Grande do Sol, Brazil.

Purpose: To evaluate the influence of facial type and anteroposterior skeletal discrepancy of complete denture wearers on residual ridge height, masticatory performance, oral health–related quality of life (OHRQoL), and satisfaction levels. ***Materials and Methods:*** A total of 56 edentulous patients (mean age of 67.1 years) were radiographically evaluated prior to rehabilitation to determine residual ridge height in the maxilla and mandible, facial type, and anteroposterior skeletal discrepancy. Masticatory performance tests with 40 chewing cycles were applied. The Dental Impact on Daily Living questionnaire was used to measure OHRQoL and satisfaction. Data were analyzed with Kruskal-Wallis test and logistic regression. ***Results:*** Dolichofacial participants presented with significantly higher bone height than mesofacial and brachyfacial types in the anterior region of the maxilla and mandible and had more mandibular bone than mesofacial types in the premolar region. Class II patients presented significantly higher bone height than Class I participants in the anterior maxilla. Dolichofacial patients performed significantly better than brachyfacial patients in the masticatory performance test. Class I patients achieved more homogenous artificial food trituration than Class III patients ($P < .05$). High OHRQoL scores were reported in appearance and general performance irrespective of facial type or anteroposterior skeletal discrepancy. ***Conclusion:*** Dolichofacial patients had superior masticatory performance compared to brachyfacial patients. Class III patients showed a reduced capacity to homogenize the food bolus. Mesofacial, dolichofacial, and Class III patients reported the best perceptions of their OHRQoL. Anteroposterior skeletal discrepancy seems to be the main factor contributing to mastication impairments in totally edentulous patients. *Int J Prosthodont 2020;33:263–271. doi: 10.11607/ijp.6353*

The success of complete dentures (CDs) is directly related to the required adaptation time and depends on anatomical structures and their intimate relationship with the prosthesis.[1] In addition, severe residual ridge resorption is the main factor that negatively contributes to the CD prognosis, causing poor retention and instability of the CD.[2,3] Patients commonly report difficulties adapting, eating, and smiling with the CD; discomfort; and complete dissatisfaction with the treatment, resulting in reduction of self-esteem.[4] In addition, the facial type (FT) of the patient interferes directly with the adaptation phase, stability, and support of the CD,[5,6]

Correspondence to:
Prof Fernanda Faot
School of Dentistry
Federal University of Pelotas
Gonçalves Chaves Street 457
96015-560 Pelotas, RS, Brazil
Email: fernanda.faot@gmail.com

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as well as with the functional and esthetic satisfaction levels. As craniofacial morphology is directly related to the harmony between the facial and perioral musculature and to masticatory muscle kinetics,[7] it has an important influence on masticatory function and esthetic demands.[5]

It has been previously suggested that the FT should be determined before the CD treatment, as this allows the production of dentures that are stable and in harmony with the skeletal and muscle patterns of the patient, significantly improving the patient's prognosis.[5,6,8] The determination of the FT based solely on clinical evaluation may have some confounding factors, as anatomical landmarks may change due to progressive residual ridge resorption, resulting in a misclassification.[9,10] Cephalometric analysis enables the use of more objective anatomical landmarks to determine the sagittal plane, plane of occlusion, and vertical dimension based on edentulous changes of complex orofacial tissues to provide adequate CD confection.[8–12] Dolichofacial patients in particular tend to adopt a tongue position that facilitates breathing. This anatomical aspect needs to be carefully analyzed to produce CDs that are stable and operate in harmony with the neuromuscular forces. Likewise, an appropriate vertical dimension must be obtained for brachyfacial patients, as these patients typically have strong masseter activity and a tendency for mandibular overload and temporomandibular dysfunction.[6] From a clinical perspective, craniofacial analysis can help to *(1)* plan and determine the functional and esthetic prognoses of a new set of CDs and *(2)* anticipate possible future problems that each subgroup of patients could face during the adaptation phase.

During masticatory function, mandibular movements can be influenced by the inclination of the occlusal plane.[13] The trajectory of the masticatory closing in the sagittal plane maintains a relationship perpendicular to the occlusal plane.[13] A smaller angle of the mandibular plane, formed by the Frankfurt plane and the mandibular plane, results in higher muscular activity and bite force for individuals with a brachyfacial profile compared to dolichofacial patients.[14–17] It is well-established that bite force and masticatory function are intimately connected and that patients with higher bite force crush food better.[18] However, anteroposterior misalignment of the mandible is a factor that may result in faulty mastication because mastication relies on interocclusal contacts.[19,20] During masticatory performance tests, dentate individuals classified as Angle Class II and Class III showed a 15% to 34% larger particle size than Class I individuals.[20] An improvement in masticatory performance and ability was also observed after orthognathic treatment for dentofacial deformities (Class II and Class III).[5,21,22]

The relationship between facial morphology and oral function is well-established in the literature, especially for dentate patients. However, few studies have investigated the influence of FT and anteroposterior skeletal discrepancy (ASD) on the oral function of completely edentulous patients.[5,23,24] Therefore, this study aims to evaluate the influence of FT and ASD on residual ridge height and masticatory function using masticatory performance, quality of life, and satisfaction levels of CD wearers as outcome measures. The null hypothesis was that different FTs and ASDs do not influence the masticatory performance, OHRQoL, or satisfaction levels of CD wearers.

MATERIALS AND METHODS

Experimental Design

This cross-sectional observational clinical study was conducted following the guidelines of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) protocol[25] and used secondary data from patients who attended the Complete Dentures Clinic at the School of Dentistry in the Federal University of Pelotas between 2013 and 2016. This study was approved by the Local Ethics Research Committee, protocol number 69/2013, and was conducted according to the Helsinki Declaration (2008). The following inclusion criteria were applied: patients must *(1)* have good oral and general health; *(2)* have worn new complete dentures for at least 3 months; and *(3)* be available to visit the university clinic during prearranged days. All CDs were fabricated with thermopolymerizable acrylic resin (TDV Dental), artificial acrylic resin teeth with 30-degree cusps (Trilux), and assembled in balanced bilateral occlusion following a well-established confection protocol. All volunteers who agreed with the terms of research signed an informed consent form. Digital panoramic radiographs were taken for evaluation of the patients' residual ridge height in the anterior and posterior regions of the maxilla and mandible. Cephalograms were then performed in the physiologic rest position[24] to categorize the patients according to their FT and ASD. Masticatory function was subsequently evaluated using the masticatory performance test, and the Dental Impact on Daily Living (DIDL) questionnaire was applied to evaluate the oral health–related quality of life (OHRQoL) and satisfaction of each patient.

Radiographic Exams

All digital panoramic radiographs were performed by a single experienced professional in the radiology service of the Scholl of Dentsitry, UFPel, with a Rotograph Plus (Dent-X) instrument equipped with digital imaging sensors and operated by a licensed technician. Image processing was performed with DentaScan software.

Afterwards, radiographic measurements related to morphology and mandibular height were performed in DBSWIN software (VistaScan) by a single calibrated examiner (E.P.) following the methodology described by Xie et al.[26] The following data were collected in the maxilla and in the mandible: midline height (anterior height); height in the region of the first premolars; and height in the region of the molars.

The cephalograms were performed with the patient positioned in the physiologic rest position: the usual position of the mandible when the patient is relaxed and holds the head upright. This was achieved by removing the prostheses and asking the patient to swallow and relax.[8,24] The cephalometric analyses were conducted in duplicate by two trained and calibrated radiologists using Cef X version 4.5.10 (CDT Informática e Electrônice).

The FT were determined using Ricketts analysis and classified as brachyfacial, mesofacial, or dolichofacial according to the following five angles: *(1)* facial axis; *(2)* facial depth; *(3)* mandibular plane; *(4)* height of the inferior third of the face; and *(5)* mandibular arch.[27] The mean values of these five angles were combined in the vertical growth coefficient (VERT) index, which was found by comparing the obtained values with the individual standards. The result was then divided by the clinical deviation, which varies for the different angles. The obtained value was inserted in a Gauss curve and received a positive sign when it tended toward brachyfacial or a negative sign when it tended toward dolichofacial.[27]

The ASD was analyzed using the SNA and SNB angles,[28,29] which characterize the position of the maxilla and mandible in relation to the base of the skull, and the ANB angle, which characterizes the maxillomandibular relation in the anteroposterior direction.[30] Patients who showed negative angles were classified as Class III, values between 0 and 4 degrees were classified as Class I, and values above 4 degrees were classified as Class II.[31]

Masticatory Performance

Masticatory performance was defined as the particle size distribution of food particles after 40 chewing strokes of artificial test food Optocal, as described in previous studies.[18,32–34] The patients were instructed to chew 3.7 g of the test material (17 cubes) for 40 masticatory cycles. The material was then dried at room temperature for 7 days and sieved using stacked sieves with eight meshes between 5.6 mm and 0.5 mm and a bottom plate for 20 minutes on a shaker.[18,32] The particles retained in each of the eight sieves were weighed separately in a precision balance, and the obtained values were converted through the Rosin-Rammler method, which determines the degree of fragmentation of the chewed food and gives the outcome median particle size (MPX50), defined as the aperture of a theoretical sieve through which 50% of the particles can pass by weight.[32] The equation also provides a "B" index (MPB), which is an indicator of the variation in particle size and describes the amplitude of the particle size distribution along the different sieves, indicating the homogeneity of the mastication.[32] Masticatory efficiency (ME) was also determined by the weight percentage of material retained in the 5.6-mm (ME5.6), 4.0-mm (ME4.0), and 2.8-mm (ME2.8) sieves.

DIDL Questionnaire

The analysis of OHRQoL and patient satisfaction was conducted by applying the DIDL questionnaire. This evaluation measured the dental impact of each domain on the patients' daily lives and the degree of satisfaction.[35] The possible answers are agree, neutral, or disagree, scored as +1, 0, and –1, respectively. The domain scores are then averaged. Lower DIDL scores in each domain indicate a poor quality of life, and vice versa. The patient satisfaction in each domain was classified following the methodology proposed by Al-Omiri et al, which uses the mean DIDL scores for each domain to classify patients as dissatisfied (score < 0), relatively satisfied (score 0 to 0.69), or satisfied (score 0.7 to 1).[35]

Statistical Analyses

Kruskal-Wallis test was used to compare the outcome variables between the different FTs and ASDs. Logistic regression (crude and adjusted) was performed to determine associated factors in the masticatory performance outcomes based on exposure variables and to control for confounding variables. For this analysis, MPX50 was categorized as good or impaired, with cut-off values that correspond to the general mean of all patients for each outcome: MPX50 = 5.16; MPB = 6.95; ME5.6 = 48.64; ME4.0 = 22.33; and ME2.8 = 11.53. The results were normalized/adjusted using the mesofacial and Class I patients as reference groups. The adopted significance level was 5%, and the analyses were conducted using Stata 14.1 software (StataCorp). The statistical power was calculated using OpenEpi version 3.01.

RESULTS

The sample population consisted of 56 fully edentulous patients, 17 men and 39 women, with an average age of 67.1 years; only 8 participants were under 60 years. The mean time since edentulism was 30 and 24.2 years for the maxilla and the mandible, respectively. Approximately 67.9% of the sample received the minimum wage, and 21.4% received two minimum wages (minimum wage in 2016 was R$880). Furthermore, 50% of the participants studied for less than 8 years during schooling age.

Table 1 Median (Range) Scores Obtained for Each Domain of the Dental Impact on Daily Living Questionnaire According to Facial Type and Anteroposterior Skeletal Discrepancy

	Facial type			Anteroposterior skeletal discrepancy		
Domain/ no. of questions	Brachyfacial (n = 17)	Mesofacial (n = 20)	Dolichofacial (n = 19)	Class I (n = 12)	Class II (n = 16)	Class III (n = 28)
Appearance/4	1.00 (–0.25 to 1)^{A,B}	1.00 (–1 to 1)^{A}	1.00 (–0.5 to 1)^{B}	1.00 (–1 to 1)^{A}	1.00 (–0.5 to 1)^{A}	1.00 (0 to 1)^{B}
Pain/4	0.50 (–1 to 1)^{A}	0.37 (–1 to 1)^{A}	–1.00 (–1 to 1)^{A}	0.25 (–1 to 1)^{A}	0.50 (–1 to 1)^{A}	0.50 (–1 to 1)^{A}
Oral comfort/7	0.14 (–0.57 to 0.42)^{A}	0.07 (–1 to 0.71)^{A}	0.14 (–1 to 1)^{A}	0.00 (–1 to 0.42)^{A}	0.14 (–1 to 0.71)^{A}	0.14 (–1 to 1)^{A}
General performance/15	0.80 (–0.73 to 1)^{A}	0.93 (–0.06 to 1)^{A}	0.86 (–0.2 to 1)^{A}	0.80 (0.06 to 1)^{A}	0.73 (–0.2 to 1)^{A}	1.00 (–0.73 to 1)^{B}
Eating and mastication/6	0.33 (–1 to 1)^{A,B}	0.83 (–1 to 1)^{A*}	–0.33 (–1 to 1)^{B*}	0.41 (–1 to 1)^{A}	0.00 (–1 to 1)^{A}	0.66 (–0.2 to 1)^{A}

Different capital letters indicate statistically significant differences between groups (Kruskal-Wallis test; $P \leq .05$).
*Power: 87%.

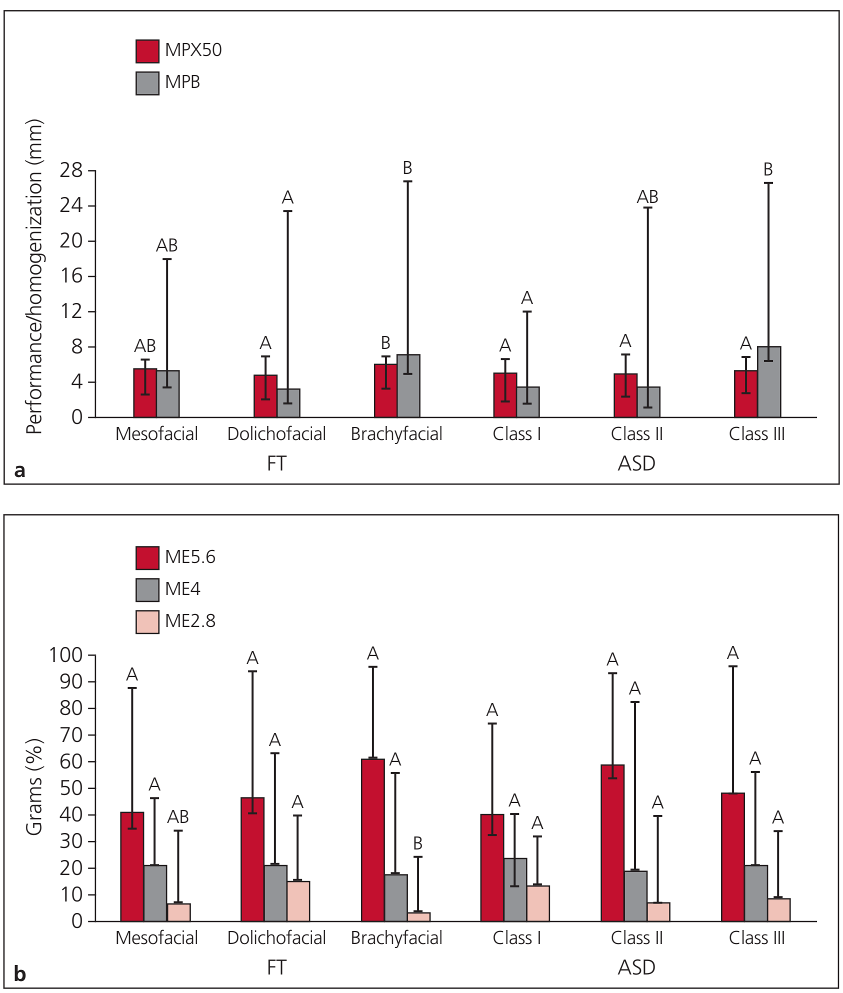

Fig 1 *(a)* Medians and ranges of masticatory performance (MPX50) and bolus homogenization (MPB) according to facial type (FT) and anteroposterior skeletal discrepancy (ASD). *(b)* Medians and ranges of the masticatory efficiency outcomes ME5.6, ME4.0, and ME2.8 according to FT and ASD. Kruskal-Wallis test, $P \leq .05$. Different uppercase letters indicate statistically significant differences between groups. Power MPX50: brachy × dolicho = 98%; MPB: brachy × dolicho = 92%; Class I × Class III = 92%; ME2.8: brachy × dolicho = 99%.

Figure 1 shows the masticatory performance (MPX50 and MPB) and masticatory efficiency (ME2.8, ME4.0, and ME5.6) outcomes according to the FT and ASD classifications. Dolichofacial patients had significantly better masticatory performance scores than brachyfacial patients; their MPX50 was significantly lower (–17%) than for brachyfacial patients ($P < .05$). The ME2.8 outcome was 55% higher, indicating more effective particle size reduction. In the ASD classes, the only significant difference was the MPB between Class I and Class III patients ($P > .05$). Class III patients presented an MPB value that is significantly higher (37%; $P > .05$) compared to Class I patients.

Table 1 lists the results of the DIDL questionnaire domains according to the FT and ASD classifications. The scores of dolichofacial patients in the appearance and in the eating and chewing domains were statistically significantly lower ($P < .05$) than the scores of mesofacial patients. According to the ASD, Class III patients presented the highest scores ($P < .05$) in the appearance and general performance domains. Figure 2 shows the categorization of the patient satisfaction levels in the DIDL domains.

The results listed in Table 2 indicate a statistically significant

Table 2 Median (Range) Values for Residual Ridge Height in Three Regions of the Maxilla and Mandible According to Facial Type and Anteroposterior Skeletal Discrepancy

	Women/ men (n)	Maxilla height			Mandible height		
		Anterior	Premolar	Posterior	Anterior	Premolar	Posterior
Facial type							
Brachyfacial	12/5	12.20 (6.80 to 25.30)^{A}	10.75 (2.55 to 20.95)^{A}	5.75 (0.90 to 14.30)^{A}	21.50 (16.55 to 28.30)^{A}	17.70 (8.47 to 24.17)^{A,C}	15.00 (8.77 to 21.22)^{A}
Mesofacial	16/4	12.75 (7.30 to 15.70)^{A}	10.65 (1.65 to 18.40)^{A}	4.57 (1.25 to 12.45)^{A}	21.70 (13.65 to 28.00)^{A}	15.13 (9.50 to 27.57)^{A}	14.02 (8.55 to 21.27)^{A}
Dolichofacial	14/5	15.60 (4.90 to 20.10)^{B}	13.45 (4.30 to 19.50)^{A}	5.95 (1.25 to 17.05)^{A}	26.75 (14.75 to 34.60)^{B}	20.62 (10.97 to 32.62)^{B,C}	16.92 (8.80 to 27.05)^{A}
Anteroposterior skeletal discrepancy							
Class I	7/5	12.00 (4.90 to 16.40)^{A}	11.80 (2.10 to 18.40)^{A}	5.67 (0.90 to 12.45)^{A}	20.75 (13.65 to 32.70)^{A}	16.20 (10.75 to 23.90)^{A}	14.10 (8.80 to 17.97)^{A}
Class II	10/6	14.60 (10.10 to 19.70)^{B,C}	11.80 (4.30 to 19.50)^{A}	5.00 (1.65 to 17.05)^{A}	26.50 (19.50 to 34.60)^{A}	20.62 (11.00 to 32.62)^{A}	16.60 (10.55 to 27.05)^{A}
Class III	22/6	13.30 (7.30 to 25.30)^{A,C}	10.85 (1.65 to 20.95)^{A}	5.65 (1.25 to 14.30)^{A}	22.70 (14.75 to 34.35)^{A}	17.70 (8.47 to 28.75)^{A}	14.05 (8.55 to 22.25)^{A}

Different capital letters indicate statistically significant differences between regions within each group (Kruskal-Wallis test, $P \leq .05$).

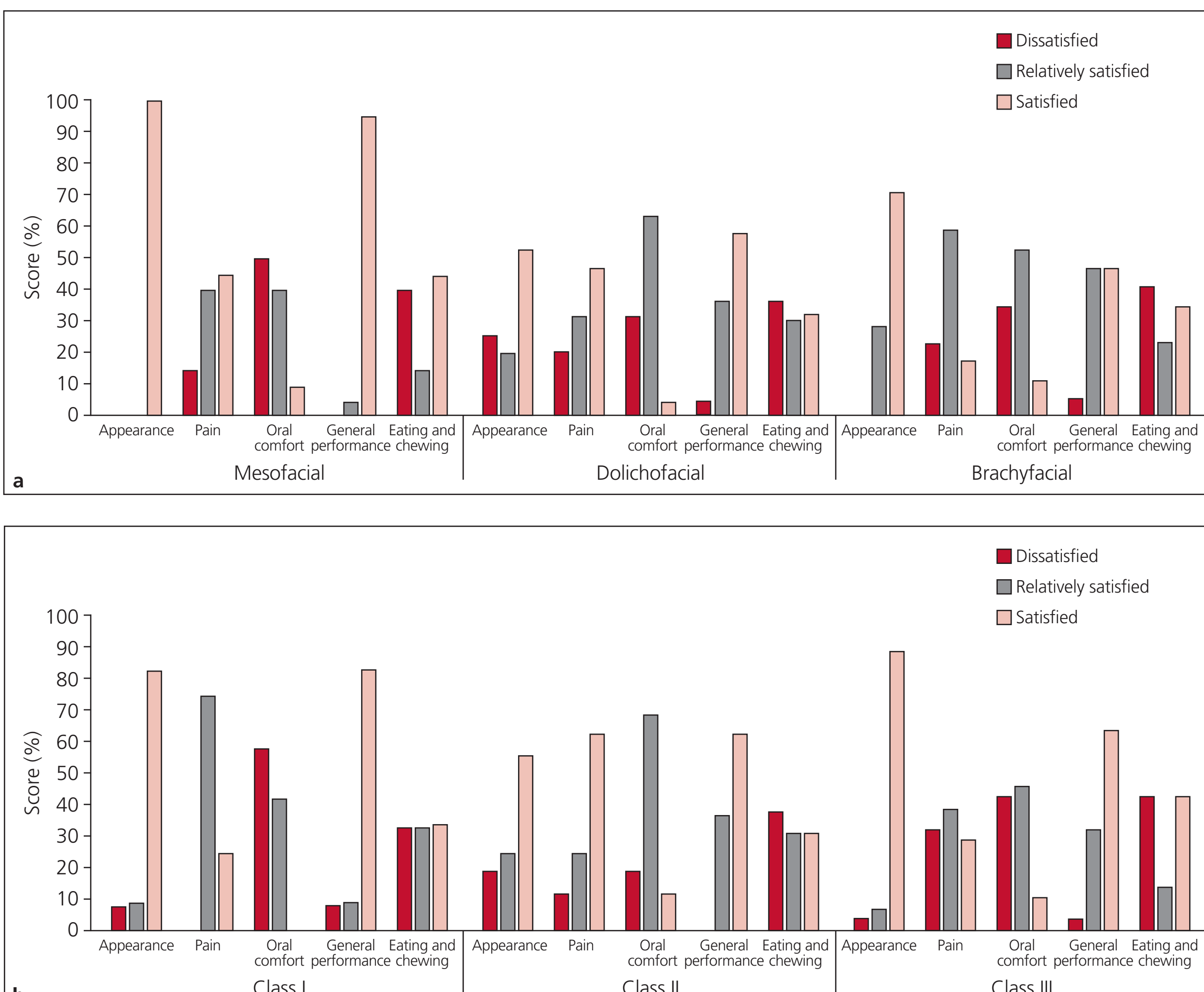

Fig 2 Self-reported satisfaction scores (%) for each domain in the DIDL survey according to *(a)* facial type and *(b)* anteroposterior skeletal discrepancy.

Table 3 Logistic Regression Analysis (Crude and Adjusted) of Associations Between Facial Type and Anteroposterior Skeletal Discrepancy According to Masticatory Performance (MX50 and MPB) and Masticatory Efficiency Parameters (ME5.6, ME4.0, and ME2.8)

	MX50 OR (95% CI)		MPB OR (95% CI)		ME5.6 OR (95% CI)		ME4.0 OR (95% CI)		ME2.8 OR (95% CI)	
	Crude	Adjusted	Crude	Adjusted	Crude	Adjusted	Crude	Adjusted	Crude	Adjusted
Facial type										
Mesofacial	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Dolichofacial	0.47 (0.13 to 1.72)	0.40 (0.10 to 1.57)	0.48 (0.12 to 1.71)	0.39 (0.09 to 1.58)	0.38 (0.10 to 1.41)	0.30 (0.07 to 1.22)	0.38 (0.10 to 1.43)	0.27 (0.06 to 1.20)	2.10 (0.56 to 7.81)	2.60 (0.63 to 10.60)
Brachyfacial	0.72 (0.19 to 2.66)	1.10 (0.26 to 4.55)	0.78 (0.19 to 3.12)	1.20 (0.27 to 5.33)	0.59 (0.16 to 2.18)	0.99 (0.23 to 4.23)	0.48 (0.12 to 1.85)	0.81 (0.18 to 3.57)	2.07 (0.53 to 7.99)	1.34 (0.31 to 5.76)
P	.52	.20	.52	.21	.34	.06	.32	.04	.44	.14
Anteroposterior skeletal discrepancy										
Class I	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Class II	0.15 (0.28 to 0.81)	0.15 (0.02 to 0.81)	0.07 (0.00 to 0.68)	0.07 (0.00 to 0.68)	0.09 (0.01 to 0.57)	0.09 (0.01 to 0.57)	0.07 (0.00 to 0.68)	0.06 (0.00 to 0.67)	14.14 (1.45 to 137.29)	14.45 (1.47 to 141.59)
Class III	0.25 (0.05 to 1.12)	0.26 (0.05 to 1.26)	0.14 (0.01 to 1.24)	0.14 (0.01 to 1.37)	0.15 (0.02 to 0.81)	0.16 (0.02 to 0.94)	0.09 (0.01 to 0.80)	0.10 (0.01 to 0.95)	9.53 (1.08 to 84.13)	8.10 (0.89 to 73.67)
P	.05	.11	.02	.04	.01	.02	.01	.02	.01	.02

OR = odds ratio; CI = confidence interval.

difference in anterior maxilla bone height for the FT and the ASD (*P* = .00 and *P* = .02, respectively). In the mandible, differences were found only for the FT classes in the anterior and premolar regions (*P* = .00 and *P* = .02, respectively). In the anterior region of the maxilla, dolichofacial participants presented mean bone heights that were 27% higher than mesofacial and 24% higher than brachyfacial participants (*P* = .01 in both cases). Regarding the ASD, Class II individuals presented 34% higher mean bone height in the anterior maxilla than Class I participants (*P* = .02), but were similar to Class III individuals (*P* = .17). In relation to mandibular bone height, the dolichofacial individuals presented 20.5% higher anterior bone heights than mesofacial participants (*P* = .01) and 19% higher bone heights than brachyfacial participants (*P* = .03). Dolichofacial individuals also had 30.7% higher bone heights in the lower premolar region compared to mesofacial patients (*P* = .01), but significant differences with brachyfacial participants were not found (*P* = .38).

Table 3 shows the crude and adjusted regression for masticatory performance and masticatory efficiency. The crude analysis indicates that only the ASD influenced the masticatory performance parameters (MPX50 and MPB). In the adjusted analysis, the ASD still influenced the MPB. The association of FT was observed only for the ME4.0 outcome in the adjusted analysis. Furthermore, there were associations between ASD and all masticatory efficiency parameters in both the crude and adjusted analyses.

DISCUSSION

The relationship between the masticatory performance and skeletal classification in patients using CDs is not well established in the current literature. Based on these data, the null hypothesis was rejected, considering that the different facial types and the anteroposterior skeletal discrepancy influenced the mastication and some domains of the DIDL questionnaire, although the different craniometric groups reported similar satisfaction levels. The FT influenced the MPX50, MPB, and ME2.8 outcomes, while the ASD influenced only MPB. The satisfaction and OHRQoL results indicate that the FT influenced the appearance and the eating and chewing domains, while the ASD influenced the appearance and general performance domains. In general, the patients were more satisfied with the appearance and general performance domains and were more dissatisfied with the oral comfort and eating and chewing domains, irrespective of the FT and ASD. It is important to note that the patients in this study did not present a masticatory performance that can be considered satisfactory or normal, irrespective of their FT and ASD.

This clinical study showed that dolichofacial patients have a significantly better masticatory performance compared to brachyfacial patients in terms of MPX50, MPB, and ME2.8 outcomes. These results differ from the study by Ochiai et al,[5] who found a slight trend toward inferior masticatory performance in dolichofacial subjects compared to mesofacial and brachyfacial subjects. The aforementioned study evaluated the impact of facial form, skeletal classification, residual ridge height on the preferred side of mastication, and swallowing threshold performance in patients with CD and implant-retained mandibular overdentures using masticatory tests with peanuts and carrots.[5] The differences in comparison to the present study can at least in part be attributed to the methodologic differences, as artificial food (Optocal cubes) and the multiple-sieves method were used to evaluate the masticatory performance.[5]

On the other hand, these results showed that dolichofacial patients had a statistically significantly higher alveolar ridge in the maxilla and in the anterior and premolar regions of the mandible in comparison with the brachyfacial and mesofacial groups. These differences in residual ridge height are in agreement with the study by Ochiai et al (2011), wherein dolichocephalic patients had higher alveolar ridge heights than mesocephalic and brachycephalic patients.[5] It is well-established that this directly affects the retention and stability of CDs.[1,2,36,37] Therefore, it is suggested that this morphologic difference at least in part explains why the dolichofacial patients reached superior masticatory performance compared to the other facial types.

Nonetheless, dolichofacial patients present more difficulties for rehabilitation with CDs because the excessive facial convexity and narrow nose cavities impair breathing, and so these individuals consequently have a tendency to breathe orally and to push the tongue forward to open the oropharynx, which directly affects the retention and stability of the dentures.[6] In this study, these functional consequences did not interfere with the masticatory performance of the patients postrehabilitation, as the dolichofacial patients had a statistically significantly superior masticatory performance compared to the brachyfacial group (MPX50: –17%, MPB: –36%, ME2.8: +120%). The performance of dolichofacial patients was slightly higher but statistically identical to the performance of mesofacial patients (MPB: –19%, ME2.8: +40%). These results might be related to the higher facial axis angle in dolichofacial patients, which increases the space to move the food bolus.

Although the ASD influenced only the homogeneity significantly, Class III patients obtained a less homogenous particle distribution than Class I patients. The amount of material retained in the 5.6-, 4.0-, and 2.8-mm sieves was also similar for all ASD classes. Another study by English et al[20] evaluated the relationship between masticatory performance and the AP position of the mandible in a dentate population and described a significantly smaller chewed particle size for Class I patients compared to Class III patients. Limited data are currently available on the masticatory parameters related to mandible misalignment in edentulous patients. Nonetheless, the present authors believe that masticatory performance after CD rehabilitation is independent of the anteroposterior mandible misalignment, as the skeletal discrepancy is corrected during the setting of the artificial teeth during the new CD fabrication. At this stage, successful CD treatment seeks to achieve a Class I occlusion.

The OHRQoL results of the present study indicate low satisfaction rates across all groups: 59% for mesofacial patients, 39% for dolichofacial patients, 37% for brachyfacial patients, 45% for Class I and Class II patients, and 47% for Class III patients (Fig 2). These data are comparable to those of Hantash et al,[3] who showed that more than 50% of CD wearers are not completely satisfied with their dentures. Furthermore, the oral comfort domain showed the lowest satisfaction indexes, irrespective of the morphologic classifications. The latter domain is thus the one with the strongest negative impact on self-perceived OHRQoL of CD patients, independent of the FT. An interesting finding was that dolichofacial patients presented statistically significantly inferior scores in the same domains in comparison to mesofacial patients, showing the lowest satisfaction of all groups for the appearance domain (26%). As is the case for dentate dolichofacial patients, the excessive convexity of the face, the skeletal open bite, and the tongue thrusting increase the difficulty of all rehabilitation phases. In addition, the increased restorative space for dolichofacial patients and the difficulty setting teeth in an esthetic or functional location can affect both the masticatory function parameters and the satisfaction and expectations of the patient.[6] Differently, brachycephalic patients reported low satisfaction levels for pain (18%) and oral comfort (12%) domains while reporting the highest dissatisfaction level (41%) in the eating and chewing domain. Brachyfacial edentulous subjects have shown higher maximum mean bite force values than dolichofacial participants.[24] Therefore, it is hypothesized that a higher maximum bite force during mastication can trigger a more intense response from the superficialized neurosensorial structures of the residual ridge, such as the incisive and mental canals. The painful sensation could be aggravated by residual ridge resorption, as already described in a previous study.[5] The latter can negatively affect the adaptation phase to the new CD in brachyfacial patients.

Class III patients reported the highest DIDL scores in the appearance and general performance domains and also contained the highest percentage of satisfied individuals (89%) regarding the appearance domain. As edentulous Class III patients require a complex denture rehabilitation, they frequently experience considerable occlusal stress over the residual ridge, which results in excessive resorption of the alveolar ridge.[21] These results suggest that designing CDs with adequate fabrication parameters can result in a considerable improvement in self-perception for these patients, especially regarding their appearance. The vertical dimension of Class III patients is reduced over time, as the dentures are worn and due to progressive resorption of the alveolar ridge. The latter results in a protruding mandible during functioning, giving the impression that the nose is too close to the chin.[19] In order to correct this functional and esthetic sequelae, it is recommended to rehabilitate Class III edentulous patients with a Class I maxillomandibular relationship to increase the vertical dimension.[19] The OHRQoL assessment indicates high dissatisfaction rates for the eating and chewing domain in all groups. This can be justified by the fact that in the objective masticatory function analyses, most particles were retained in the initial sieves (ME5.6), indicating a prominent masticatory deficiency reflected in the MPX50, MPB, and ME5.6 outcomes in all cases. Thus, the objective evaluation of masticatory performance is in accordance with the high percentages of dissatisfied patients in the eating and chewing domain of the DIDL questionnaire. The dissatisfaction resulted from their impaired ability to chew and bite and from the restrictions related to food type and food preparation.

Cephalometric evaluation is a tool that helps to optimize the rehabilitation treatment of edentulous patients. The combination of clinical and radiographic methods is recommended for an adequate assessment because the FT and ASD can negatively influence masticatory function and OHRQoL when patients are CD wearers. Cephalometric evaluation involves little risk since it requires low irradiation doses and can contribute to the confection of more adequate CDs.[9–12] Furthermore, this evaluation enables the dentist to provide the patient with a clear prognosis and manage the patient's expectations concerning rehabilitation and adaptation of the CD.

The limitations of this study include the absence of masticatory evaluations such as bite strength, salivary flux, swallowing threshold test, mouth-opening capacity, and occlusal pattern. These analyses are important, as they can further constrain the masticatory type of CD wearers. In order to improve the understanding of the masticatory performance of CD wearers with different FTs and ASDs, more studies are needed that use different methods for masticatory function evaluation, including groups that allow for comparison between masticatory performance and OHRQoL outcomes among dentate and edentulous patients. Also, the sample of the present study was comprised of relatively young totally edentulous individuals who had been edentulous for long spans of time, with limited education and financial means, so the extrapolation of these results to different groups is limited. Finally, parallel studies that follow patients facing rehabilitation options that modify the retention degree of the dentures, such as overdentures or implant-supported dentures, would also be interesting.

CONCLUSIONS

The FT and ASD influence the masticatory function outcomes and contribute to mastication impairment, as brachyfacial patients experience problems with particle size reduction and homogenization, and Class III patients show a reduced capacity to homogenize the food bolus. The ASD seems to be the main factor contributing to mastication impairments in totally edentulous patients. Furthermore, the patients were more satisfied with the appearance and general performance domains and were more dissatisfied with the oral comfort and eating and chewing domains, irrespective of the FT and ASD.

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REFERENCES

1. Jacobson TE, Krol AJ. A contemporary review of the factors involved in complete denture retention, stability, and support. Part I: Retention. J Prosthet Dent 1983;49:5–15.
2. Tallgren A. The continuing reduction of the residual alveolar ridges in complete denture wearers: A mixed-longitudinal study covering 25 years. J Prosthet Dent 1972;27:120–132.
3. Hantash RO, Al-Omiri MK, Yunis MA, Dar-Odeh N, Lynch E. Relationship between impacts of complete denture treatment on daily living, satisfaction and personality profiles. J Contemp Dent Pract 2011;12:200–207.
4. Erić J, Tihaček Šojić L, Bjelović L, Tsakos G. Changes in oral health related quality of life (OHRQoL) and satisfaction with conventional complete dentures among elderly people. Oral Health Prev Dent 2017;15:237–244.
5. Ochiai KT, Hojo S, Nakamura C, Ikeda H, Garrett NR. Impact of facial form on the relationship between conventional or implant-assisted mandibular dentures and masticatory function. J Prosthet Dent 2011; 105:256–265.
6. Chaconas SJ, Gonidis D. A cephalometric technique for prosthodontic diagnosis and treatment planning. J Prosthet Dent 1986;56:567–574.
7. Throckmorton GS, Finn RA, Bell WH. Biomechanics of differences in lower facial height. Am J Orthod 1980;77:410–420.
8. Brzoza D, Barrera N, Contasti G, Hernández A. Predicting vertical dimension with cephalograms, for edentulous patients. Gerodontology 2005;22:98–103.
9. Hindocha AD, Vartak VN, Bhandari AJ, Dudani M. A cephalometric study to determine the plane of occlusion in completely edentulous patients: Part I. J Indian Prosthodont Soc 2010;10:203–207.
10. Strajnić L, Misković B. Computerized cephalometric evaluation of changes following treatment with complete dentures. Med Pregl 2012;65: 163–167.
11. Strajnić L, Stanisić-Sinobad D, Marković D, Stojanović L. Cephalometric indicators of the vertical dimension of occlusion. Coll Antropol 2008;32:535–541.
12. Kumar D V, Mehta SS, Deshpande S, Gupta A, Chadha M, Kumar C. A cephalometric analysis to establish a correlation of different ridge relations to three levels of camper's line in edentulous patients: An in vivo study. J Indian Prosthodont Soc 2018;18:299–304.

13. Ogawa T, Koyano K, Suetsugu T. Characteristics of masticatory movement in relation to inclination of occlusal plane. J Oral Rehabil 1997;24:652–657.
14. Proffit WR, Fields HW, Nixon WL. Occlusal forces in normal- and long-face adults. J Dent Res 1983;62:566–570.
15. van Spronsen PH, Weijs WA, Valk J, Prahl-Andersen B, van Ginkel FC. Comparison of jaw-muscle bite-force cross-sections obtained by means of magnetic resonance imaging and high-resolution CT scanning. J Dent Res 1989;68:1765–1770.
16. Bakke M, Holm B, Gotfredsen K. Masticatory function and patient satisfaction with implant-supported mandibular overdentures: A prospective 5-year study. Int J Prosthodont 2002;15:575–581.
17. Raadsheer MC, van Eijden TM, van Ginkel FC, Prahl-Andersen B. Contribution of jaw muscle size and craniofacial morphology to human bite force magnitude. J Dent Res 1999;78:31–42.
18. Fontijn-Tekamp A, Slagter AP, Van Der Bilt A, et al. Biting and chewing in overdentures, full dentures, and natural dentitions. J Dent Res 2000;79:1519–1524.
19. Ciftçi Y, Kocadereli I, Canay S, Senyilmaz P. Cephalometric evaluation of maxillomandibular relationships in patients wearing complete dentures: A pilot study. Angle Orthod 2005;75:821–825.
20. English JD, Buschang PH, Throckmorton GS. Does malocclusion affect masticatory performance? Angle Orthod 2002;72:21–27.
21. Ashy LM, Sukotjo C. Prosthodontic and surgical management of a completely edentulous patient with a severe class III skeletal maxillomandibular relationship: A clinical report. J Prosthodont 2013;22:490–494.
22. Abrahamsson C, Henrikson T, Bondemark L, Ekberg E. Masticatory function in patients with dentofacial deformities before and after orthognathic treatment—A prospective, longitudinal, and controlled study. Eur J Orthod 2015;37:67–72.
23. Tallgren A, Holden S, Lang BR, Ash MM Jr. Correlations between EMG jaw muscle activity and facial morphology in complete denture wearers. J Oral Rehabil 1983;10:105–120.
24. Melo ACM, Ledra IM, Vieira RA, Coró ER, Sartori IAM. Maximum bite force of edentulous patients before and after dental implant rehabilitation: Long-term follow-up and facial type influence. J Prosthodont 2018;27:523–527.
25. Bastuji-Garin S, Sbidian E, Gaudy-Marqueste C, et al. Impact of STROBE statement publication on quality of observational study reporting: Interrupted time series versus before-after analysis. PLoS One 2013;8:e64733.
26. Xie Q, Wolf J, Ainamo A. Quantitative assessment of vertical heights of maxillary and mandibular bones in panoramic radiographs of elderly dentate and edentulous subjects. Acta Odontol Scand 1997;55:155–161.
27. Ricketts RM. The role of cephalometrics in prosthetic diagnosis. J Prosthet Dent 1956;6:488–503.
28. Steiner CC. Cephalometrics for you and me. Am J Orthod 1953;39:729–755.
29. Steiner CC. The use of cephalometrics as an aid to planning and assessing orthodontic treatment. Am J Orthod 1960;46:721–735.
30. Riedel RA. The relation of maxillary structures to cranium in maloclusion and in normal occlusion. Angle Orthod 1952;22:142–145.
31. Tweed CH. The diagnostic facial triangle in the control of treatment objectives. Am J Orthod 1969;55:651–657.
32. Slagter AP, Bosman F, Van der Bilt A. Comminution of two artificial test foods by dentate and edentulous subjects. J Oral Rehabil 1993;20:159–176.
33. De Lucena SC, Gomes SG, Da Silva WJ, Del Bel Cury AA. Patients' satisfaction and functional assessment of existing complete dentures: Correlation with objective masticatory function. J Oral Rehabil 2011;38:440–446.
34. Marcello-Machado RM, Bielemann AM, Nascimento GG, Pinto LR, Del Bel Cury AA, Faot F. Masticatory function parameters in patients with varying degree of mandibular bone resorption. J Prosthodont Res 2017;61:315–323.
35. Al-Omiri MK, Hammad OA, Lynch E, Lamey PJ, Clifford TJ. Impacts of implant treatment on daily living. Int J Oral Maxillofac Implants 2011;26:877–886.
36. Allen PF, McMillan AS. A review of the functional and psychosocial outcomes of edentulousness treated with complete replacement dentures. J Can Dent Assoc 2003;69:662.
37. Huumonen S, Haikola B, Oikarinen K, Söderholm AL, Remes-Lyly T, Sipilä K. Residual ridge resorption, lower denture stability and subjective complaints among edentulous individuals. J Oral Rehabil 2012;39:384—390.

Literature Abstract

Current Status on Lithium Disilicate and Zirconia: A Narrative Review

The introduction of a new generation of particle-filled and high-strength ceramics, hybrid composites, and technopolymers in the last decade has offered an extensive palette of dental materials, broadening their clinical indications in fixed prosthodontics in the light of minimally invasive dentistry dictates. Moreover, recent years have seen a dramatic increase in patient demands for nonmetallic materials, sometimes induced by a metal phobia or alleged allergies. Therefore, the attention of scientific research has been progressively focusing on such materials, particularly on lithium disilicate and zirconia, in order to shed light on the properties, indications, and limitations of the new protagonists of the prosthetic scene. This article aims to provide a narrative review regarding these popular ceramic materials as to their physical-chemical, mechanical, and optical properties and their proper dental applications by means of a scientific literature analysis and with reference to the authors' clinical experience. A huge amount of data, sometimes conflicting, is available today. Both in vitro and in vivo studies highlight the outstanding peculiarities of lithium disilicate and zirconia: unparalleled optical and esthetic properties, together with high biocompatibility, high mechanical resistance, reduced thickness, and favorable wear behavior, have been increasingly orientating the clinicians' choice toward such ceramics. The noticeable properties and versatility make lithium disilicate and zirconia materials of choice for modern prosthetic dentistry, which requires high esthetic and mechanical performances combined with a minimally invasive approach. The utilization of such metal-free ceramics has become more and more widespread over time.

Zarone F, Di Mauro MI, Ausiello P, Ruggiero G, Sorrentino R. *BMC Oral Health* 2019;19:134. References: 174. Reprints: Maria di Mauro, mariadimauro94@gmail.com —*Terry Walton, Australia*